Chapter 2. How? The Logical Problem of Consciousness

(Cassirer- Hilbert- Maturana: an Archimedean Fulcrum)

> "... 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*."[1] (Ernst Cassirer)[2]

The problem of "consciousness" and the profoundest paradoxes of the mind-body problem: the "Cartesian theater", the "mind's eye", and the "homunculus" are *logical* problems. They are problems of *logical possibility*. How could cognition, how could mind, ordinarily taken, *exist*? It is not so much a problem of what it is that they *actually are*, but rather a problem of how is it even possible that they *could be*! How, as Leibniz framed it, *could* "the many be expressed in the one"? How could we *know*? In the context of realism, ordinary logic allows not even a possibility -other than an eliminative reduction, (a denial), of the problem -and of sentiency itself.

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[1] Compare also Lakoff: 1987, p.353. "Most of the subject matter of classical logic is categorization."

[2] Cassirer 1923 pps.3-4

He continues: "The Aristotelian logic, in its general principles, is a true expression and mirror of the Aristotelian metaphysics. Only in connection with the belief upon which the latter rests, can it be understood in its peculiar motives. The conception of the nature and divisions of being predetermines the conception of the fundamental forms of thought. In the further development of logic, however, its connections with the Aristotelian ontology in its special form begin to loosen; still its connection with the basic doctrine of the latter persists, and clearly reappears at definite turning points of historical evolution. Indeed, the basic significance, which is ascribed to the theory of the *concept* in the structure of logic, points to this connection. ..."

[But] "... The work of centuries in the formulation of fundamental doctrines seems more and more to crumble away; while on the other hand, great new groups of problems, resulting from the general mathematical theory of the manifold, now press to the foreground. This theory appears increasingly as the common goal toward which the various logical problems, that were formerly investigated separately, tend and through which they receive their ideal unity."

It is just this "general mathematical theory of the manifold" to which he refers at the end which, I will argue, forces an even further extension of Cassirer's own arguments.

The "schematic model" of my first hypothesis cuts to the core of these problems. Coupled with Ernst Cassirer's extension of traditional logic, (his "Functional Concept of Mathematics"), itself extended again in light of the expansion of logical possibility innate in David Hilbert's "implicit definition"[1] for the axiom systems of pure mathematics, it illuminates them and demonstrates a specific "how" for the first time. The answer turns on an extension of the formal logical Concept[2] and with it, of logic itself. Surprisingly that answer will allow us to retain our normal, ("folk"), conception of mind as well.

Let's Start from the Other End: First Hilbert's "Implicit Definition":

1. David Hilbert's book, "Foundations of Geometry"[3], is a recognized milestone in the history of mathematics. In it, he proposed a new axiomatic foundation for Euclidean geometry. His novelty lay in his *methodology* however.

His axioms, (as usual), referred to certain *objects*: "points", "lines" and "planes" and to relations between them: "to belong to", "between", and "congruent to". Hilbert's radical innovation, however, lay in the fact that he quite purposefully never specified, (and never *had* to specify), what "point", "line" and "plane" were *to be* or the *meanings* of the specified relations. He never required a specification of properties. He stipulated that the *sole* significance and exclusive consequence of his "objects", (undefined terms), was to be in *their operationality as expressed in the axioms*. They were to be "*implicitly defined*" by those axioms. The success and the fertility of the subsequent extension of his approach across the whole of modern mathematics illustrated thereby that mathematical axiom systems, insofar as they *are* mathematical, need define their terms and their elements, (their "objects"), only *operationally and internally*, not referentially. They do not define those terms in terms of set theoretic operations on primitive properties.

Consider the "integral domain" of Modern Algebra as a typical application of Hilbert's ideas. Axiomatization begins with the simple assumption, (*conditionally*) of a set of "elements", (objects), -its "domain"- which obey a set of rules, (axioms). These objects, (of its domain -and "existence" terms generally), are assumed *only*, (as Wilder points out) "presumptive(ly)" and "permissive(ly)" however. We are told *nothing* about them in an objective sense.

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[1] as strongly distinguished from his "Formalism" which is quite a different issue

[2] I will be employing a convention of capitalizing the word "concept" when it denotes the formal, technical notion of the concept to avoid such verbiage as "the concept of the concept", etc.

[3] "Foundations of Geometry", Hilbert, 1910.

The only objects posited explicitly and definitionally are the identity elements '0' and '1', the additive and multiplicative identity objects respectively. But these identity objects are presumptive and permissive as well. They are wholly specified as *just* the identity elements under these operations and no more - they are not the real(?) 0 and 1 or any other real objects.[1] No *properties* 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 '#', for instance), are conceived as totally *blind* operations as well.

What are we *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 whole of their definition and it is totally operational. What is conceptually significant about the Integral Domain is that there are *two distinct* operations, connected by the distributive law, not that they are some *special* operations.

In Modern Algebra, "equality", ("="), is unqualified and axiomatized as well. It is taken specifically as an "equivalence relation", (under the rules/axioms of reflexion, symmetry and transitivity), but it is the *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 equivalent under the *basic* equivalence relation of "equality", (i.e. that "4" = "3 + 1").

We are allowed to derive the other elements of the domain solely operationally as well - in terms only of these two givens, the '0' and the '1', (subjects of the only specific existence postulates). Thus '1' + '1' = '2', for instance, and '2' + '1' = '3', etc.[2] We can derive another element '-1' as the additive inverse, (under the conditional "existence" axiom of the additive inverse), and 'negatives' of the others as well. Continuing this (conditional) process, solely

[1] These terms presume *only* existence, not any particular properties of that existence. This, I suggest, is what it *means* for them to be "permissive".

[2] Under the assumption that '0' ≠ '1'

in terms of the axiomatic laws, (operationally), we can build the whole of an integral domain and it relates[1] to the real integers "up to isomorphism".

"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.

The 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, *blind*, objects, *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.[2] This is, as Schlick says, a genuine "Copernican revolution", (after Kant's usage), in the history of mathematics. 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.[3]

Hilbert's conception results in a novel and very different *kind* of "object",[4] one which is *wholly constituted* as an expression of the logical relations of the axioms. It is a *logical* object! Hilbert's brilliant reformulation of its foundations,

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[1] given the addition of the Well-ordering principle, itself wholly operative as well

[2] Compare Cassirer: "…we have in pure mathematics a field of knowledge, in which things and their properties are disregarded in principle, and in whose fundamental concepts therefore, no general property of things can be contained." , "Substance & Function", p.18 Does this mean that we must follow Hilbert into "formalism" -i.e. the simple manipulation of "marks"? I don't think so, for there is nothing *particular* about any given choice of marks in an axiom system- e.g. the identity elements might be named by *any other* marks, so long as the usage is consistent. It is the relationality, the operationality of those marks in a connective system which is significant. What "implicit definition" furnishes, then, is a *concept* embodying the invariant relationality of the system under all consistent substitutions. What is important about it is that that invariant relationality is non-trivial -e.g. that an " integral domain", (taken abstractly), *can* correspond with the real (?) integers "up to isomorphism"! (Birkhoff & Mac Lane, 1953, p. 34)

[3] Cf. The section immediately following this and the Afterword: Lakoff / Edelman for a further discussion of Aristotelean Logic.

[4] Consider the "object" of Chapter 1 in this light.

almost trivial in appearance, has become the heart and soul of modern mathematics.[1] Mathematics no longer looks to experience for its substance[2] or its validity. It concerns itself, rather,[3] solely with the fertility and the rigorous *internal* consequences of systems of explicit ideas. Ultimately, it is the science of the total possibility of order.[4]

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[1] I make a very large distinction between "implicit definition" and "formalism", both products of Hilbert's sweeping intellect. The latter deals with a formal and mechanical methodology of proof while the former deals with actual and internal logical implication -which is not the same as its formal expression. Most working mathematicians are not particularly committed to "formalism", but they are very definitely committed to "implicit definition". Every time a mathematician goes to definitions, (which is all the time), he goes to the undefined terms of the system he is dealing with -and no further!

