Consciousness: a *Simpler* Approach to the Mind-Brain Problem, (Implicit Definition, Virtual Reality and the Mind)

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Abstract

No explicit model of consciousness has ever been presented. This paper defines the beginnings of such a model based in mathematicians' "implicit definition" as compounded with virtual reality. Dennett's "color phi" argument suggests the necessary extension to fit real minds. I conclude that the mind is wholly intentional and virtual.

There are several ways to present any given idea. For a proposed solution to the mind-brain problem, this is important. The approach from biology[1] is the only logically self-contained one I think. It must begin from a solid biological perspective to credibly propose any viable or original solution to the problem of consciousness. That is not easy reading however. There is another route that could be taken. It is not logically autonomous, but it provides an easier access to the ideas I would like to present here. It begins with an attack on the difficulties of "consciousness" *per se.*

Nowhere in all the profound and litigious debate on the mind-brain problem can I find any concrete model of consciousness even suggested. Consciousness is identified, variously, with meaning, linguistic function, computation, brain process... Demands like "unity" and "understanding" are either vaguely conceptualized, disputed in principle, or reduced to distributed mechanical or logical process and eliminated. Nowhere are the tenets of the "mental side" of dualism, (e.g. wholeness, unity, knowing, meaning, non-extension, non-spatiality…), more than simply posited, (or denied), -and quite vaguely at that. "Emergence", to this date, has made no concrete suggestion -other than, (paraphrasing): "whatever neuroscience eventually concludes about brain function is what it is!"[2] What is needed is some *explicit* model of consciousness within which the dialogue might be visualized.

[1] See Iglowitz 1995

[2] -i.e. its conception is as vague as theirs

I would like to propose such a model here[3], and then examine how well it meets our desires for a description of consciousness. If it is plausible, then I think we will have made a positive advance. The model I will propose is an old one and abstract. It is, moreover, flawed in reputation and insufficient as it stands. Nonetheless, I think it provides an indication as to where we would like to go and the beginnings of a viable language in which to envision our goal. The model, drawn from mathematics, is "implicit definition".

Implicit Definition: The Concept

"Implicit Definition" is a mathematical conception first enunciated by David Hilbert[4] at the turn of the last century in his pioneering book, "Foundations of Geometry".[5] The book is a respected and recognized milestone in the history of mathematics. In it he proposed a new axiomatic foundation for Euclidean geometry, but his approach was subsequently extended across a wide range of mathematics. The core of the conception lies in his *methodology*.

Hilbert's axioms for Euclidean geometry, (as usual), referred to certain objects: "points", "lines" and "planes" and to relations between them: "to belong to", "between", and "congruent to". His radical innovation however and the core of his conception lay in the fact that he quite purposefully never specified, (and never had to specify), what "point", "line" and "plane" were to be. Nor did he ever specify the meanings of the relations between them. He did not require a specification of properties! The sole significance and exclusive consequence of his "objects", (i.e. the undefined terms: "point", "line", "between", etc.), was to lie entirely in their logical operationality as expressed in the axioms which related them. Thus they were said to be "implicitly defined" by those axioms. A "point" or a "line", for instance, is exactly that which the axiom system within which it is specified determines that it is -i.e. it is neither reductively nor referentially defined.[6] They are "blind" posits, shaped only by the rules of connection.

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[3] Note: I cannot possibly detail the whole of my proposal nor answer more than a small part of the problems it raises within the confines of this (article) format, but I *can* try to expose some crucial aspects of it. See Iglowitz, 1995 for a comprehensive treatment. See especially Chapter 2 for the model and Chapter 1 for the biological rationale.

[4] and strongly distinguished from the "Formalism" he also argued. They are not the same. Formalism says that all there is is a *manipulation* of tokens, (it is a theory of proof). They *never* gain meaning -they are always tokens. Implicit definition is a very different idea. It is specifically a theory of meaning, (="definition" in "implicit definition"). It is a delicate point, and I'm not sure that Hilbert himself ever distinguished them clearly.

[5] Hilbert, 1902

[6] Thus, paraphrasing Hilbert, we might just as well substitute "cigar" for "point" and "Xanadu" for "line", let us say, and all theorems would still remain provable.

Hilbert's was a radical revolution in the history of thought. The surprising thing is that it worked- this "shaping" is enough! It worked in geometry and it worked subsequently across the whole field of Modern Algebra. The important thing for our problem is the new power and dimension it opens for logic. It exposes a new possibility in our conception of "objects"- i.e. of *things* themselves! It is a possibility necessary for any viable conception of "mind".

Moritz Schlick, (physicist/philosopher and founder of the famous "Vienna Circle"[7]), grasped the deep implications of Hilbert's innovation:

> "[Hilbert's] revolution lay in the stipulation that the basic or primitive concepts *are to be defined* just by the fact that they satisfy the axioms.... [They] "*acquire meaning* only by virtue of the axiom system, *and possess only the content* that it bestows upon them. They stand for entities *whose whole being* is to be bearers of the relations laid down by the system.", (my emphasis).[8]

It is difficult to bring this conception to life for one who has never plowed these fields. (See Text Box for an overview and the first prototype model.) These "things" actually do all the things we need them to do. They develop the necessary complexity to stand in place of "real objects" and they take on a very "live" character. They do all the things that real mathematical objects do, ("up to isomorphism"), and, short of metaphysics, they can supplant them.

A First (Prototype) Model

The Primitive Model: the Integral Domain of Modern Algebra (An Example of Hilbert's Conception)

Consider a typical application of Hilbert's ideas: the "Integral Domain" of Modern Algebra, (like the ordinary whole numbers of arithmetic). Axiomatization begins with the rawest assumption of a set of "elements", (its "domain"), meant to obey a small set of operative rules, (axioms -e.g. the laws of Closure, Uniqueness, the Commutative and Distributive laws). The objects of its domain and "existence" terms generally are assumed, (as Wilder points out) only "presumptive[ly]" and "permissive[ly]" however. They are assumed, (conditionally only), solely to legitimize our employing the rules. We are told *nothing* about them in an objective sense.

