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The Neurobiological Paradigm of Consciousness

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Kuhn in his defining moment of 'revolutionary science' simultaneously defined and deconstructed the notion of paradigm in Philosophy of Science. Existing paradigms are always under determined by new methods and new facts such that tradition shattering complements determine the attitude to scientific inquiry. Neurobiological explanations (NBE) of human consciousness throw up quite a few disparate facts like activated processing of neural masses that do not have to either supervene on syntactic or corresponding external content from the world. NBE, therefore, marks a shift from a synthesized and integrated nativism to an activation based multiple processing of accessible internal states. But such a shift is not without its casualties: computational neuro-biological models of Churchland, Dennett and Searle are either reconstructed to fit into the self-organizing autonomous agency of the mind, or they are abandoned along with many a philosophical parallelism drawn between biological systems and the conscious processes.

The so called cerebral celebrities like the globally available physical state N and the hard problem-binding problem duet are now exchanged with a partially ordered matrix of non-conscious judgments that depends on propagation of a dynamic neural loop. Such a partial ordering opens up a new neurobiological paradigm of 'radical interpretation' of the feedback loop created out of activation and transition. This offers a different choice of 'parameters' that plays the natural game of conscious decisions differently, by way of introducing continuous and graded levels of activity. In the words of Stuart Kauffman of *Investigations*, 'Being autonomous agents, cells must, as individuals living in communities, make the maximum number of reliable discriminations possible and act on them reliably, without "trembling hands".'¹

If neural descriptions of conscious phenomena achieves what Kauffman called 'expanding the adjacent possible', that is, a transitivity of the form, the representation of a content in

a neural mass N is sufficient to represent that content in the Conscious neighbourhood of the agent. Such a transitivity marks a Turing type computation of internal states of an organism that works in a dynamic manner in order to evolve a semantic content that not only establishes a context dependent relationship with physical constituents of the system, but it also assumes an epistemic 'view from within' kind of function. Such a function is dynamically incoherent at the level of physical constituents, while it attains an epistemic regularity and success at the level of self-organization. Dynamic incoherence at the level of the causal affect of the world is the determinant of context dependent self-organization that contingently orders the internal states of the biological system. Kauffman's methodology of 'Boolean networks' that is self-consistently self-organizing along a classical limit portrays co-evolving networks in a fitness landscape. These networks assume the form of 'information carriers' that could be decoupled from a particular dynamic agency. Further, it is possible

to maintain a distinction between genes that carry information, that is, those which know the amino acid configurations in themselves as well as what they are going to encode, *and* those genes that merely copy certain codes. Such a distinction brings out a distinction between internal/external boundary conditions that is conceptualized by Howard Pattee as 'semantic closure' condition of coding and information through genes in a material symbolic system.² Such a closure is a necessary result of a dynamic system that can reproduce the initial conditions of replication, but this does not need a prior knowledge of the code, it only needs information about its own components. Such information is carried by a configuration of amino acids to implement a semantic relationship with the genic products. Such a semantic relationship depends on the structure of codes that genes carry with themselves, which is communicated through the processes of selection. The moot question that we can ask at this point is, can the neurobiological explanation use genetic processes as a substratum of constitution of conscious agents?

Taking conscious agents to be self-consistently self-organizing, one can go into the functioning of the system in terms of influence of an external world that can act as the trigger for selection of certain memory tokens that constitute the internal state of the system. Such an internal state acts upon the repercussions generated within the system by the external trigger by way of selection of 'meaning' that can only be understood in the context of selection pressure on the agent. Such a meaning is emergent as the internal states of the agent are caused by a dynamic interaction with the selection mechanism. This is how the molecular strings of genes only become symbolic representations if the physical symbol tokens are, at some stage of string processing, directly recognized by translation molecules (tRNA's and synthetases) which