Hilbert was a "catholic" mathematician in the small "c" sense -he had enormous scope. It is the "king of invariants" who sired "implicit definition", I believe, and not his twin –i.e. the father of "formalism".

[2] As Cassirer commented, this does not mean that it does not look to experience as the origin, the suggestion for its ideas, but rather that it does not accept experience as the *arbiter* of its substance.

[3] as is clearly visible in the evolution and reassessment of modern geometry -in the grounds for the resolution of the "parallel postulate" problem and Non-Euclidean geometries, for instance, and in the whole of Abstract Algebra.

[4] This is the lesson of Abstract Algebra. I will make this case later in this chapter as part of the argument for the Concept of Implicit Definition.

Schlick characterized Hilbert's innovation this way:[1]

> "The revolution lay in the stipulation that the basic or primitive concepts are *to be defined*[2] 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)[3]

This is the description of a genuine and profound "Copernican Revolution" in logic itself. Here "relation"[4] logically defines "entity", not the converse. *This entity* is a function of (logical) process. But "implicit definition" has another deep logical significance. It does not define its "objects" within the dualistic and oppositional context implicit in the foundations of classical Aristotelian logic. It does not define them within the classical schema of presentation[5] / attention[6] → abstraction[7] of properties.[8] It defines and resolves its objects, rather, by *internal* and *logical* resolution *of its fundamental operations*, and therein supplies the first clue to a logical possibility for sentiency -i.e. for the many-in-the-one.[9] Cassirer's analysis, (and actual reformulation), of the formal logical Concept[10] is crucial to an appreciation of the full implications however. Hilbert and Cassirer together, in company with the "schematic object" of Chapter 1, supply a new logical ground - the logical ground necessary for a resolution of the problems of sentiency, and, finally, for a resolution of the mind-body problem.

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[1] See also Einstein (1954), P.234, and Wilder (1967), Pps.3-8

[2] It is crucial to understand that "defined" is used in a very different sense in mathematics than in the sense of ordinary "dictionary definition". It specifies the *actual*, the whole and exclusive *existence* -for mathematics- of the entity defined. Mathematics students are ingrained in this as the very first step towards "mathematical maturity".

[3] Please note the close parallel to the argument I made in the "training seminar" of Chapter 1

[4] i.e. the constitutive relations specified in the axioms

[5] cognition of objects/sets of atomic properties

[6] attention to specific properties of the former

[7] abstraction = set theoretic intersection of those properties

[8] The problem of the "homunculus", I will argue shortly, is *already* implicit in this (classical) framing of the concept.

[9] –i.e. that our objects are not perceived or referential objects, but *created* ones!.

[10] Cassirer, 1923, Pps.3-233, especially Pps. 3-26

Cassirer and Classical Logic:

2. Cassirer argued that “the object” of modern mathematics, and “the object of mathematical physics” as well, (their "ideal" objects), are *conceptual* objects (only). He maintained that the Concept they actually embody in modern science is not the classical (Aristotelian) "generic Concept" however, but is rather a new "Functional Concept of Mathematics", (Cassirer’s *Concept*). He argued that modern mathematics and modern physics have *already* reconceived the formal logical "Concept" itself, albeit tacitly.[1]

The Classical Concept:[2]

Cassirer summarized the genesis -and the still-continuing usage- of the classical generic Concept as the simple abstraction and the idealization, through "attention", of a commonality of "marks", (properties), in a series of presentations.

> "But what was beyond all doubt, as if by tacit agreement of the conflicting parties, was just this: that the concept was to be conceived as a universal genus, as the common element in a series of similar or resembling particular things."[3]

A series of presentations with characteristics: (a,b,c,d), (a,c,d), (a,c,e), for instance, is held to bring forth the classical concept: {a,c}. From *mere abstraction*, (via attention), the whole of the doctrine of the classical Concept follows from these simplistic origins. "Every series of comparable objects has a supreme generic concept, which comprehends within itself all the determinations in which these objects agree, while on the other hand, within this supreme genus, the sub-species at various levels are defined by properties belonging only to a part of the elements."[4]

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[1] ibid. Also see his "Einstein's Theory of Relativity"

[2] See also “Afterword: Lakoff, Edelman…” for another discussion of the classical concept.

[3] "Substance and Function", p.9

[4] ibid p.5 This passage, (delineating, incidentally, the mathematical "power set"), suggests also the absolute hierarchy of concepts, (and theories), implicit in the classical conception. Cassirer's alternative, (which I will discuss shortly), reveals a new possibility, developing into his theory of "symbolic forms" which I will elaborate in Chapter 4.

But the successive broadening of a concept necessarily correlates to a progressive lessening of its *content*; "so that finally, the most general concepts we can reach no longer possess any definite content."[1], [at all!]. The ultimate genus - "something"- is totally (and logically) devoid of specific content!

Contra the Aristotelian Concept:

The Concept in this form, however, is clearly not adequate or consistent with scientific, nor even with *ordinary* usage:

> "When we form the concept of metal by connecting gold, silver, copper and lead, 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."[2]

It would not suffice to characterize "metal", for instance, "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." Similarly, we would not retain 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 form of procreation, of breathing, etc., which can be pointed out as common to all animals."[3]

Cassirer's Alternative: "The Functional Concept of Mathematics":

Cassirer proposed an alternative and considerably more plausible basis for a *different* technical logical Concept -borrowed from mathematics - "the Functional Concept of Mathematics":

> "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 strictness fully to retain them. When a mathematician makes his

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[1] op. cit p.6
[2] ibid P.22
[3] ibid P.22

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]

We do not go therefore from a series: a-alpha$_1$-beta$_1$, a-alpha$_2$-beta$_2$, a-alpha$_3$-beta$_3$... directly to their common element a, (Cassirer argues), but replace the alphas *by a variable* x, and the betas *by a variable* y. Therein we unify the totality in the expression "a-x-y", (actually w-x-y, where "w" is the constant function w(p) = a, (for all p), of the "generic concept"). This expression can be changed into the "concrete totality" of the members of the series by a continuous transformation, and therefore "perfectly represents the structure and logical divisions of the concept"![4]

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[1] ibid P.20-23

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

[3] ibid P.20-23

[4] ibid, P.23 As one of Kant's commentators urged about one of the latter's arguments, I find this argument as "mirabile dictu". It is the clear and true expression of *what we mean* by a "Concept". It is the functional assemblage of a *set of rules*. Rosch and Lakoff have argued in more recent times, (based in hard empirical data), that the categories of actual human beings, actual human cultures, actual human languages are not, in fact, grounded in the classical Aristotelian "Concept" but are based, instead, in prototype, metaphor, metonymy, association, radial categories, etc. But what are these, (in their anthropological totality), but the *free posit* of rules of category formation? Cassirer has provided a more classical and rigorous conceptualization. It incorporates the possibility of *all* (consistent) rules in a classical formulation.

Clearly this *does* better correspond with ordinary and scientific usage than does the classical concept. It is the functionality of our definitions which specifies the concept. The mathematical "subset" is the limiting, rather than the typical, case therefore.

Cassirer's "series" may 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.

Thus he fundamentally reconceives the formal Concept, *this our ultimate logical building block*, as "the "Functional Concept of Mathematics". It is the *functional* rule, F(x,y,z,...), which organizes and embodies the totality of its extension.