The only objects posited explicitly and definitionally are the identity elements '0' and '1', the additive and multiplicative identity objects

[7] which included Rudolf Carnap and Kurt Goedel

[8] Schlick, Moritz., translation by Albert E. Blumberg, 1974

respectively, (and their conditionally supplied additive inverses). But these identity objects are presumptive and permissive as well. They are wholly specified as simply the identity elements under these operations and no more - they are not the real (?) 0 and 1 or any other real objects, (nor are they necessarily distinct). No referential properties other than these simple internal and operational ones can be derived from the fact. Indeed, they are preferentially named otherwise -"e", for instance or placed in quotes by mathematicians to divorce them from real experience. The "addition" and "multiplication" operations, ('$' and '#' as perfectly good designations for instance), are conceived as totally blind operations as well.

What is conceptually significant about the mathematical Integral Domain is that there are *two distinct* operations, connected by the distributive law, not that they are some *special* operations. What is conceptually important about it is that the result, not grounded in a refinement of properties, is not logically sterile.

What are we actually given about the "e" object, ("1", for instance, or "0")? What properties are assumed? Only that under the *unspecified operations* '#", ("multiplication"), or "$", ("addition"), the result of combining any other objects with them, (e.g. [e # x, or "0" $ y], x,y any members of the domain), that the result is again x or y respectively.

$$x \ \# \ e = x, \ y \ \$ \ "0" = y$$

This is the absolute whole of their definition and it is totally operational. The "equality" relation, ("="), tying all this together is unqualified and axiomatized as well, (as it is in Modern Algebra generally). It is taken specifically as an "equivalence relation", (under the rules/axioms of reflexion, symmetry and transitivity), but it is taken as the most basic (and equally blind) equivalence term under which all other equivalence relations, ("≡"), are defined. It is not necessary to assume, (a priori), for instance, that "4" and "3 + 1" are "names" for, (i.e. denote), the same object, only that they are operationally equivalent under this most basic equivalence relation of "equality", (i.e. that "4" = "3 + 1").

We derive the other elements of the domain operationally as well, (under the additional conditional assumption that '1' ≠ '0'.). Thus '1' + '1' = '2', for instance, and '2' + '1' = '3', etc.[1] Another element, "-1" also "exists" in the same way as the "0" and the "1" as the additive inverse of the "1" element, (under the conditional "existence" axiom of the additive inverse: if x, then -x), and 'negatives' of the others as well. Continuing this

(conditional) process, solely in terms of the axiomatic laws, (operationally), we can build the whole of an integral domain and it relates to the real integers "up to isomorphism". The objects of this integral domain do the same things, the truths about them are the same as for the "real integers", and they can substitute for them -up to isomorphism!

The relevant point of all this is that the whole process of specification - i.e. the whole of the definitional content of the elements, (objects), of this integral domain is achieved solely in terms of the blind operations specified in the axioms acting on property-indiscernible, *equally blind*, objects, and not by set theoretic refinements on primitive, (atomic), properties of these elements. Nowhere in this axiomatic system are the primitive operations identified with real integer operations, (or any other "real" operations), nor are they dependent upon them. The case is the same for the elements/objects of the system. Nowhere are they dependent upon any "real" objects, so no real properties may be legitimately identified with them. This is, as Schlick says, a genuine "Copernican revolution" in the history of mathematics, (after Kant's terminology). More, it is a new kind of logic, distinct from the logic of Aristotle which is wholly dependent on set theoretic refinement of original properties of its objects.

Hilbert's conception results in a novel and very different kind of "object", one which is *wholly constituted* as an expression of the logical relations of the axioms. It is a wholly logical object and it is "tangible", (i.e. non-vacuous)! Repeating Schlick's insight:

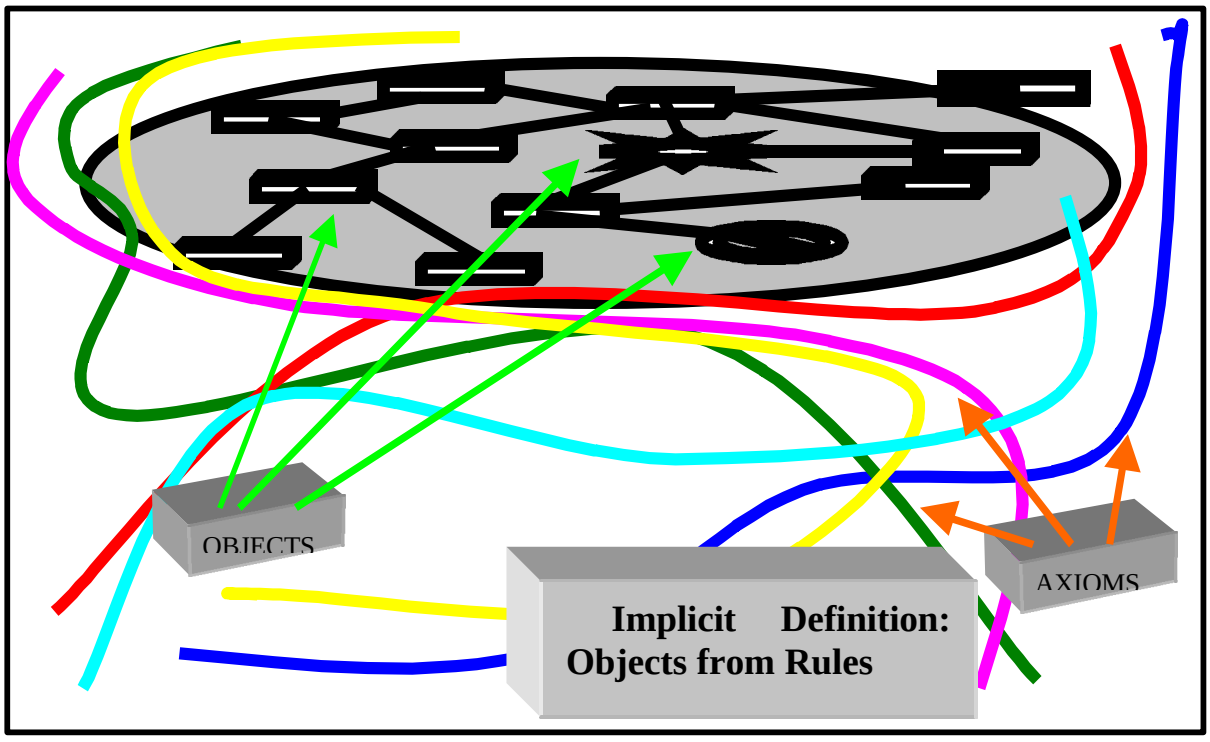
> "The revolution lay in the stipulation that the basic or primitive concepts are *to be defined*[1] just by the fact that they satisfy the axioms."
>
> [They] "*acquire meaning* only by virtue of the axiom system, *and possess only the content that it bestows upon them*. They stand for entities *whose whole being* is to be bearers of the relations laid down by the system.", (Schlick, 1974, my emphasis)