thereupon execute specific but arbitrary actions (protein synthesis). The semantic closure arises from the necessity that the translation molecules are themselves referents of the gene strings. Through such translation molecules, which themselves are alterable in the process of decoding DNAs, and by this, they can switch on or off any part of the Gene. In other words, it would be proper to consider the notion of semantic closure in terms of arbitrariness such that the code for protein contained in Genes is switched on or off in relation to their causal role in interactions with RNAs. The notion of semantic closure, therefore, provides for a different translation molecule giving rise to a different genetic code. So, *there is a code switching mechanism latent in the very process of decoding.* What made it clear is the discovery of messenger RNA (mRNA) molecules containing information not coded in DNA. The difference in code between pre-transcription and post-transcriptional alteration of genetic information was called 'RNA Editing'. The term is used to identify any mechanism which will produce mRNA molecules with information not specifically encoded in DNA. Further through such a mechanism of alteration of translation molecules, there is a connection between the gene and the non-genetic factors that can also encode significant information and can enter into larger regulatory processes of interaction. Such interactions are crucial to determine the strength of interaction between a genetic structure and the environment.

The question is, can such explanations based on genetic activity explain the claim of mind or consciousness in the brain? The crucial feature of consciousness understood in terms of a distinction as employed by Ned Block in terms of 'phenomenal consciousness' and 'access consciousness' is of much use here. If genes constitute information about a certain phenotype and its brain,

do we maintain that genes as carriers of information are phenomenally conscious, while they do not per se access information about what the phenotype expresses in terms of self-consciousness or consciousness of the world? This gives us a clue to understand why *genes do not encode information such as how to fold a protein. The mechanism of protein folding comes for free with the laws of matter and self-organization.* Such laws of matter are expressed not just by the genetic code but by the entire causal pathway through which amino acid in genes would bind themselves with other molecules like nucleic acid. What the genes do is to organize the protein sequence into a code that carries 'information' as a material symbol system (MSS) with a semantic content. What Pattee argued is that such a MSS gives us a precise semantic message that could be rendered as a self-organization of protein sequences.³ He further argued that there is no open-ended evolution without symbols, but conversely, there is no need for symbols without material self-organization. Such a material organization is a genotype encoding amino-acid chains (initial conditions) for proteins to be folded into dynamical self-organization. Such proteins-to-be-folded is mediated by coding relations that bear a dynamic incoherence with the environment. This incoherence can make us think of genes not as description or programmes, but as data to the dynamic self-organizing agent. How a *semiotic code* between symbols and building blocks (DNA/RNA) can arise from a material system is still very much a mystery both for biological and cognitive systems. The semiotic code between bases of nucleotide is a double stranded molecule running in two opposite strands such that bases across from each other are complementary. For example, a DNA strand is a set of nucleotide bases like {a,c,t,g} in which a and t are placed opposite and c and g are placed opposite to each other. Various ways in which base-pairing

could be permitted follows the basic rule of pairing opposites such that one strand uniquely determines its opposite. When DNA is converted into RNA, it follows the same interactions that occur between opposite elements of the base-pair in the DNA and indeed between DNA and RNA bases during the process of transcription. The relationship between DNA and RNA assumes a semiotic relationship in the sense that DNA-RNA sequences are signs for proteins and genes that are produced out of this interaction follows, according to Pattee, follow the laws of the environment. This following of law is explained in terms of dynamic incoherence with the environment that acts as a selection mechanism.⁴ But such a mechanism turns out to be 'fuzzy' as the emergent relationship between self-organizing system and the external environment turns out to be non-descriptive symbolic systems that do not follow laws of self-replication in toto.⁵ Rather evolutionary strategies of self-organizing systems can alter the interactive patterns that are emergent by way of operating within a causally enactive environment. Therefore it could be maintained that parameters determined by the genetically encoded material symbol system are causally as well as semantically closed, although they are not necessarily self-replicating. This violates a Von-Neumann type 'Universal Instructor'⁶ machine primarily by way of post-transcriptional coding relationship that evolves through context dependence. How this context dependence results into a creative reproduction of a genetically encoded self-organizing system could be understood following the processes of RNA editing. By a close parallel what cognitive scientists do is to treat such context dependency of symbol manipulation in terms of an unalterable signifier-signified relationship that makes reprogramming subject to laws of *eigenstates*.⁷ Such Eigenstates

represent the externally observable manifestations of the phenomenally accessible cognitive states. Such eigenstates, in case of MSS in biological-genetic organisms turn out to be fuzzy that takes care of emergent causal networks between internal-external environments.