***Concept vs. Presentation*:**

Cassirer's new formal Concept is no longer logically derivable *from its extension* however:

> "The meaning of the *law* that connects the individual members is not to be exhausted by the enumeration of any number of instances of the law; for such enumeration lacks the generating *principle* that enables us to connect the individual members into a functional whole."[2]

If we know the relation according to which a b c . . . are ordered, we can deduce them by reflection and isolate them as objects of thought. "It is impossible, on the other hand, to discover the special character *of the connecting relation* from the mere juxtaposition of a,b,c *in presentation*."[3] [4]

> "That which binds the elements of the 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."[5]

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[1] ibid P.16

[2] ibid P.26

[3] ibid P.26, my emphasis

[4] cf. Stewart, 1995, "Fibonacci Forgeries". Stewart's article illustrates the case. The "insufficiency of small numbers" leads to an indeterminability of any finite series.

[5] ibid P.17

This is the *definitive* argument against “abstraction” as the *general* case and “presentation” as an ultimate foundation for logic. The association of the members of a series by the possession of a common "property" is only a *special case* of logically possible connections in general. But the connection of the members "*is in every case* produced by some general law of arrangement through which a thorough-going rule of succession is established."[1]

Contra The Theory of Attention:

The "*theory of attention*"[2] therefore "loses all application in a deeper phenomenology of the pure thought processes", (i.e. cognition). The similarity of certain elements, (under the classical view), can only be (conceptually) meaningful when a certain point of view has *already* been established[3] from which the elements can be distinguished as like or unlike. This identity of reference under which the comparison takes place is, however, "*something distinctive and new as regards the compared contents themselves*."[4]

The distinction between the concept and its extension, therefore, *is categorical*[5] and "belongs to the 'form of consciousness'".[6] It is "a new expression of the characteristic contrast between the member of the series and the form of the series".[7]

Cassirer argued that it is the equivalent of his "Functional Concept of Mathematics", rather than the generic concept, that is the *actual* "Concept" which

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[1] ibid P.17, my emphasis

[2] It is "presentation" vs. "attention" which is at the basis of the oppositional orientation of classical logic, and which is ultimately, I will argue, the origin of the problem of the homonculus.

[3] Compare Lakoff: “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) See Afterword: Lakoff / Edelman. This is surely directly relevant to the context problem as well, (i.e. "the frame problem), in Artificial Intelligence research. (cf. Dreyfus, 1992)

[4] ibid p.25

[5] But see my discussion later.

[6] op. cit P.25

[7] ibid p.26

has been employed throughout the history of modern science.[1] He offered a convincing co-thesis, furthermore, that the objects of mathematics and science are "implicitly defined", (in Hilbert's sense), specifically.[2] The "functional concepts", (their primitive laws), implicitly define their conceptual "objects" -and these are the actual working objects of science.

Major Consequences:

Cassirer's "Functional Concept" marks a profound advance to understanding, (and our specific problem), in two respects:

(1) it redefines the formal Concept, *fundamentally*, as a "functional rule" and,

(2), it isolates the concept as (logically) separate from, -as from a "different world" than -the "objects" it "orders". The concept is no longer inherent in the elements it orders, (e.g. of "perception"), nor is it (logically) derived from them. It is:

> "a new 'object' ... whose *total content* is expressed in the relations established between the individual elements *by the act of unification*."[3]

***Re Presentation*:**

The Concept is a purely intellectual -and original- entity, a "peculiar form of consciousness, *such as cannot be reduced to the consciousness of sensation or perception*."[4] It is neither a copy of nor an abstraction from its extension. It is an *independent* and "mathematically" functional "ordering" *–an act of unification!* It is a rule not logically derivable[5] from presentation. *That* rule, I will argue, is provided by biology, *not* by revelation.[6]

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[1] "...the concept of function constitutes the general schema and model according to which the modern concept of nature has been molded in its progressive historical development." (ibid, P.21) See also especially: *Einstein's Theory of Relativity*, Cassirer 1923

[2] Discussing Hilbert, Cassirer says: "The procedure of mathematics here", (implicit definition), "points to the analogous procedure of theoretical natural science, for which it contains the key and justification." ibid p.94

[3] ibid P.24

[4] ibid p.25, my emphasis

[5] i.e. under classical logic

[6] i.e. it is not transcendent –nor does it provide a "God's eye view"!

Cassirer has removed logic, (in his critique of the formal Concept), from the simple abstraction of perceptual objects, (i.e. presentation). It becomes instead an *internal* function of the mind, (and hence, I will argue, of biology) –i.e. a "new form of consciousness".

I will now proceed to argue a very natural extension (and, I think, a completion) of Cassirer's thesis: "the Concept of Implicit Definition". This Concept, part of that *same* "new form of consciousness" is also internal and logically independent from perceptual presentation as well. I will argue, in fact, that it *creates* its very "objects" – its "extension" -*within* the same free act of unification. Even our very "perceptual objects", (as well as our "intellectual objects"), I will argue, are resolved within the same internal (biological) act. This will remove, (in agreement with Maturana, Walter Freeman, and Edelman), the need for "presentation", (*metaphysically taken*), altogether. It is the (presented) "perceptual object", I will argue, which has been hypostasized! A new formulation of the Concept and its subsequent logic will allow the resolution of the logical paradoxes of sentiency.

Cassirer's Concept, (the Functional Concept of Mathematics), is unique in that its arguments show that the fundamental logical Concept is *not* derived from presentation or perception. It is a free and independent act (of unification). It is a "new form of consciousness" according to Cassirer and *not* dependent on them. But if his arguments are believed, (and I think they are *very* strong), then there is a very *natural* extension of Cassirer's Concept wherein the rule, (which determines the concept), can be likened to the conjunction of the axioms in an axiom system and its objects, therefore, to the objects of implicit definition. That result opens a new possibility –it potentiates the possibility *that objects as well*, (and not just intellectual concepts), can be free creations, acts of unification of that same new consciousness and not dependent on presentation or perception either!

It is clearly in "*presentation" itself* that the paradoxes of the homunculus and the Cartesian Theatre arise, after all, and these are specifically paradoxes of presentation. If our perceptions were *presented to* us,[1] -if mind, consciousness and perception were presentational and dualistic, (which is implicit in the presentation/attention → abstraction of classical logic) -then the paradoxes of sentiency would be innate and unresolvable. But if those perceptions arose *within* us, and if consciousness arose as a whole, (as the unified rule of "ontogenic coupling", after Maturana, as I will argue), then sufficient grounds for a complete resolution of the problem would be established. This is not an answer from solipsism, dualism or idealism however, but from *realism* sans information and presentation.

[1] as is assumed under the classical view

The Concept of Implicit Definition:
(a natural extension of Cassirer's "Functional Concept of Mathematics")

3. Cassirer's "Functional Concept of Mathematics" does not exhaust the possibilities however -not even for mathematics. The "implicit definition" of axiomatic mathematics has specific and *converse* consequences for the formal Concept. Since, (following Cassirer), an actual concept is now defined by any (definite and consistent) conceptual rule, I propose that a mathematical axiom system is itself a perfectly good Concept in Cassirer's sense. Axiom systems embody more profound rules than Cassirer considered however, and I propose that they define the *ultimate* concepts. Here it is a logically complex, (and typically non-serial), rule which defines the concept, (i.e. the conjunction of the axioms), and conversely, (and significantly), following Hilbert and modern mathematics, it is a definite, logically precise and consistent rule of generation of its "extension" -i.e., of its implicitly defined elements as well.[1] But axiom systems are not logically "dimensional", (strictly implied in Cassirer's F(x,y,z...)), nor do they normally define a "series"; they define the raw (broadest) manifold itself.[2]

There is no *a priori* presumption of dimensionality in the domain of an abstract axiom system. Nor can the elements of the mathematical manifold be characterized a priori, (dimensionally), *as functional values* of the individual axioms. Their "objects" are *not* "objects" of the sort: (a1(x), a2(y), a3(z), ...). Axioms do not interact *dimensionally*, they interact *operationally*. The combination of axioms, and their rule of generation, (Cassirer's "continuous transformation"), is purely, profoundly and complexly logical. A mathematical axiom system need not characterize a "series" or a "series of series" moreover.[3]

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[1] I am concerned here with the object of implicit definition *only insofar* as it is a logical object, only *insofar* as it is a mathematical object. This is the actual object of implicit definition. I am not concerned with the (different) objects of models with which it may be made to correspond, i.e. with the objects of its possible realizations. This is quite a different case and quite a different object. It is the logical object *per se*, I will argue, that solves the homonculus.