Beyond the confines of mathematics, this is a genuine and profound "Copernican Revolution" in *logic* itself. Here relation defines entity, not the converse. This entity *as entity* is a function of (logical) process. Implicit definition does not define its objects within the dualistic and oppositional context implicit in the foundations of classical Aristotelian logic. It does not define objects within the classical schema of **presentation** / **attention** → **abstraction** of properties. It resolves them instead by internal resolution of its

fundamental operations. These are internal, logical and autonomous objects of the system as a whole. Implicit Definition therein supplies the first clue to a logical possibility for sentiency. It supplies the first logical possibility for the hardest problem of sentiency as it is ordinarily conceived: the "many-in-the-one", and it supplies a crucial clue to the problem of how a *biological* system, an operational, mechanical system of response, could "know" anything at all. I will propose that such a biological system can know its objects because they are solely *operational* objects. They are the implicitly defined objects of modular "axioms" of response. This is the prototype model I propose.

Its objects "acquire meaning…and possess … the content …it bestows on them". I propose that the objects of the mind are the implicitly defined *operational* objects of the brain. This is a *constitutive logic* not requiring reference, obviating the necessity of an observer and a homunculus. Implicit Definition supplies the first possibility, consistent with science, for "mind" in our natural sense of the word, and its first primordial model.

Footnote: “Relation”, definable *within* a mathematical system, (as an n-tuple, for instance), is an operation of a different order and meaning than the operational, (relational), primitives of that system which are employed *to define* that “relation". The primitive operations of an axiom system, ("addition" and "multiplication", for instance), are the *constitutive relations of axiomatics*. When axiomatics defines a “relation” internally, however, it is a subsidiary relation and has a different import –it is defined *relative to* the primitives.



Knowing, Meaning

Implicit definition is particularly interesting in the *way* it would know its entities moreover - if "knowing" could be said to be relevant to this system. It would be the system *as a whole* which would know them. They are, in fact, objects *of* the system as a whole. It is only as such that they exist at all. "Meaning" and "understanding" would stand likewise. "[They] acquire meaning only by virtue of the axiom system, and possess only the content that it bestows upon them". This system, moreover, is non-spatial and non-extensive. Its "substance" is a logical and unified substance from the very bottom.

Granting the supposition just a little longer, its entities would not be known in a "planar" or "dimensional" sense however. They would not be "seen from above" or presented to the system, (i.e. they would not be known in reference). They would be known, instead, logically and internally as part of a viable and autonomous "constitutive logic", (using the term in its exact Kantian sense)! They would manifest within it.

A Virtual Model:

Does this have promise as the beginnings of a model of consciousness then? Could it be considered in any sense as an explicit model? Yes, I think it could if we considered such a system as a *virtual* model -as a virtual reality! Its "entities" would then become genuine, (i.e. "tactile"), objects existing within a virtual world. They would become *tangible*!

But existing examples of virtual realities, (games and instruments), specifically input into our sensory organs you will understandably object. The "realities" they embody still imply a "me", a "seer" to make them tangible and known. This particular virtual model makes sense for our purposes when we reconceive it, (and its objects), in a special way -not as something *to be seen*, but rather, as the seer itself -i.e. as the mind itself! It makes sense when we consider it not as some *tool* we use in mental conception, but rather as the "we" itself, the constitutive model implicitly defined by the operative process of the brain. If this were consciousness, then our objects would in fact be known to the whole. The problem of "the one and the many" would be solved. The antinomies of the homunculus and the Cartesian Theater would disappear. It does not require yet another seer, and is itself the Cartesian Theater. Perceptual objects, (and conceptual objects), would no longer be presented *to* another seer, they would be implicitly defined as *part o*f the seer and *known*. They would not be known in reference!

Imagine yourself and the objects of your mind as a product of implicit definition. Imagine them as the implicitly defined, operational artifacts of the axioms of your brain. Those axioms, I propose, are the modular, macroscopic physical components of brain physiology. I propose that they are the modular units of response. They implicitly and virtually define a world and a mind.

This is the case I suggest as a prototype model for the consideration of mind and I think it fits many of our intuitive ideas of what a mind actually is. It supplies the beginnings of an answer to the issues of wholeness, unity, knowing, meaning, non-extension, non-spatiality. It is also *biologically* cogent, as it supplies the beginnings of a non-eliminative answer to the problem of how a biological organism, considered as a system of physical response,[9] could internally embody knowing or meaning at all. The rules of this system, (its "axioms"),[10] are, I argue, the adaptive and pragmatic rules of evolutionary survival. These are the operative rules of the brain. (They needn't be simple however.)

The gross anatomy of the brain seems to argue for such a modular, (axiomatic), approach.[11] The perplexing simplicity of the division of the brain into definite gross anatomical substructures is corroborative. If the brain were "wired" randomly and incrementally on a "breadboard"[12], (as we would expect if it were developed in response to incrementally acquired evolutionary information), we would expect an amorphous clutter. Instead, we see very definite gross structure.

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[9] Behavior, considered as a system of physical response, is specifically a program of *creative -i.e. original* physical response. (This is the point of Maturana, Edelman, Freeman) From the standpoint of evolution, the *specifi*c response of an organism doesn't matter -only that it gets the job done. Crudely put: one can kill a mosquito with either a newspaper or a flyswatter, (it really doesn't matter), and natural selection has no preference between the two. The proper criterion is *adequacy*, not *matching*, (i.e. not recognition, parallelism, or representation). You must kill it, but you needn't know it is a mosquito! It is not a *causal* relationship. Calling it a "system of physical response" does not invoke a "stimulus-response" metaphor, but that is certainly the way we ordinarily think of it. This is a complex epistemological problem which I have addressed in Iglowitz, 1995.

The problem of metacellular response becomes then the specific problem of the organization of such creative processes. But these are *intentional* processes -they are not informational but purposive. The agenda, I will conclude, is wholly intentional.