COMPUTABILITY AND PLASTICITY OF EVOLUTIONARY MECHANISM

Autonomous Agents (AA) stand out as a model of self-replication as well as action in/on the world.⁸ Autonomous agents not only functionally know what a part of it does, but it also alters its states in response to the world. The tradition shattering challenge comes from the intelligent character of AAs, who not only makes it possible to give an *interpretation* of their states as reflective and rational in the sense of what they do. The ascription of self-consciousness to AAs in terms of their recognition of themselves as the same thing/being is justifiable by facts of semantic-semiotic-linguistic genoneural architecture, which is also an emergent property of AAs. Such AAs are situated in two interrelated contexts: one in the connection between evolution and computational embodiment of AAs and second, looked from the side of the world, how evolution throws up self-constructing agents. This double situatedness of AAs in embodiment and agency, both taken together are implicated in a co-constructing, co-evolutionary and localizable topos or space that blur the boundary between the real and the imaginary, between the experiential and the fictional boundaries of centring consciousness in an agent. In this crossing of boundary, blurring of boundary between the genoneural and the lived specie, the incommensurability between neurobiological and the anthropological paradigms of consciousness falls apart.

a. Genoneural Structure of Consciousness

Methodologically speaking, there is an inherent challenge to the closures produced by computational-intentionalistic and building block approaches to consciousness that thrives on a metaphysical two-dimensionalism: the envatted and the enclosed versus the enworlded and the enacted. From the point of view of a disembodied paradigm of reason and control, it is possible to disengage mind/consciousness from AAs in the sense of AI, but the challenge is that AAs are nonpositional and yet base themselves on the concrete universe of external world that supplies the context. Given that Kuhn adopted a transcendental perspective in determining paradigms, the role of AAs in the immanent world of the concrete produces incommensurability with the very notion of paradigm and therefore, assumes autonomy. This autonomy of AAs outside paradigmatic sciences creates a demand for itself such that some of the qualitative features of the transcendent can now be re-translated into the domain of the AAs. This is the neurobiological explanation of AAs, where the explanans is evolving in relation to explanandum and hence assuming the form of a critical reflection on parallel between them. The parallel that is drawn between the computational and the cognitive roles of mind, between the genoneural architecture and the lived expressions of conscious mind is based on an apriori/aposteriori factual/counterfactual connection that demands reduction of consciousness in that connection. Such a reduction not only leaves an explanatory gap but it also becomes a simultaneous movement between a conscious machine and the real world consciousness, which is a move from the intensional to the extensional referent.⁹ Such a move is an abstract parallelism that identifies a

physical substratum with consciousness in terms of similar roles: role played by physical processes in explaining consciousness is the same as role played by consciousness in explaining first person ascription of mental/physical states. But there is no conceptual apriori entailment of physical processes from consciousness and vice versa- the parallels do not meet ever in their explanatory purposes. The conceptual gap rather demands that we discover a common underlying layer to both the physical processes and consciousness may be in world of pure bits or in a unifying theory. The best outcome of this demand is brought forth in its non-accomplishment in a twisted matrix: blurring of the boundary between the physical and the embodied by way of shuffling and mixing them in a given centre of consciousness. Further the parallelism takes the form of a structural hierarchy (S-H) that posits an underlying state as the explanatory basis of the physical aggregate of the total structure as in the case of the physical process. Yet another form of this parallelism finds its expression in a control hierarchy (C-H) that turns underlying states into messages that are assigned a linguistic-semantic and semiotic role in the structural description of Consciousness as an integrated whole.¹⁰