[2] I.e. the abstract set taken in its broadest, most general mathematical sense

[3] Cassirer, like Kant before him, considered the "series", (or a series of series), as the ultimate possible mode of logical and conceptual organization. He saw it as the ultimate expression, and only possible principle, (rule), for a logical function, (i.e. a logical principle which specifies its extension), other than identity. He based his new formal concept, ("the Functional Concept of Mathematics"), upon that belief.

But that conception is inadequate and inaccurate for the case of modern mathematics. Axiom systems exactly describe, (specify), elements, (their extension), that are not generally,

Indeed, this is the exception rather than the rule. What it must and does embody, however, is the raw manifold itself, (its domain).[1] It embodies the "logical continuum" generated by its axioms. It embodies an "order" of a higher degree of freedom.

The instances of Cassirer's "Functional Concept", (the objects of its extension), are the continuous generation of its rule. The instances of the implicit definition of mathematical axiom systems, the implicitly defined "elements" of their manifolds, are logically continuous as well -they are the continuous generation of a more profound rule which, *by definition*, exhausts, (and defines), its extension. The "elements" of the mathematical domain are precisely *all and only* those "values" implicitly defined by, (logically generated by), a particular system of axioms -in a sense *precisely parallel* to Cassirer's. They are the pure embodiment, (crystallization), of the "order" of its rule. Its elements are *virtual* elements expressing its innate order. The whole of their meaning and the whole of their being, (*mathematically*), is solely such. The manifold, (domain), represents the functional and conceptual "values" of its system of "generating relations". Its elements are logical elements.

The "elements", (mathematically conceived), of axiom systems are not "objects" *upon which* a system of "generating relations" acts, however, or to which it relates. They are *products* of it. There is no a priori presumption of their distinct and separate existence. Wilder, pertinently, characterizes the "existence" terms of axiom systems as "presumptive" and "permissive" only.[2] Axiomatic "existence" is an operative term only. The elements -*the objects*- of axiom systems are logical "invariants" of their generating relations and internal to the rule itself.[3] Neither "presentation", (nor reference), is implicit in them. They are "entities *whose whole being* is to be bearers of the relations laid down by the system."

(i.e. not a priori), organizable on a series principle. Axiom systems embody a larger and broader logical principle, (a rule which specifies its instances), and a broader logical concept, (as demonstrated, I suspect, by Goedel). The elements of a mathematical domain are fully prescribed, ("functionally" in Cassirer's sense), by their axioms, (their rule), but this rule is not "series". It is a complex logical rule -not referring to, but internally generating its extension as a virtual expression of its own innate ordering. It is the rule of implicit definition. This rule, following Cassirer, (I will argue), defines a new concept, the "Concept of Implicit Definition".

[1] which is not, a priori, *implicitly* dimensional.

[2] Wilder, 1967, P.18

[3] Contrary to this view, Resnik,(Resnik, 1992), criticized an example of such a "structuralist" conception of mathematics in terms of the theory of reference. Under my hypothesis, however, the theory of reference *itself* becomes highly problematic. (cf Quine, 1953, pps.139-159, "Reference and Modality") Also see Chapter 4.

I urge that this -the Concept of Implicit Definition- is the *ultimate* logical rule, and the ultimate "ordering". It captures the ultimate functionality, (in Cassirer's sense), of a logical system and generates its extension, (its abstract "domain"), as a virtual embodiment of its *own* (logical) "ordering" -its rule. An axiom system, (conceived mathematically), is a rule which *wholly specifies* its "elements" -by definition.[1]

I propose, therefore, a new and largest formal "Concept": the Concept of Implicit Definition. I propose it in strict analogy to the case of the mathematical axiom system and in strict extension of Cassirer's Concept. It is the natural extension of Cassirer's Functional Concept of Mathematics, and embodies, I propose, the ultimate rule, (in Cassirer's sense), of order. But it is a generalization of Cassirer's formal concept, not an instance of it. Conceptual "dimensionality", (a "series of series"), implicit in Cassirer's linear function of functions: F(x,y,z..), is a *special case* of the "rule" -and of the formal Concept.

The concept of an axiom system, its "rule" of implicit definition, embodies something absolutely new and unique amongst concepts however. Its extension is *precisely* its own analycity. The "being", (and the "meaning"[2]), of its elements are, by definition, *identical* with the purely logical "singularities" of the (complex) rule -and the concept- itself. They "are ... defined just by the fact that they satisfy the axioms."[3]

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[1] See prior "Elaboration" discussion

[2] see above --Schlick

[3] Wilder quotes Nagel: "Indeed, if geometry is to be deductive ... only the *relations* specified in the propositions and definitions employed may legitimately be taken into account." (Wilder, 1967, p.7)

Implicit Definition vis a vis Presentation:

Like Cassirer's Concept, (its conceptual progenitor), the Concept of Implicit Definition is not *oppositional*: i.e. it does not (logically) presuppose "abstraction" or "attention" either. It too is a "peculiar form of consciousness", an "act of unification ... not reducible to the consciousness of sensation or perception". But *this particular* "act", (unlike Cassirer's), does not presuppose "presentation" either. It does not just logically specify its extension; it logically encompasses it! The rule of "implicit definition" itself then, following Cassirer, is logical exhaustion and its "objects" are *purely logical* objects. They are "crystallizations" - i.e. logical "invariants"[1] of and internal to the rule itself.[2] This Concept, I suggest, does not entail "extension" at all -it is a (complex) unity.

Cassirer's Concept, (the Functional Concept of Mathematics), is unique in that its arguments show that the fundamental logical Concept is not derived from presentation or perception but is a free and independent act of unification. It is a "new form of consciousness" *not* dependent on them. The Concept of Implicit Definition, (an extension of Cassirer's thesis), opens a further possibility, however. It potentiates the possibility *that objects as well* can be free creations, acts of unification of that same new consciousness, (and biological organism I argue), and not derived from presentation or perception either. This is a radical idea admittedly. Though somewhat repugnant and somewhat astounding to our preconceptions, it is certainly consistent with the biological conclusions of Maturana, Edelman, and Freeman wherein perception and consciousness, (whatever those may or may not be for these authors –more generally, the internal biological function), of an organism do *not* derive *information* from the world. But that is just what perceptual presentation would imply. The positive and the immediate consequence of this new rendering of the Concept, (C.I.D.[3]), is that we now have the tools to understand –completely resolve in fact- the problems of the "homunculus" and the Cartesian theatre. The virtual objects of implicit definition are *known* to the system as a whole. For it is only *as implicitly defined*

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[1] cf Cassirer, 1923 pps.36-41

[2] Implicit definition is important when something significant is *actually* defined. The "objects" of abstract mathematics, (integers, for instance), are, (in opposition to Mill),"concrete", viable and fruitful. Its element specifies a particular kind of object, and that object is specifically a "crystallization" of a peculiar kind of "*ordering*"! It *embodies* the logical and relational *essence* of that ordering -and that's all! Its "objects" are "crystallizations" of its rule -just like the objects of the training seminar. The rules here, (and there), I argue, define the object, not the converse. But here the actual mechanism of that "crystallization" is transparent. The "calculus" defines the object, and the definitional mechanism is implicit definition.