[10] I am using the word "axioms" in the sense of Modern Algebra, (not of philosophy). Those axioms are the *rules of manipulation* of its objects. E.g. -the distributive law of an Integral Domain. This is *Hilbert's* sense of "axiom". The axioms of the brain are the fundamental, and, I propose modular, operative rules of response.

[11] Axiom systems are modular by definition. Consider the stepwise addition of axioms in the progression from the abstract group to a field, for instance. Each stage defines a different system and different objects.

[12] I.e. a generic electrical circuit board for protyping

Previously there was no conceptual model matching the requirements for a mind at all. A virtual model logically paralleling axiomatic mathematics supplies the first prototype conceptual model. I admit that this model is nowhere near specific enough as it stands and presents many further problems. I do think it is a long advance on the present situation however -i.e. of no cogent conceptual model at all. For the first time it gives us a way to conceive an answer to the problem of how a brain, (a system of pure biological process), could "know" *anything*. It supplies clues to "meaning" and to "objects". It resolves the "homunculus" and the "Cartesian Theater" and, (perhaps most importantly), the model is logically and biologically *autonomous*.

The problems raised by this hypothesis are, of course, enormous and varied. The Churchlands, for example, have raised reasonable questions about the actual scale of the purported "unity" of consciousness. These are undoubtedly legitimate objections, (and not particularly new[13]), but I do not think they answer the need for some minimal core of unity. There are many other questions as well, but they are not within the scope of this particular writing.[14] The real problems I should be discussing here are those dealing with the actual viability and possible extensions of the proposed model itself. One of the key issues is that which I will dub the "static problem". It is a technical issue and important.

The "Static Problem"

The axiom systems of mathematics tend to create uniform, "static" fields of objects, the integers, for instance, or the real numbers. True, there are special, unique objects within them, pi, or e, or 1 for instance, but these are not promising for the kind of usage we will need to see for viable mental objects. To this point, the model I have proposed stands more in the sense of a Platonic "form", and lacks the viability of Aristotle's conjunction of "form and matter" for the existence of *actual, special* objects. Let me try to suggest the beginnings of a solution for the existence of such objects within such a system. Let me try to suggest a rationale for actual perceptual objects!

Daniel Dennett, (though he is a confirmed anti-mentalist), has provided an inspiration. It derives from his treatment of the "color phi" phenomenon, -though his conclusion must be stood on its head. I suggest that the answer to the "static problem" and the ground of viable perceptual objects lies in recognizing

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[13] See the sections of Cassirer's "Symbolic Forms" dealing with perceptual abnormalities for example. It is an old discussion, but clinically based, very lucid and still quite pertinent. (Vol.III, pps. 205-277)

[14] See Iglowitz, 1995

intentionality as a primary component of brain process.[15] It is a necessary "axiom".[16]

The Color Phi: Towards the Necessary Extension of the Model

"The color phi" names an actual experiment wherein two spots of light are projected in succession, (at different locations), on a darkened screen for 150 msec intervals with a 50 msec interval between them, (citing Dennett). The first spot is of a different color, (red, say), than the second, (green). Just as in the case of motion pictures, (the "phi phenomenon"), subjects report seeing the continuous motion of a *single* spot, but interestingly, they report that it changes color, (from red to green), midway *between* the two termini![17] Dennett bases a very interesting, (and, I feel a very important), argument against the very possibility of a "Cartesian Theater" -against a unity, (and "figment" = substance), of consciousness on this well documented and reproducible experiment. Dennett's argument, in brief, is this:

Mental states or a "Cartesian Theater", if they exist, are subject to the laws of causality, of time precedence. For one event to affect another, it must occur *before* it. Let me, for discussion's sake, label the events described. Let E1 be the ("heterophenomenological"[18]), perception, (hereinafter to be called by me "h-perception"), of the first, (red), spot. Let E2 be the h-perception of the red-changing-to-green midpoint, and let E3 be the h-perception of the final green spot.

Dennett argues, based on the principle of causality, that E2 cannot occur until after E3. Since there were only two actual, (physical), events, (the first and second projected spots), he argues that the h-perceived midpoint, (the "mental event", i.e. red-changing-to-green), cannot occur until *after* the reception of the second *actual* event, (green projection), as it was that which provided the very

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[15] Ultimately, I argue, it becomes the *whole* of behavioral process-i.e. it is the only component.

[16] Freeman, interestingly, incorporates intentionality, (via the limbic system), as a key element of his model of brain function.

[17] and not, for instance, that it is red all the way till its terminus, with a final and sudden change-to-green.

[18] Dennett introduces the very useful criterion "heterophenomenological" to describe "mental events", which he does *not* believe in, to describe whatever-it-is that is named by them, i.e. to talk about them as they are (linguistically) used by real bodies and brains, (which he *does* believe in), but with a neutral metaphysical commitment.

sensory data *necessary* to the h-perception of change. Other than a (mystical) hypothesis of "projection backward in time", there remain for Dennett just two possibilities for an internal, "Cartesian Theater" consistent with the experiment: the "Stalinesque" and the "Orwellian" hypotheses.

The first involves the creation of a "show trial" staged by a subterranean "central committee", (after the fact of both real events, of course, and involving a "delay loop"), wherein the complete, (and partially fabricated), sequence, (red ->red-changing-to-green -> green), is "projected", (i.e. achieves sentiency). Under this hypothesis, the whole of our sentiency, (our consciousness), occurs "after the fact". The second possibility, the "Orwellian" hypothesis, is that the actual events are received by our sentient faculty *as is*, but that our memory then rewrites history, (just as the thought police of Orwell's "1984" did), so that we *remember* not two disjoint and separate events, but the connected, and pragmatically more probable sequence red -> red-changing-to-green -> green.

Dennett argues that ultimately *neither* theory is decidable -that either is consistent with *whatever* level and kind of experimental detail science may ultimately supply, and that, therefore, the only pragmatic distinction between them is purely linguistic, and therefore trivial. He argues that there *is* no "great divide", no actual moment, (nor existence), of sentiency, but only the underlying brain process, (which *all* theories must countenance), itself. Based on the "spatial and temporal smearing of the observer's point of view", he expounds his thesis of "multiple drafts" wherein there *is* no "theater", only brain process -and its various "speakings", (drafts).

And yet the *observer himself* has absolutely no problem with these events! *His* perspective is very clear: E1 → E2 → E3. It is our interpretation (and rationale), for this sequence that causes the problem.