The neurobiological challenge lies in understanding how the symbolic role of DNAs as the building block of self-constructing autonomous agents emerge in an activation of biocognitive phenotype that embodies the process of its becoming? In other words, how is that a biocognitive phenotype is both a product and an effector of genoneural architecture? What seems to be the apriori necessity of the role of consciousness in the human-world embodiment is an intersubjective realization of ascriptions of content, which gets its *affect* in a genoneural architecture that passes through such a

necessity in a dynamic iteration of certain patterns. Such ascriptions cannot prestate the initial conditions and the boundary conditions.

b. Language in Genes as Conscious Codes

Finite number of symbols (e.g. codons in DNA) can encode a finite number of primitive parts (e.g. amino acids). Functional structures that can be constructed from these 'parts' are 'recognition sites' that recognizes which structure of amino acid matches or mismatches these codon or mRNAs. Such matches could be counted from a number of mutations that have occurred from a given initial condition. The encoded messages in genes which we call 'representations' are embodied and enacted through this process of parsing a part of the code. For example, a grammar for an RNA molecule called transfer RNA (tRNA) provides a syntactical and structural description of how tRNA is going to capture a folded structure of protein, but such a description is based on actual protein structure of the tRNA. Therefore, it is rather a rule following move or a strategy that is evolved in operations like re-combination and splicing. More than the physical process, tRNAs follow a pathway of action that is strategically embedded, depending on which protein it is going to fold. Can this pathway be expressed for the symbol manipulation kind of operation through representation of external reality as cognitive scientists would design in understanding neuronal behaviour in the brain? Or is it like the extended Computationalism that reduces the functioning of self-organizing systems to connections with external-world-as-memory? Or is it like an off-line advance planning to match with the task that tRNAs perform? The agent neutral neural phenomena in their dynamic structures, as explained by an inherent and embedded functionalism

with a computational-intentionalistic-connectionistic-synaptic explanation conflates agency with manifest external functions. But the conceptual role played by tRNAs in amino acid folding is 'instructional' such that genes can produce a certain phenotype in the causal network of the organism and the environment. The sense of instruction here is that tRNAs fold protein in a certain way, which is essentially a part of code-switching events in evolution as well as in mutation.

The sequences of amino-acyl-tRNA synthetases are proteins that assign amino-acids to codons. Those tRNAs that are charged with the correct amino-acids can produce functional proteins from genes. How do the first synthetases arise that functionally distinguish within classes of amino acids and codons? A defined code in DNAs catalyzes the synthetases to assign the correct genetic code. Some genetic sequences interpreted by assignment catalysts are reflexive with respect to the mechanism of their interpretation. The choice of a certain subset of all the proteins as catalysts also is reflexive with respect to genetic information. But the genetic information needed by a catalyst is ambiguous until the catalysis work begins in the tRNA. In other words, the amino-acid structures in DNAs undergo states of transition in catalysis in order to reorganize the genetic information. This reorganization is constrained by the way catalytic proteins in tRNA are related to their sequences. A set of proteins that execute the rules of a genetic code can be re-constructed from not just the functions of genes but from what those protein containing cells perform. For example, promotion of dendritic growth by the gene called CPG15, an activity induced signaling molecule and the role that it plays mediating synaptic plasticity is a case in point.¹¹ Such signaling molecules are reflexive by their very structure in a self-regulated expression of genetic

information. The important philosophical question is, *can we ascribe phenomenal consciousness to such self-regulated expressions?*

Two arguments: (1) Cariani argues that to the extent an adaptive epistemic system constructs itself and determines the nature of its own informational transactions with its environs, to that extent the system achieves a degree of epistemic autonomy relative to its surroundings¹² and (2) Von Neumann's argument maintains that if we do not have symbolic descriptions directing self-replication, then an organism must replicate through material self-inspection of its parts.¹³ Cariani's argument about epistemic autonomy expounds the notion of brains as material systems capable of supporting conscious awareness in terms of classes of linkages between neural patterns produced by sensory inputs (external semantics), those produced by internal coordinations (syntactics), and those produced by intrinsic goal-states with correspondences in the structure of experience. These internal co-ordinates are catalysts that unfold protein sequences in the relevant areas of the brain. So, it has both a subjective and objective dimension, for example, genes encoding odour receptors proteins are active in the olfactory neurons such that each olfactory neuron expresses only one receptor gene.¹⁴ The neural signal patterns generated by internal coordinations are the means by which the brain interprets its own states. Such interpretations are causally re-afferent and they are circularly built up through dynamically created templates such that they act as autonomous subjective states of the brain. The tRNA molecules that map particular tri-nucleotide codons to particular amino acids in transcription implement the interpretation of the genetic code that plays not just a physical-constitutive role in the genoneural architecture. Rather tRNAs observe and interact with their genic environment and this results into alter-