[3] my "Concept of Implicit Definition"

resolutions of the system as a whole that they exist at all! This is a major advance on the problem and enables the only realist solution of the problem yet proposed other than a denial of the problem itself. It was in "presentation" *itself* that the unresolvable paradoxes arose after all. To repeat myself however, the denial of (metaphysical) "presentation" does not result in solipsism, but in *realism* sans information and presentation.

Why is this relevant to mind?

4. Why is this significant to the problem at hand? It is because *this* Concept seems "tailor-made" to the logical problem of mind: It is capable of solving the homunculus problem and that of the Cartesian theatre. It can resolve objects without presentation, (without "the homunculus"), and supplies the "theatre"! It also supplies an autonomous theory of meaning.

Cassirer has established the equivalence of "concept" and "rule". If, (1) following the arguments of chapter 1,[1] we are no longer concerned with representation, (nor, with it, of "presentation"), and (2) if, tentatively, mind were taken as the unified rule, (the "act of unification"), of brain response,[2] -if it were taken as the *unified rule* of the "structural coupling"[3] of the brain -then (3), (following Cassirer), "*mind" might reasonably be identified with the "concept", (in the larger constitutive sense), of the brain*. If that particular concept were analogous to the "Concept of Implicit Definition" in mathematical axiom systems furthermore,[4] then it would not just "take account" of the elements of its "extension", it would *know* them![5] Their "meaning" and their "being" would be logically manifest *internal* to that concept, (and rule), itself. They would be resolved as *virtual* expressions of that very rule. They would "acquire meaning ... and possess only the content that it bestow[ed] upon them." They would be *logical* entities "whose whole being [was] to be bearers of the relations laid down

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[1] and of Chapter 3, and of Maturana and Varela, Edelman and Freeman

[2] I.E. As an organizational rather than a representative model as I argued in chapter 1

[3] See Chapter 3: Maturana and Varela

[4] This is consistent, certainly, with the "schematic object" presented earlier. How *could* evolution crystallize its (schematic) objects? The implicit definition of process -of "rule"- provides an explicit mechanism and rationale!

[5] If there is a tendency to characterize my thesis as a variation of functionalism, then it should be noted that it involves a totally different notion of "function", (and "relation").

by the system." (I argue that the "logic" just mentioned is a constitutive logic[1]. I will argue presently that it is the schematic calculus of Chapter 1!)

But these particular entities -as cognitive and perceptual entities- *no longer* (metaphysically) presuppose attention or abstraction -*nor do they presuppose presentation*. Therefore, they do not presuppose that which it would be presented *to* -i.e. a "seer"! The logical problems of "the object" -the problem of the homunculus, the problem of "the mind's eye", the "Cartesian theatre", (which are the principal enigmas of consciousness) -are thereby solved in principle. The fundamental duality, implicit in classical logic, between "seer" and "seen", "thinker" and "object of thought", "perceiver" and "perceived", or, more fundamentally, *between cognition and presentation*, is bridged. The unity, and the very possibility of cognition of "the object" -the global perspective of the many in the one- is explained in the unity of its existence as a virtual object of implicit definition. For it is only globally that such a virtual object even *exists* as an object. In our rational universe, then, the Concept of Implicit Definition seems the most appropriate,[2] as a model, to the logical problem of "consciousness". There *is* no categorical disjunction between the "form of the series" -i.e. the "rule" of implicit definition- and its "elements". They are unified in the concept itself.

*Contra Cassirer***:**

Cassirer "bent" the focus, however:

> "there is no danger of hypostasizing the pure concept, of giving it an independent reality along with the particular things. ... Its 'being' consists exclusively in the logical determination by which it is clearly differentiated from other possible serial forms ... and this determination can only be expressed by a synthetic act of definition, and not by a simple sensuous intuition."[3]

There are two crucial flaws in his argument, however:

(1): In the axiom systems of pure mathematics, the *elements* are also expressed by an "act of definition", (albeit an analytical one) -i.e. that of "implicit definition". They are themselves manifestations of that "peculiar form of consciousness, such as cannot be reduced to the consciousness of sensation or perception."

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[1] after Kant's usage

[2] the *only* appropriate yet suggested!

[3] Cassirer, 1923, P.26

(2): While he states that the application of the Functional Concept is embodied in the concept itself,[1] he argues that concepts are different *in kind* from their extension. These are "objects" of a different world from that of the "particular things" -the objects of "simple sensuous intuition". I argue, (in concert with my first thesis), that the "objects" of "simple sensuous intuition" are *themselves* ultimately objects of "implicit definition" and part of that *same* "peculiar form of consciousness". It follows, then, (given my hypothesis), that there is no *simple* sensuous intuition at all -it does not exist. It is the *perceptual object* which has been hypostasized! His dichotomy of the "being" of the pure concept and the "being" of the "particular things" need not stand on either leg.

Cassirer did not generalize the "Functional Concept of Mathematics" into "the Concept of Implicit Definition". The "new consciousness", furthermore, stopped short of "sensuous impressions" themselves. For him, the latter were absolute and unknowable. They were, in effect, the focal point upon which the various forms of knowledge, his "Symbolic Forms",[2] were oriented, but could never reach. They were the rock upon which he erected, in Swabey's characterization, his "epistemological theory of relativity".[3] His "object of knowledge" was a purely conceptual object, implicitly defined by the fundamental laws of the sciences, -their "generating relations". The "objects of perception", the "particular things", were of a different and untouchable world, the rock splitting the intellect in two.

The Crux of the Issue: Presentation

Cassirer did Promethean work, however. He demonstrated the fundamental inadequacies of the classical Concept, both in its scope and specifically as regards "perception". He illuminated the profound and expressly logical chasm between the Concept and the perceptual realm, (the "material" with which it purportedly deals!), and hence the pervasive *duality* which "perception", i.e. "sensuous impressions", necessitates for mind and logic. Even Cassirer's "Functional Concept of Mathematics" was insufficient to the fundamental problem, however, and he remained inside the "magic circle" of perception. The opposition of "Concept" and "percept", (e.g. "attention/abstraction" and "presentation" or still even the opposition of Cassirer's "Functional Concept" and presentation -"sensuous intuition"), and the dualism which is implicit in it, is the

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[1] "if I know the relation according to which a b c ... are ordered, I can deduce them by reflection and isolate them as objects of thought" ibid p.26

[2] cf Cassirer 1953 and Chapter 4

[3] op. cit P.v. I will have much more to say about "Symbolic Forms" in Chapter 4.

essence of the issue. It is a genuine antinomy and the actual genesis of the problem. Already contained in "abstraction", already implicit in "attention", already embodied in "presentation" is the dualistic homunculus: i.e. that *to which* "presentation" is offered. There was no way heretofore that we could even *conceive* of an answer to this problem because it was *the formal Concept itself* which generated it. *This* was the retort in which the "homunculus" was conjured!

"Implicit definition", however, belongs *totally* to the "new form of consciousness" -as do the "objects" which it "orders". But here, (beyond Cassirer), there is no longer the assumption of a *presentation* of "elements", (psychological impressions or otherwise), from one world to an intellectualizing, (cognitive), faculty in another. There remains, therefore, *no implicit need* for the dualistic homunculus in cognition. This explains why the two worlds are compatible. There are not two worlds, but one. This "peculiar form of consciousness", this "new consciousness" I maintain, is the *only* consciousness.