I think Dennett has a very strong argument, but I want to refocus it. Nondecidability is all very well and good, but it is a much weaker line than the one he started out with- on the possibility of *synchronization*! In a very real sense, I feel it is very similar in intent and consequence to Einstein's famous "train argument" against simultaneity.

Dennett and Einstein: on Synchrony

Consider, (with Einstein), an imaginary train moving (very fast)[19] down a track, with an observer, (TO), standing midway on top of the moving train and observing two (hypothetically instantaneous) flashbulbs going off at either end of the train. The train goes by another (stationary) observer, (SO), standing (hypothetically infinitely close) by the track as the bulbs go off. Suppose that the

[19] nearing the speed of light

moving observer, (TO), reports both flashes as simultaneous. He argues that since both photon pulses reach him simultaneously, (simultaneity is granted for all frames on the local, infinitesimal scale, and thus agreed on (?) by *both* observers who are assumed infinitely close -i.e. side by side), that therefore the pulse from the rear of the train, having to "catch" him, must have left its source sooner than the pulse from the front which added his velocity to its own and so must have left later. Relative to SO, (stationary observer), however, the two sources travel the same distance to a *stationary* target, (himself). Since TO and SO are momentarily adjacent to each other, (i.e. within a local frame), they should be able to agree that the two pulses *arrive* there simultaneously. What they cannot agree on, however, (in that instance), is whether the events, (the flashes), *occurred* simultaneously *-nor that the other could have thought, (i.e. could have observed), them so!* Time, in Dennett's words, is "smeared"![20] (We could, of course and significantly[21], vary the parameters to make *either* event "earlier" and the other "later".)

Just as Einstein's two observers, near the limits of physical possibility, cannot agree whether the two lights were *simultaneously* flashed at the ends of the train or not, (i.e. cannot establish a common temporal frame of reference), nor, (given that situation), that the other could observe them locally as such, neither, given Dennett's pointed argument, can we establish a common temporal frame of reference for "the world" and "the mind" at the limits of cognition. For macroscopic science, these limits are at the scale of the speed of light. For atomic physics, they are at the scale of Planck's constant. For the brain, I suggest, they are at the scale of *minimal biological response times*, i.e. in the 100 msec. range.

I agree with Dennett that "the color phi" identifies a legitimate and critical aspect of the mind-body problem. The spatial and temporal "smearing" of the percept and the non-explicit reference of qualia that he demonstrates forces a profound extension to our traditional conception of the "theater". But his dimensional "smearing" actually fits very well[22] with the model I am proposing. I submit that it is more plausible in terms of the "focus" and "function" of an operational object than in terms of his "multiple drafts", "demons" and "memes" in the "real world". His objections to the ordinary "Cartesian Theater" are admittedly valid, -but so were those of Helmholtz and Cassirer before him:

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[20] Are the observers, (and the experimental apparatus), then "heterophenomenological"?

[21] i.e. -relative to Dennett's problem, (suppose they were asynchronous "just enough"!)

[22] when taken "heterophenomenologically" -i.e. with a neutral ontic commitment.

Helmholtz, Cassirer and Dennett's Dilemma

> "If we conceive the different perceptual images, which we receive from one and the same 'object' according to our distance from it and according to changing illumination, as comprehended in a series of perceptual images, then from the standpoint of immediate psychological experience, no property can be indicated at first by which any of these varying images should have preeminence over any other." [23]

It is only the *totality* of these data of perception that constitutes what we call empirical knowledge of the object; "and in this totality no single element is absolutely superfluous." No one of the successive perspective aspects can claim to be the only valid, absolute expression of the 'object' itself; "rather all the cognitive value of any particular perception belongs to it only in connection with other contents, with which it combines into an empirical whole."

> "...In this sense, the presentation of the stereometric form *plays 'the role of a concept*'", (my emphasis), "'compounded from a great series of sense perceptions, through the living presentation of the law, according to which the perspective images follow each other. This ordering by a concept means, however, that the various elements do not lie alongside of each other like the parts of an aggregate, but that we estimate each of them according to its *systematic* significance...."

Consider the strong consequences of these observations however. Our actual (physical) percept is not only constructed from a temporal series of sense impressions, but from lateral ones as well. It is specifically named as a "stereometric" image -from two eyes! So must it be constructed from the rest of our perceptual input as well -from audible, olfactory, and tactile impressions. Surely the multiple cortical maps are pertinent as well.

The "cognitive value of any percept belongs to it *only* in connection with the other contents, with which it combines into an empirical whole." "In this sense the presentation of the stereometric form", [the percept], "*plays the role of a concept*". [my emphasis]

What Cassirer *Means* by "a Concept" However

The meaning of this statement, *from Cassirer*, is important. Cassirer spent

[23] Cassirer, 1923, pp. 288-289, citing Helmholtz

much of his life in a debate on the actual constitution of the technical logical "concept" whose traditional Aristotelian interpretation he strongly disputed. His original reformulation of that concept must be considered for an understanding of his argument here. Consider the force of his examples:

> When we form the concept of metal …we cannot indeed ascribe to the abstract object that comes into being the particular color of gold, or the particular luster of silver, or the weight of copper, or the density of lead; however, it would be no less inadmissible *if we simply attempted to deny* all these particular determinations of it." (This would be the classical interpretation -my emphasis.)

It would not suffice to characterize "metal", he argues "that it is neither red nor yellow, neither of this or that specific weight, neither of this or that hardness or resisting power". But it is necessary to add "that it is colored in *some* way in every case, that it is of *some* degree of hardness, density and luster." Nor could we the general concept of "animal", "if we abandoned in it all thought of the aspects of procreation, of movement and of respiration, because there is no [one] form of procreation, of breathing, etc., which can be pointed out *as common*", (my emphasis), "to all animals."[24]

He proposes instead a reformulation of the logical concept as the "functional concept of mathematics" which parallels the concept-making process of mathematics. Here the special cases are not lost, but rather retained in *functional* form in the generalization to a genus. This, he argues, has been the *actual* working concept of modern science generally since, at least, Isaac Newton. A simple mathematical example is the general equation of the straight line: $y = mx + b$. As m and b range through real values, it fully embodies all the straight lines in the plane. The equation fully embodies and *can reconstruct* the whole of its domain. This is not an abstractive concept.