native and even multiple interpretations of the same nucleotide sequence. As Semir Zeki argues how form, colour and movement are understood differentially in various areas of the brain follow how genes are mapped in neurons in those areas. In the case of prosopagnosia, as Zeki shows that the capacity to recognize familiar faces is absent thereby showing in genic terms that the genetic code responsible for 'information about a face' remain inert, although the regular visual neurons are fired.¹⁵ These internal patterns are not related to goal-states which the brain can measure or observe and this non-relation is experienced as pain or grief. But the pattern is there as genetically encoded functions in a damaged neural area only need an improvement. Following laws of self-organization, these internal states are simultaneously effectors and affected as explained by Ramachandran's study on synaesthesia where brain areas for smell get crosswired with colour neurons. In fact synaesthesia as a phenomenon can explain the brain process that recognizes, although wrongly, colours as sounds and shapes as tastes, which are not affected due to smell areas being affected. This is an embodiment of the phantom colour that Merleau Ponty called 'reproduction intention'.¹⁶ Such an intention is expressed in the neural assemblies of the brain that makes use of genetic information by way of what Merleau Ponty explained later as a need for 'form' to enter into the world.¹⁷ This also is a telling evidence of the epistemic autonomy that arises in organizing the neural configurations such that genetic code works in a bottom up way. tRNA molecules are single nucleotide triplets attached to single amino acid that are located by codons at ribosome such that codons can strip off amino acid from the distant end of tRNA and add it to the protein that ribosome is building from mRNAs. In case of prosopagnosia, for example, the polymorphic character of expression in

genes *affects* at least two different areas of the brain, namely olfactory and visual. The modular distinction that is supposed to be there between distant area and nearer area seem to get crosswired in a modified sensorimotor activity. The affect is that the corresponding reports enjoy only a first personal veracity without an integrationist perspective. In case of prosopagnosia, the properties of being such a sort can be there in the Subject without being conscious of it. Such affect is different from mere processing deficits such as 'congrual processing'¹⁸ of inputs from the face as an object, rather it has to do with the subjective incapability to recognize the face as an object. This means that there is no corresponding representation of the face in the brain, but there is a mere awareness of something external, like a pattern that could be accessed by a flick of the eye or attention. In terms of mRNA and tRNA it simply means codons strip off those proteins from tRNA that are responsible for smell in an 'instruction' for vision- it overcomes distances within brain areas by mere awareness. Ramachandran's explanation of synaesthesia in terms of absence of sequencing that happens through importation from one region of the brain to the higher regions as in the case of normal brains merely explains the context of synaesthesia.¹⁹ It does not explain what is to see, hear or taste for a synaesthetic Subject, rather it only explains the effects in terms of underlying physical processes. In contrast, need for 'form' is phenomenal in order to explain how synaesthetic subjects organize their world.

How Subjects organize their world could be understood from Von Neumann's arguments about self-inspection by molecules like Genes. The internal processes that transcribe and translate the genetic information contained in the DNAs do not fully specify the neural configurations that act as stand-in for on-line intelligent