Mind-Brain: The Hypothesis:

> "... every transformation of the genuinely 'formal' concept produces a new interpretation of the whole field that is characterized and ordered by it" (op. cit. p.26)

6. Let us suppose that "mind" is the "implicit definition" of the process, (rule), of brain response. Let us suppose that the relationality of brain process is like the system of "generating relations" of an axiom system,[1] and that even the "objects of perception", *the "sensuous impressions" themselves*, are implicitly defined within that system,[2] (alternatively that our "objects" embody the "calculus" of evolutionary design as per Chapter 1). The "objects of perception", then, are not *imposed upon* the brain, (or presented to it), but are logical invariants of brain process itself.[3] The "objects" are products of the "categorical act" -the implicit definition of the brain.

"Implicit definition", as a thesis for mind, does not presuppose "presentation" to generate its "objects" nor is it antinomical. Its "objects" derive

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[1] I will suggest a physical paradigm shortly.

[2] i.e., that "perturbation", "triggering" modifies process! cf Maturana and Varela (1987), pps. 166-171, on brain plasticity.

[3] If "mind" is the "concept of brain process", then its rule -implicit definition- is primal logic itself. Conversely, if "logic", at its root, is the *embodiment* of that rule, then the relevancy of logic, as the expression of the ontogenic coupling of the brain, requires no teleological presumptions!

from the logical connection of process. "Sensuous impressions", therefore, are not presentations *to* a process, they arise internal to the process itself.

If we take "the object of perception" as being a specific "object of *conception*", (taken in the new, larger sense of "Concept")[1] -if it is not, in fact, a copy, a "mirror" of externality, but an internal functional construct -*a schematic artifact of the process of brain response* as I have argued in my first thesis, then we have arrived at a viable solution to the whole of the general problem of cognition. The unity of the object is the unity of its implicit definition as a virtual element in a system of fundamental constitutive relationality[2]. But the "relationality" purported here is not the relationality of Functionalism. It is not the classical conception, nor even a Cassirerian "functional" conception of the relationality of fine-grained brain structure, but rather the (logical) "generating relationality" of implicit definition -of the brain as process.

***A Possible Physical Paradigm*:**

7. What is desperately needed at this point, obviously, is a *physical* paradigm. How might this "axiom system" model -which seems to fit the fundamental *logical* problem of "mind" so well- be implemented as a biological model? An operational approach seems quite promising. Considering brain dynamically, -in terms of what it does, (its function), rather than in its fine-grained physical structure, certainly fits the necessary context of "structural coupling", (response).[3] The perplexing *simplicity* of the division of the brain into definite gross anatomical substructures, for instance, is suggestive. (If it were "wired" randomly and incrementally on a "breadboard", 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.)

Might not the distinctive, purely and abstractly geometrical function of the cerebellum,[4] -considered as a *functional unit of response* -provide a pointer in the right direction?[5] Might not these, or *some other* structural sub-units, considered as *modular units* of process -of "ontogenic coupling" -*be "axioms*"?[6] [1]

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[1] I.e. within the context of a *constitutive* logic

[2] i.e., in Maturana's terminology, of "ontogenic coupling"

[3] see Chapter 3

[4] i.e. doing tensor transformations. See Churchland, 1986, pps. 412-458

[5] The training seminar may still have things to teach us.

[6] Or, as another possibility, think about the multiplicity of specific *types* of neurotransmitters in the brain. If the brain is monolithically structural –with the axons and

If the "objects of perception", the "sensuous impressions" themselves, are "objects of the intellect",- i.e. implicitly defined purely conceptual entities, ("conception" in the larger sense), then a Copernican revolution into a new logical world-view, centered in the "Concept of Implicit Definition", resolves the whole of the problem of cognition. The processes of judgement, intellect, even "perception" -are not profoundly distinct or separate from the "objects" judged, from the "objects" with which they deal. Perception, conception,[2] logic, and "object" are all aspects of the *same* process -the implicit definition of the "generating relations" of brain.

But what of "meaning"? In short, let me repeat Schlick's comment with a different emphasis: "'point', 'straight line', 'plane', 'between', 'outside of', and the like) ... to begin with, *have no meaning or content*. These terms *acquire meaning* only by virtue of the axiom system, and possess only the content that it bestows upon them." Meaning itself can be explicated as a function of "implicit definition". It is an expression of logical "positionality", (order), in the context of relationality in which it is realized.[3] (This is actually very close to the naive sense of "meaning".)

Consider, finally, Patricia Churchland's comment about theoretical systems:

> "It emerged that the *meaning*", (my emphasis), "of the most respectable of theoretical terms was defined implicitly by the theory the terms figured in, not by the empirical consequences of the theory. Terms such as 'force field', 'energy', and 'electromagnetic radiation' were prime examples where

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dendrites as “wires” of a sort and the synaptic neurotransmitters as a sort of variable “solder”, then why did evolution go to the trouble of making so many kinds?

The fact of their multiplicity of type suggests another interpretation: that of multiple, *superimposed* structures, (modules?), sharing neurons and distinguished by their response to specific neurotransmitters. This raw speculation would be another possible conception of “axioms”, i.e. functional blocks in the brain.

[1] This suggests a very definite line of research, i.e., the detailed investigation of gross substructures in primitive nervous systems. It suggests a line of interpretation in terms of modules of response, i.e. "axioms", whose interaction would define the "objects" of their perceptual worlds! What is it like to be a planarian worm? This may not be a ludicrous idea after all!

[2] The "elements" of the manifold are "implicitly defined" by their generating relations, but so is "between", "line", ... Could not the "purely intellectual" object, (concept), -as distinguished from the perceptual object- be conceived as the product of co-definition from embedded axiom systems. It would then be an implicitly defined "object" of a different precision, a different "resolution". The element of a group, for instance, is less "resolved", in this sense, than the element of an integral domain or a field.

[3] See Dreyfus 1992 for the context/"frame" problem

meaning was a function of the embedding theory and where operational definitions were laughable."

"*Whole theories have empirical consequences, and it is whole theories that are the basic units of meaning*", (my emphasis), " -not terms, not sentences, and not subparts of the network. To be acceptable as an account of nature, a theoretical network must, *as a whole*, touch an observational base, but not every acceptable sentence or term in the network must do so." (P.S. Churchland, 1986, pps. 265-266)

I am proposing that the human mind itself is a theoretical (and operative) network, and it is only as a whole that it touches its base -i.e. its environment. As a whole it determines the meaning of its terms and implicitly defines its "objects". I propose that not only our theories and the meanings of their terms, but that our cognitive objects *themselves* are implicitly defined as well. It is only in the context of the system of response that they "touch" our environment, ("have empirical consequences"). The "object" of cognition refers to its, (the system's), *own* operationality and not to an external object. I propose that it is not the objects of the system that touch objective reality, externality; its *"axioms"* do!

If the brain/mind relationship is like the relationship of the axiom system to its implicit definition, then "we" do not deal with "presentations" to us, either for abstraction, conception *or* perception. Rather, "we" are the system of implicit definition *in which* the so-called "presentations" are created. This completes, I feel, a reasonable and appropriate preliminary definition[1] of "mind".[2]

Convergence.