For Cassirer, the logical "concept" becomes instead *a function*. "Metal", for instance, is necessarily colored in *some* way", [x], in every case, it is of *some* degree [y], "of hardness, density", [z], "luster", [w]. He reformulates the formal concept as a *functional rule*, f(x,y,z,...), which organizes and *fully embodies* the totality of its extension. The concept is "the form of a series". That "series" may be ordered by *radically variant* principles however: "according to equality", (which is the special case of the "generic Aristotelian concept"), "or inequality,

[24] ibid P.22

number and magnitude, spatial and temporal relations, or causal dependence"[25] - so long as the principle is definite and consistent.

If the concept is indeed functional, it follows, he argues, that the "concept" cannot be the *mere abstraction* of its extension. It is an *independent* and *original* contribution instead, logically distinct from what it orders!

> "That which binds the elements of [a] series a, b, c, ... together is not *itself* a new element, that was factually blended with them, but it is the rule of progression, which remains the same, no matter in which member it is represented. The function F(a,b), F(b,c),..., which determines the sort of dependence between the successive members, is obviously not to be pointed out as itself a member of the series, which exists and develops according to it."[26]

Cassirer's Crucial Result for Cognition

Cassirer has split "information" from the percept itself! The percept is now constructed, not deduced. It is intentional. The distinction between the concept and that which it "orders", (he concludes), is "a new expression of the characteristic contrast between the member of the series and the form of the series".

This is the "systematic significance", (the "playing the role of a concept"), he purports with Helmholtz as necessary for "the presentation of the stereometric form" and " empirical knowledge of the object" -i.e. it is a *rule of construction*. But that rule is not (deductively) derived from the contents themselves. It is a new and *original* content - "a new form of consciousness" at work. (The source of this contribution, I strongly suggest, is evolution[27], not logic!) I urge, extending Cassirer's insight, that the stereometric form itself, the percept itself,[28] is *wholly* a function. We do not perceive even our simple perceptual objects in any direct sense. We *construct* them. I will argue that this "new form of consciousness" is the *only* form of consciousness!

If we take the mind as specifically a "predictive" and "intentional"[29] model, (surely biologically cogent and which extension I will suggest shortly), rather than

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[25] ibid P.16

[26] ibid P.17 -Also see Lakoff 1987 on this issue.

[27] -i.e. *biology* See also the Edelman discussion to follow

[28] This, the percept as concept, is clearly at odds with, but, (I argue), a legitimate extension of, Cassirer's ideas.

[29] I have approached intentionality from two perspectives. My argument starts from the standard philosophical and cognitive science conception - to build a case that there are no *non-intentional* objects in the mind, (conceived thusly). Ultimately, (from the standpoint of brain

a static and "representative" one[30], then the temporal and spatial "smearing" of the percept do not have the implications against the "theater" *per se* that Dennett attributes to them. I argue that simple percepts themselves, (e.g. even the very E1 and E3 themselves), are conceptual, (albeit specialized, invariant and constitutive), and therefore, following Cassirer, functional. They are entities of order and process -and they *are* "smeared". It is the ordinary nature of functions to be smeared! What Dennett explains by "multiple drafts", (and the "demonic" process he envisions beneath them), I explain by "focus". We focus the percept, (via implicit definition) according to operational need.

The Facts of Phi

The fact is that the midpoint E2 is *actually experienced* in repeated experimental confirmations! It does have actual conscious existence, (assuming you believe there is such a consciousness in the first place)! The conscious existence of E2 is clearly specifically intentional however -whatever *else* could it be? Thereby it provides a very important clue to viable mental objects in general -to include E1 and E3 themselves! I suggest that *all* of our mental objects - all our *actual* mental objects are intentionally constituted! I suggest that the solution to the "static problem" lies in adding axioms of intentionality to the axioms of ordinary process.

The original "phi phenomenon", (the illusion of motion in a motion picture), is even more significant to the problem of consciousness than the "color phi" phenomenon however. The frank credibility and intentional depth, (i.e. the realism), of a series of oversized, rapidly sequenced still pictures, (a movie), is quite suggestive. Its potential for an uncanny parallelism with our ordinary experience suggests that the latter, (i.e. ordinary experience), is *itself* a predictive and integrative phenomenon grounded in an intentional model in precisely the same manner as I propose the "color phi" to be.

The effect of motion pictures is clearly intentional, as are the objects within them. To the extent that they are not merely patterns on a screen, their objects come alive. We *believe* them. We agree or disagree with them. We like them or hate them. They give us "experience" which we did not have previously and

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science), I think it is another issue. "Intentionality", from that biological perspective, is what I describe in the next-to-last paragraph of this paper: "It ["intentionality"] consists in [is] the integration and organization of, (i.e. theorizing on), our other empirically adequate, (but equally blind), behavioral response." It is an autonomous internal generation, an integration and organization of biologic process. Walter Freeman has suggested such a program specifically, and Humberto Maturana, (1987), and Gerald Edelman, (1992), hint at it.

[30] i.e. vis-à-vis current process

provide interpretations of future events! Their objects are clearly intentional objects however, in just the same sense as the color phi objects. They are just the interposition *of a series of oversized, rapidly sequenced still pictures!*

An Extension of the Model: A Brief Sketch

Let me try to flesh out this model briefly. Let me try to sketch the design of real minds! Follow me in a thought experiment! Keeping your eyes fixed to the front, you perceive this paper in front of you, (in your conscious perceptual model), the wall behind it, and, perhaps, the pictures of your family. There may be pens and pencils, books. You may hear music from the stereo next to you, (and perhaps still in peripheral vision). There may be a window, and the lights of the neighbor's house beyond it. *But there is no wall behind you!*

There is no car in the driveway outside of your house -indeed, there is no "house" at all. There is no city, no taxes, no friends. The sun does not exist in this model. There is no government, no "universe", -no tomorrow! The (purely?) perceptual model is incomplete as a model of "reality" and it is, (Naturally!), inadequate even to keep you alive. There is something else necessary for completeness of any model of your sentiency, i.e. a new perspective on it. It is an *intentional* aspect. It is necessary to supply the object behind your back and the reality "over the hill"! It supplies the connection to "tomorrow" and "yesterday". It supplies "causality". It is necessary for the completeness of a model of "*the world*".[31]