consciousness. Genetic information rather works offline by way of decoupling on-line from off-line, while at the same time internal states and processes can be exploited by an organism to develop certain connection with the external. This makes any sequence of nucleotide possible and its informational value does not depend on couplings with the external environment. Such functional dynamic structures like nucleotide do not depend on physically non-functional descriptions. Rather they unfold themselves so that they can replicate and this function of 'replication' cannot take place without an inspection of its internal states, as if such states are owned in various parts of the constitutive elements (e.g., genes) of the dynamic structure. In the genoneural architecture, such genes play a cognitive role by unfolding themselves from the code or symbolic structure of itself and thereby selecting those parameters that allow replication through inspection of its parts. Such selection based replication acts like a gene or protein copier and a reader that correctly reads the information encoded in the gene. Such copier and reader role of genetic molecules construct the initial conditions from the dynamic function of the genes, which is mediated through an arbitrary coding relation that translates nucleotide sequences into amino-acid sequences that express genetic information. At this point a crucial distinction could be made: genotypes without descriptions of amino acids that they are going to fold might reproduce themselves differently, while phenotypes bearing determined coding relations shall reproduce themselves in toto. As far as genotypes are concerned they can recover the initial conditions, while the phenotypes evolve into a complex organism that cannot recover the initial amino acid building blocks. Protein sequences as symbols do not participate dynamically (chemically) in the self-organization process of the encoded

building blocks. Rather, they participate as information carriers which are effectively read to construct initial conditions for self-organization.

In the case of autonomous agents, such a self-organizing process enters into an intersemiotic identification of functions like reading, copying and reproducing. Such an intersemiotic identification of processes are mapped into the complexity of organization of autonomous agent. In other words, determination of conditions of identification of processes implies a space of distribution of singularities such as synthesis/folding of protein that goes for determining the very character of genetic information. Protein acts as the space for self-determination of the genes. In our metaphysical and transcendental notion of ground of Consciousness, such self-determination remains indiscernible unless genetic information/code finds its semiotic relation within the specific areas of the cell/brain. One can talk of AAs in a manner that it does not need specification of a completely determined brain, as that would amount to a kind of neural reductionism. One implication of such reductionism is that it assumes an internal first person state as well as a blissful ignorance of the microphysical parameters of the conscious experience. Contrarily, a genetic explanation of consciousness is an intersemiosis between the syntactical, i.e., base pairing rules between codons and tRNAs and the semantical, i.e., the phenotypic traits. The very nature of the intersemiosis can be understood from how the syntactic and the semantic relate to each other by way of performing roles that are signified by genetic code. The signifiers of reading and copying as syntactic roles and the signifiers of semantic properties such as localized genes turn into 'signified' in the course of self-organization. This also marks a transition from semiotic states to world states. Such a transition again signifies an absence of self-

referring subjectivity in the very process of ensuring self-inspection through signs.

PARALLELISM REVISITED

What sophisticated parallelism between the genetic and the anthropomorphic-linguistic approaches to Consciousness aims to do is to read one off from the other without exploring the possibility that one can read the other off only from a situation of mutual embeddings. How such embeddings happen in explanations could be grappled with from a specific theoretical move of dissipating some of the usual binaries like self/nonself; conscious/non-conscious etc. into the self-organizational properties of autonomous agents who make the external into internal in order to make functionings a process of decoding the world from the internal codes. As Post-structuralists famously state that the self as an agent is produced by a discursive formation by way of freeplay between the semiotic code and the world, similarly in the context of genetic explanation, it could be surmised that consciousness is a process of forming and forging gene-organism relations that complements the conscious relation between the self and the world. For example, the way genes response to the external or the way genes tolerate an external intervention and the way in which they work as an assembly to establish a fit between the world and the organism is much more than causal. It is quite self-conscious as each molecule knows how to respond to the role played by other molecules in the system to evolve in an open ended manner.²⁰ Such evolution makes molecules behave in a manner that the causal connections with the world can be subsumed under the process of self-inspection. This makes the world jump out from the activated states of the system to an abductive knowledge of the mind. This is a simultaneous organization of the self

and the world that manifests itself in almost indiscernible molecular interactions that subsume the very consciousness of it only to give birth to a depth that consciousness can only fathom with. This is what made Wittgenstein to remark, 'Being able to climb a mountain' may be called a state of my body. I say 'I can climb it-I mean I am strong enough'.²¹