8. My (second) thesis furnishes the basis for a coherent biological explication for "mind" and "consciousness". If even the "percept" is just a special (and natural) aspect of the (extended) "concept", then mind is clearly a logical[3] continuum, (what else is there?) But that logical continuum would clearly be

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[1] cf Chapter 5

[2] Incidentally," implicit definition" suggests *another*, more mature perspective than those presented in the earlier discussion on "models". Under this perspective even the schematic models and their artifacts are not (evolutionarily) "*constructed*" for (efficient) "*use*". The "objects" arise *incidentally* -they are *implicitly defined* as a result of the evolutionary optimization of brain organization around process and response. They are the "undefined terms" of a categorical "axiom system". Under this perspective we do not *use* our model, we *live in* it.

[3] in the sense of Kant's constitutive logic

complementary to the operational continuum proposed under the first thesis. This concordance suggests an identity: that our "objects" are logical *as well as* operational objects[1] and vivifies my logical hypothesis of mind.

The evolutionarily argued object of the first thesis is a virtual and schematic object of *process*. It is a continuous manifestation of the field of process which underlies it. The independently argued object of the second thesis, (derived from considerations of formal logic), is a virtual and schematic object of *logic*. It, too, is a continuous manifestation of the (here logical) process which underlies it. This strongly suggests an isomorphic correspondence between the results of two very different and plausible approaches to the problem. It is the discovery of just such correspondences that are crucial to the advancement of science.

But biology itself argues the correspondence. Taking a biological, (and reductive materialist), perspective,[2] logic itself must be taken as a human, (and evolutionary), artifact. The alternative would be to assign *transcendent*[3] properties to logic, a position clearly contrary to the very spirit and rationale of materialism itself. From the standpoint of biology, both "logic" and "concept" must *themselves* be considered reductively and evolutionarily.

The final biological rationale for human logic itself, (i.e. that aspect of human behavior which we call logic), is clearly *evolutionary*, -i.e. it is determined by natural selection. Logic is then necessarily a pragmatic rule of correspondence, (a procedural rule), between the brain and its environment. The (primitive) rule of "logic" itself is therefore operational, (rather than transcendent), and "concept", as *part of* that logic, must be considered likewise. This suggests a striking conclusion: *the first two theses are equivalent!* The "mind" is the "logical", (-i.e. "*bio*-logically" operational), "concept"[4] of the brain.[5] It is the "unified rule" of brain process. (Within this context, I assert that Hilbert's thesis serves as the clear foundation for a deep and autonomous theory of meaning.)

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[1] This correspondence has the potential of supplying a vital and fundamental biological heuristic principle to psychology itself which, if realized, could be as important to psychology as evolution has been to biology. It could supply a *fundamental* operative rationale and tool for the investigation of mind and consciousness based in biology.

[2] whose use I will justify in Chapter 4

[3] rather than "transcendental" -after Kant's usage.

[4] "concept" and "logic" both conceived reductively as biologic processes.

[5] This, as I noted before, removes another "miracle", i.e. the startling simplicity and sparsity of the rules of logic and science. From the standpoint of my theses, the appropriateness of our "objects" and the simplicity of their mutual relationality are precisely the point of their existence!

This, I propose, supplies the actual basis, grounded in a new formal Concept, for the "constitutive logic" which Kant postulated to lie beneath our perceptions. I propose that my first thesis provides its specific and precise biological rationale and my second thesis explicates its "objects". Our perceptual objects are not objects *in reality*; they are the implicitly defined logical objects, (alternatively, clearly now, operative objects), of this constitutive logic. They are objects of process.

A crucial turning point in my argument:

9. This, I maintain, constitutes the final physical answer to the mind-body problem. Naturalists can accept this answer as complete, (and the problem as solved), if they like and dismiss any further questions. But inherent in my thesis as well is the assertion that our objects *are not* representative and informational. To believe that they could still remain so becomes, (under my thesis), equivalent to a hypothesis of "divine harmony", (possible but implausible). This, (right here then), is a crucial turning point in my argument. I hereby reorient the whole of my argument up to this point and declare it[1] as a reductio ad absurdum of *ordinary* Naturalism[2]. By this, I most definitely do not reject the *relationality*[3] of Naturalism or of Naturalist science. But I do maintain that I have demonstrated the implausibility of *absolute* reference and *absolute* information.[4] The next chapters will elaborate this point explicitly and invoke a variation of Cassirer's scientific epistemological relativism, which preserves Naturalist science in a deeper realism. The argument up to this point has been in the demonstration of a counterexample, -*a significantly better counterexample I think*- which fits the presumptions of Naturalism and the facts of the problem as seen from the Naturalist perspective.

The unity of consciousness, the unity of mind is a logical, a conceptual and operational, rather than a spatial unity.[5] The paradoxes of the Cartesian Theater

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[1] I have not been "cute" nor, I think, deceptive. It was necessary to establish the language of discussion and a context. The audience I seek is that of working scientists, and I have addressed myself to them. I seek to extend the field in much the same direction -and to the same purpose - as modern physics extended itself. I will resolve the obvious difficulties in the next three chapters.

[2] As distinguished from "relativized Naturalism" -see Chapter 4

[3] i.e. the web of implication and predictivity

[4] cf Chapters 1, 3 and Appendix A

[5] Just "Where" and How this unity *exists*, (i.e. What), will be addressed in the third thesis, (Chapter 5). Incidentally Dennett also concluded that "mind" is a logical entity! See Appendix F: "Dennett".

do not derive from an innate flaw -or fantasy- in "mind"; they derive from a deficiency of ordinary logic.

Hubert Dreyfus[1] concluded that the brain cannot be simulated in a digitally based computer,[2] but he explicitly allowed the possibility of an analog implementation. Cassirer produced, in fact, an analog, (i.e. a functional), concept -"the functional concept of mathematics". He suggested the requisite (analog) expansion of logic as well:

> "..it must become evident that we stand here before a mere beginning that points beyond itself. The categorical acts which we characterize by the concepts of the whole and its parts, and of the thing and its attributes, are not isolated but belong to a *system* of logical categories, which moreover they by no means exhaust. After we have conceived the plan of this system *in a general logical theory of relations*", (my emphasis), "we can, from this standpoint, determine its details. On the other hand, it is not possible to gain a view of all possible forms of connection from the limited standpoint of certain relations emphasized in the naive view of the world. The category of the thing shows itself unsuited for this purpose in the very fact that we have in pure mathematics a field of knowledge, in which things and their properties are disregarded in principle, and in whose fundamental concepts therefore, no general property of things can be contained."[3]

The "general logical theory of relations" he predicts, though it involves an extension of his own "Concept" is, I propose, the "generating relationality" of implicit definition. The concept of the axiom system -the Concept of Implicit Definition- resolves the problem Dreyfus so correctly defined, but it resolves it, (contrary to Dreyfus' expectations), within the platonic tradition.[4]

My thesis resolves the fundamental problems of "mind" and "consciousness", i.e. "perception" and the primal logical problems of the "homunculus", the "Cartesian theatre", and meaning -and it is the only theory yet proposed that does. But these are the *greatest* enigmas of mind. (The other is that of providing a possible substance for mind which I have addressed in chapters 3, 4 and 5.) How can a *part* of a whole be comprehensible *to* a whole. How can a mind "see" its contents without an infinite regress? How can a

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[1] See Appendix C: "Dreyfus"

[2] His arguments are strong but I do not necessarily agree with his conclusion.

[3] Cassirer op cit P.18

[4] cf Dreyfus Appendix

spatially and temporally distributed process *cognate* a part of itself? Other than an eliminative reduction of mind itself -i.e. an actual negation of mind in our normal sense altogether, (which is the answer of most –realist- modern theorists), there seems no other possibility. Supervenience, unless taken magically, doesn't really make a lot of sense. "Grandmother cells" or "pontifical cells", (William James), do not work. Eliminative reduction, on the other hand, throws away the baby with the bath. Its answer is that there *is* no "mind" in our normal meaning of the term. We are linguistic automatons -i.e. "zombies".[1]

***Plain talk*:**

10. Let's talk loosely for a bit. We do not start with absolutes *anywhere* in our logical and scientific endeavors. Somewhere we start with beliefs. I, for one, believe that I have a mind and a consciousness in the *naive* senses of those words. I think most of you believe that you do too. By this we do not just mean that our bodies mechanically and robotically produce words and actions which "cover the territory" -which merely simulate, (substitute for), sentiency in our naive sense of it, but that there is some universal and unified existence which is *aware*. But how?