It is necessary, (specifically following Dennett!), even for the individual "objects" of perception itself, (E1 and E3 for instance[32]). This model, I suggest, is where E2, (the object of Dennett's perplexity), lives. It cohabits there very comfortably with E1 and E3 which, I argue, are *also* predictive and intentional objects. There is a seamless integration, (above the scale of 100 ms, let us say), of what we normally think of as our pure percepts and the intentional fabric within which they are woven.[33] This model, I propose, is the actual "home" of

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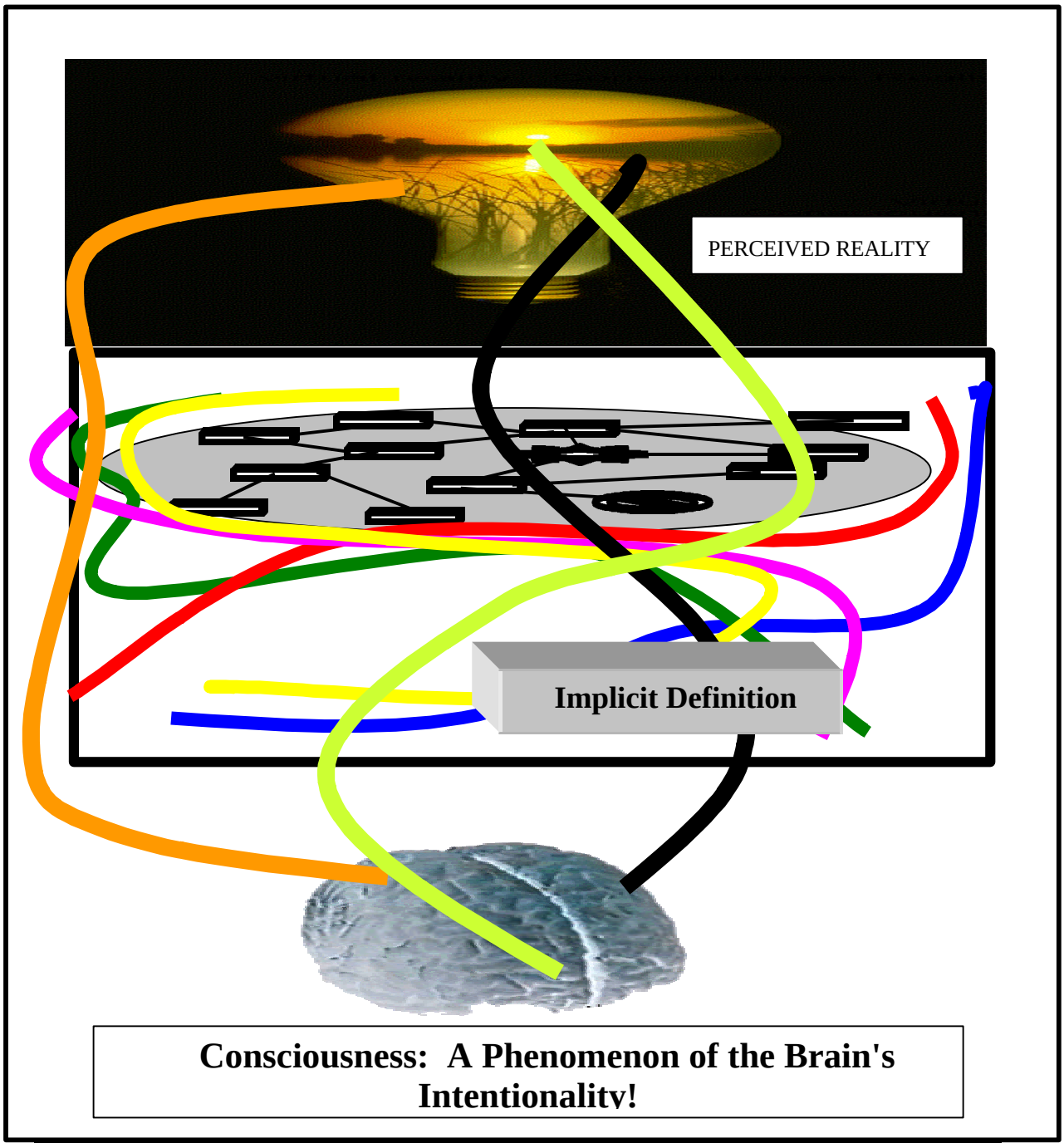
[31] It has been asserted that " Most animals live very well with such a (minimized, non-intentional) perceptual model of 'reality' (cf. Uexkull)". (Anonymous reviewer). Is this so? Consider a cat tracking a mouse as it runs behind a tree. Or consider a bumblebee pursuing you yourself as you dance and run!

[32] which, he concludes, do not *themselves* exist!

[33] Dennett argues strongly and convincingly that "figment", (mental states), are logically inconsistent with our, (his), ordinary (naï ve) views of cognition and reality. But let us turn Dennett's argument around. The "color phi", he himself says, embodies a precise and reproducible experiment -you and I would both expect to "see" it! If, instead of accepting his conclusion, we choose to accept the *reality* of that figment -E1, E3, *and E2*, -if we believe that

mind, and the legitimate purview of a truly scientific psychiatry.[34]

I propose that the *whole* of our consciousness is a virtual intentional model. I propose that the field of virtual reality is the archetypal science of the mind. It is the primitive beginning of scientific psychiatry.



E2 is *actually* perceived, (whatever it may be), then his argument takes on a radically different import.

[34] Consider the world-views implicit in paranoia or schizophrenia, for instance, or in bipolar illness

Further Considerations:

But what could axioms of intentionality be? They would be *theorizing* axioms. Not axioms *of* a theory, mind you, but axioms of theory *construction*. Brains theorize to cope with an everchanging reality. Penrose made a start towards analyzing the criteria of good theories.[35] All the great theorists acknowledge aesthetic criteria in theory construction. Even the current debate acknowledges at least some -"Occam's Razor" is a case in point. There are others.

But why posit *theory construction* as the basic function of brains? It is because it is difficult to posit *knowledge* to biological systems. Their functioning entails only survival. The *methods* of survival, however, are not fixed. Edelman, for instance, speaks of the multiple possibilities for response to a given antigen. Successful response does not depend on prior *knowledge* of the antigen.[36] It depends, rather, on the prior, evolutionarily determined existence of empirically adequate, (but cognitively blind), responses, (antibodies). So too must be our other cognitive response. It consists in the integration and theoretical organization of our *other* empirically adequate, (but equally blind), behavioral response. It is an *intentional* program!