What Wittgenstein meant is that the verb 'climb' is to be understood not in terms of the mountain but in terms of the ability of the agent. The question here is, is the ability necessarily self-referring, or it is more of an apriori cognizance of capability? Wittgenstein's answer lies partly in the capacity to use the word 'ability' correctly in language and it partly lies in organizing the act as represented by the verb in language. In genetic explanations, consciousness is more like this simultaneous correct use and organization of the information by an organism in which genes are both the cause as well as the effect organized by a network of prior connections between the genes and the world. As Hermann Weyl remarked,

... we need *signs*, real signs, as written with chalk on the blackboard or with pen on paper. We must understand what it means to place one stroke after the other. It would be putting matters upside down to reduce this naively and grossly misunderstood ordering of signs in space to some purified spatial conception and structure, such as that expressed in Euclidean geometry. Rather, we must support ourselves here on the natural understanding in handling things in our natural world around us. Not pure ideas in pure consciousness, but concrete signs lie at the base, signs which are for us recognizable and reproducible despite small variations in detailed execution, signs which by and large we know how to handle.²²

A genetic code is like these signs made with evolutionary mechanisms on the 'fitness landscape' of co-evolving species. Although such signs follow the

laws of physics, but when they are treated as observables, they are understood the way Wittgenstein understood 'climb' reflexively that is by way of observing the reflexivity between genes and the evolution of self-inspection in autonomous agents. We can justify this by reproducing what Gary Marcus says about this reflexive character of genes.

Genes are widely seen as either blueprints or deterministic dictators but, in fact, neither view is correct. A single organism's collection of genes—its genome—can lead to many different outcomes, depending on the environment surrounding that genome. The African butterfly *Bicyclus anyana*, for example, can take on two different forms—a colorful version in the rainy season and a dull brown version in the dry season—depending on how its genes are switched on and off.²³

In other words, the capacity to switch on or off according to environment as well as the internal capacity to know what the other parts are going to do are essential for an autonomous agent to have judgments as they are reflected in choice of action. What is reflected gets decontextualized from the process of its culmination in a notion of consciousness that centres on the supremacy of the self. It means that the genes can do what phenomenal consciousness can do and this doing do not depend on access to states of mind/world. Access is rather an end product of a flexible re-wiring of brain areas. Such re-wiring ensures recursivity of genic communication that reproduces the phenotype with functional variations. It could be argued that a single gene can take multiple functions and its copies can take new functions. Otherwise, a single gene can serve multiple functions recruited in multiple domains. In all such cases, the autonomy of the agent in being aware remain intact, although it will establish new kind of dynamic loops that will break the stable circuitry of cognition.²⁴ This also shall make an abductive

switching from awareness to consciousness without the apriori necessity that a conscious machine, going by our usual metaphysical presuppositions should possess. This will rather be recursive neural-genic loop that needs an access to an external world and such an access shall be further regulated by self-constructing loops through self-inspection.

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8. Kauffman, Op. cit., p. 64. He argues that AAs perform one complete thermodynamic cycle.
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Need For a Participatory Model of Development

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An attempt has been made here to critically examine the various perspectives of development. Of these, the dominant paradigm of 'Modernization' based on the capitalist path of development was found inadequate and weak for the development of the developing nations. Instead of development of new nations, this led to crisis of income and regional disparities, poverty, unemployment and underemployment, shanty living conditions, inadequate educational and healthcare facilities and

population growth. In response to inadequacy of this paradigm, Latin American scholars proposed a framework of development for the developing nations, which is a derivative of Marxian perspective of political economy and recognizes the underdevelopment of new nations as a consequence of the development of the developed nations. These have been referred hitherto as the Dependency Theory or the World System Theory within the realm of the sociology of underdevelopment.

Of these neo-Marxian perspectives, the World System theory has been observed to come closer in understanding the influence of international capitalism as a factor of development or underdevelopment of a nation. However, this perspective also falls short of the expectation of the developing nations and has faced the wrath of both the Marxists and the non-Marxist scholars. It would be worthwhile to examine the critique on this perspective before we direct our attention to the need for the participatory model of development in the context of

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