Contemporary Naturalists, (Dennett, the Churchlands, Hofstadter, ...), universally and necessarily deny naive sentiency -the "mind's eye", the "matter", the "figment" of mind. They preserve only linguistic and neural process. They forthrightly, (to their credit), reduce mind to strict mechanism -to spatially and temporally distributed process. Mind, in a non-reductive, (i.e. a non-reinterpreted), sense, cannot exist for them. In this, I feel, they have completely lost credibility. They ask me to deny *me* in order to retain my beliefs about ordinary things.

Even idealism and dualism do not resolve the underlying logical problem however -the *how* of Leibniz's "expression of the many in the one", for even then how could *this* part of even a mental "substance" know *that* part? These are logical problems -the problem of the "homunculus" and the problem of the "Cartesian theatre". Where does there exist even the *possibility* of a solution? Implicit definition, virtual existence -and logic as biology- this is the *only* example within our intellectual horizons that seems to hold even *any* promise for sentiency in this our ordinary sense of it. It suggests the only scientifically plausible solution to "the mind's eye" and the "Cartesian theatre" and the only non-eliminativist, (for "mind"), answer to the homunculus problem. These are answers which *must* exist if mind in our ordinary sense is, in fact, to be real.

[1] cf Appendix F: Dennett

Implicit definition permits knowing, (as a whole), what are, in some real sense, our distinct and separate parts -precisely because those parts, (objects), are in fact non-localized and virtual (logical) expressions *of* the whole. It opens the first *genuine* possibility, therefore, for a resolution of this essential requirement of "naive" consciousness.

But *that* pathway, (implicit definition), *does not make sense from the standpoint of representation*! For implicit definition solves the problem *logically* -from the standpoint of constitutive logic -and speaks to nothing other than its own internal structure. "Objects", (under implicit definition), are known *to* a system, (i.e. universally/globally), *only* because they are specifically expressions *of* the system. It becomes a viable and natural solution to the problem of awareness, therefore, *only* when the objects of consciousness themselves are conceived operationally and schematically, (and specifically, *logically*[1]), rather than representatively.[2] When our objects are taken as specifically schematic representations of process however, (as per my first thesis), the solution becomes both natural and plausible -the logical problem of sentiency is resolved.[3] I assert that no other actual solution, (other than a denial of the problem itself), has ever been suggested. This is the argument from the second to the first hypothesis -and different from the argument from the first to the second presented earlier.

But this conclusion is greatly strengthened by the arguments of the first chapter and of Appendix A –and by the conclusions of several eminent contemporary biologists. My biological thesis, *considered biologically*, (i.e. aside from its admittedly profound, but purely epistemological difficulties -which I will make good in chapter 4), is exceedingly strong. How could evolution organize -*as it had to organize*- the reactive function of this colossus of sixty trillion cells? Even this formulation of the question disregards the yet more profound complexity of the reactivity of the individual cells -also organisms- themselves! It was the overwhelmingly crucial issue in the evolution of complex metacellulars. My thesis of schematism is both viable and plausible in this context. But what does this evolutionary development and organization of the reactive process of complex metacellulars have to do with "*information*"?

That the progressive evolutionary reactivity of this megacollosus occurred under the bounds of real necessity is, of course, a given. It is the basic axiom of Darwinian "survival". But that it could *match* that possibility -i.e. that it could

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[1] and “bio-logically”

[2] That the objects of this constitutive logic would further *represent*, however, would be a genuine assumption of the miraculous -possible but difficult.

[3] though not the *substance* problem. That is a separate metaphysical issue addressed by my third thesis.

achieve a (reactive) *parallelism* to that bound -i.e. "information!" -is a hypothesis of quite another order and teleologically distinct. [See Illustration]

It is, I assert moreover, mathematically immature. Objective reality is a *bound* to the evolutionary possibility of organisms, but under that bound infinitely diverse possibilities remain.[1] I may, as a crude illustration for instance, posit an infinity of functions under the arbitrary bound Y = 64,000,000. I may cite semi-circles, many of the trigonometric functions, planar figures, curves, lines ... ad infinitum. Only one of these matches the bound, and only a specific subset, (the horizontal lines Y = a, a <= 64,000,000), parallels it. It is a question of the distinction between a bound and a limit. The reactive evolutionary actuality of an organism certainly exists within, (and embodies), a *lower bound* of biologically possibility. But that some such, (*any* such), organism, (to include the human organism!), embodies a *greatest* lower bound -i.e. that it, (or its reactivity), *matches and meets*, (or parallels, i.e. knows!), the real world does not follow. *That* premise is incommensurate with the fundamental premise of "natural selection" and stands as the "parallel postulate" of evolutionary theory. Organisms do not *know*, organisms *do!* Organisms survive!

How much *more* plausible is it not that the primary and crucial thrust of evolution was *coordination*, and specifically a coordination of allowable or appropriate, (rather than "informed"), reactive response? I submit that, even solely biologically, the schematic object is far more plausible than the representative one. It involves no "magic", and is totally consistent with our ordinary conceptions of biology.

In the realm of beliefs, however, my alternative, like the Naturalists', is *also* bad. It also goes against gut beliefs when it says that we have no direct, (even a mediated/sophisticated), referential knowledge of *metaphysical* reality. But this is *exactly* the finding of contemporary physical science. It was the crucial enabling insight of quantum mechanics, for instance. Though my thesis goes against instinct, the whole course of modern physics stands by its side.

I submit that no other viable, (i.e. non-eliminative or non-dualistic), explanation, i.e., an *actual* explanation rather than a prevarication, has ever even been offered for mind and consciousness as understood in our ordinary sense. The argument, then, is one of demonstration. If no truly viable alternative can be offered, then this one must be considered seriously.

I argue that the operational process of brain, (and its evolutionarily determined structural optimization), *implicitly defines* its "objects", its "entities" in the same sense and in the same manner that the "process" of an axiom system implicitly defines *its* "objects". The "objects of perception", I argue, are "mental

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[1] As an illustration, (as I quoted Edelman in the "Afterword"), there are numerous *different* ways that an antibody, for instance, can cope with an antigen -see Afterword.

objects". They are *constitutive conceptual objects*. But they are schematic objects, (alternatively, "operational objects"), only, in no necessarily simple correspondence with objective reality. They are *metaphors of response!*[1]

***Conclusion*: (chapter)**

11. Considered physically, I propose that mind is a rule. But it is a rule that internally and logically resolves objects. Following Cassirer it is, (because it is a rule), therefore a concept as well. But it is a new and larger *form* of Concept. This is the reason we were unable heretofore *even to conceive* of a solution to the problems of the homunculus, of the "mind's eye", and the "Cartesian Theatre". It was because our formal Concept *itself*, (and the rule in which we encompassed it), was *too small*!

In the next sections I will correlate my evolutionary and logical hypotheses with the standard paradigms of biology and physical science -and argue that they are a better "fit" than that of naive realism or contemporary Naturalism. Maturana and Varela's evolutionary perspective is absolutely pertinent here, -and their arguments are impeccably drawn. The brain, as brain, is a reactive system -functioning "with operational closure" -and not a (realistically) representational

1 Cf Chapter 1