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[35] See Penrose, 1989

[36] It is interesting and important that Edelman identifies *both* the immune system and human cognitive function as examples of what he terms "recognition systems"! But the "recognition" he identifies is recognition in the sense of the biological immune system on which he is an acknowledged expert.

> "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, 1992, P.78

Cognition, our *ultimate* "recognition system", he argues, is a *parallel* case and must be reconceived accordingly.

Conclusion:

As a conceptual model, implicit definition makes positive inroads on the problem of consciousness. It is, I think, the only cogent model on the table. (But see below). It provides explanatory ideas and makes sense within the current dialogue while at the same time providing answers to the ancient questions. It must be admitted that it opens more questions than it answers, but that is the *nature* of science. It is, moreover, just what we might hope for in a new discipline.

Postscript: Are there Other Explicit Models?

In the paragraph above, I made the claim that this is the only explicit model on the table. What I meant by this was that it was the only explicit model of consciousness *specifically*. But any theory of mind must marry with biology! Without that tie, it is mere dialectic. Let me therefore briefly critique the few explicit models actually proposed. They are all biological: Crick's, Penrose's, Maturana's, Edelman's, and Freeman's…. All of them have strengths, some more than others. None of them actually provide a rationale for consciousness however - they are theories of brain function. Some are logically compromised, (Maturana, Edelman, Freeman) -they lose the legitimacy of their own language by the epistemology implicit in them. (This is a long discussion, outside the confines of this paper.[37])

Standard neuroscience is eliminative for "mind". It attempts to reduce brain function to discreet steps. As research, it is impeccable, but it retains "mind" only as a hope. The Churchlands express that hope best as "emergence". Somehow mind, as we normally conceive it, will emerge from the complication of process just as water emerges from the properties of its constituent hydrogen and oxygen. I think they are wrong -they obfuscate the reduction of *theories* with their fundamental premise of a necessary ontological reduction to "material". The necessary discreteness of brain process in space and time implicit in the latter does not admit the possibility of a unified mind and consciousness. **Crick's hypothesis,** as part of this category, provides a synchronization of process; it does not unify or explain consciousness. It explains the synchrony of brain function, but gives no clue to autonomous meaning or internal cognition.

Edelman's hypothesis is somewhat more complex, but is deficient on the same grounds as Crick's. His epistemology is more complex, (and nearer to the

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[37] See Iglowitz, 1995, specifically the discussion of the inconsistency of Maturana's epistemology, (in Chapter 3). It is applicable to Edelman and Freeman as well.

truth, I think), but with it he compromises the language within which he expresses it.

Walter Freeman's is the most interesting of the proposed models to me. He begins by trying to understand just one small part of the incredibly complex brain completely, (the olfactory system). The olfactory system is the most primitive sensory system and sensory input is surely the heart of the representation problem**.** He has started from what seems to be the soundest approach to the mind-brain problem -take the most primitive, the simplest part and follow an evolutionary rationale. He concluded that his empirical results were incompatible with "information" and "representation" and proposed a solution grounded in nonlinear dynamics instead. He proposes an extension of his conclusions to the brain as a whole. Though I am woefully ignorant of nonlinear dynamics, his general approach is certainly the right one. What particularly interests me is his incorporation of intentionality, (via the limbic system), and his disavowal of "information" and "representation" in his conception. I do not think he has solved the problem of consciousness however.

His "sequences of amplitude modulated spatial patterns observed in the brains of animals and humans in the gamma range of the EEG" do *not* show that "consciousness is organized and based in discrete global patterns in much the way that a black-and-white cinema is composed of frames with a high repetition rate." His problem in this, like the others, is that spatial frames integrate -become conscious -only to an observer. (It is the "homunculus" revisited.) Even taking the whole global pattern as the mind itself, how does one part of even that *mental space* know another part? His mental space is *specifically* a physical space. This is the unequivocally logical problem which I have addressed with "implicit definition".[38]

I think that his work may have an even more profound import for this problem, however. Integrating sensory and intentional perspectives, it suggests itself that he may actually be laying the broader, biological foundation for an expansion of technical logic itself -a deep logic which would include intentionality**.**

Freeman has beautifully *crystallized* and profoundly reoriented the problem of the mind. He correctly argues that it is not a problem of the perception of "sensations", (Kant, Cassirer), but a problem of response and the generation of a different, (though related), perceptual world *internal* to the organism. For Freeman, (and for Edelman, and Maturana as well), "information" *never passes*! The chaotic boundary he describes between the two corresponds to Maturana's "structural coupling" and to my "interface"! But it is *internal to* this interface that

[38] Freeman's response was that "in my view, the frames give content to a process that IS the observer". (his CAPS). But how does this process integrate? How does it *know*? This is the specific problem I have addressed in my model.

the problem of consciousness must be solved -not in the plain physical description of it. This is the coupling between biology and logic that I have argued elsewhere as the "concordance"[39]between biology and logic. This is the ground within which the problem must be solved.

Logic, after all, is *itself* biology! It is a biological and evolutionary program organizing response. From that point on however, I argue that meaning, knowing and "wholeness", (all the aspects of sentiency), must be generated internally to the new logic so constructed.[40] If my supposition is true, then Freeman's hypothesis could supply the link between the purely logical "implicit definition" I have proposed and its concrete biological foundation. It would supply the biological basis for consciousness and a *truly* "embodied logic".[41]

Like Edelman, (because of their common covenant with biology), Freeman disavows "representationalism", and he names himself an "epistemological solipsist". This is unfortunate. There are other epistemological positions better suited to his conclusions and the demands of modern science. Cassirer's "Symbolic Forms" is more fitting.[42] It is the very embodiment of the epistemological relativity required by his, (and my), formulation of the problem. It exonerates our doing science and our behaving as we do, (as brains ourselves), in a world those brains cannot ultimately know.

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[39] See Iglowitz 1995, Chapter 2. It is too long a discussion to include here.

[40] See Iglowitz, 2001, "Mind: The Argument from Biology"

[41] Using Lakoff's term

[42] See Iglowitz, 1995, Chapter 4 for a synopsis of Cassirer's "Symbolic Forms"

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