*DELTA LIFE SKILLS*sm

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Integral Energy Psychology

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PART ONE: THE RADIANT ENERGIES BALANCE (REB)sm PROTOCOL: PHILOSOPHY/RESEARCH/THEORY BACKGROUND©

Section:

13.8. THE INTERFACE BETWEEN ENVIRONMENT, INFORMATION, ORGANISM AND THE EMERGENCE OF MIND

(Dear reader, this section is NOT written in intelligent lay-person English.)

(see also Oschman, section 16.7.)

13.8.1. INTRODUCTION

Furman (Furman and Gallo, 2000) emphasizes the importance of pattern recognition and map building as the nervous system makes a model of the world and environment. "[R]eceptors are designed to report news of difference to the internal environment of the organism...a complex interface [the brain and nervous system] is needed to encode, translate, and transfer information patterns to the appropriate regions and systems to initiate a coordinated collective response...The pattern-processing medium...to accomplish this task is the neural-net: the subneural cytoskeletal-net; and the cells, proteins, molecules, and atoms...How do...nerve cells know where to go and in which direction to grow in order to provide...the information-processing pathways...that mediate unified, collective behavior... [One way] is through a pattern-based navigation system, guided by the signaling protein *nerve growth factor* (NGF). In this way, nerve axon and dendrite fractal branching patterns can follow a chemical pathway that specifies the location of the target cells and organs that must be connected. From that point, connections are continually modified by stimulation from internal and external pattern-based information or lack thereof, making use of...the *activity-dependent synapses*...[Thus] the human neural-net is able to change structure and function in the presence of changing internal and external information patterns, thus maintaining continued correspondence with an ever-changing external and internal world. In this way...human beings can maintain a relatively accurate and dynamic map or model of their world, thus producing...adaptation." (Furman and Gallo, pp. 73-74)

"How does this pattern-processing medium change in the presence of information?...[T]he selection and transport of...new signal molecules down a neuron's axon...to the synapse...is dependent on the cell's cytoskeletal-net. As the pattern of the cytoskeletal-net changes in response to information patterns, so does the selection of neurotransmitters and their pathway of travel...[T]he cytoskeletal-net is capable of spontaneous pattern and pathway change in the presence of the appropriate signaling molecules, thus radically changing connectivity patterns in the neurosynaptic-net of the neocortex."

"The subneural cytoskeletal-net itself is made up of much smaller pattern-based building blocks called *tubulin*, a protein capable of snapping together to form elaborate *microtubules*, tubular networks for communication and transport. These...networks hook together in complex and dynamically changing patterns with the help of *microtubule associated proteins* (MAPs), a 'molecular glue.' Within the context of the cytoskeletal-net, tubulin...oscillate between two...states (different shapes or patterns) caused by the *dipole oscillation* of an electron located in its elbow...[C]ontinual movement of these electrons is implicated in the [emergence] of consciousness [awareness], for if this oscillation is restricted by the presence of a large molecule wedged within the tubulin dimer elbow, the [person] loses consciousness. When the restriction is removed, consciousness is regained."

"Hi-speed *biophoton emission* (signaling) throughout the cytoskeletal network...cause[s] this electron oscillation, as well as the resulting conformational change of the tubulin dimer, in response to changing information patterns...Cytoskeletal polymers...undergo coherent, collective conformational oscillations in the nanosecond time scale (one billionth of a second). Hence, new patterns of biophoton activity can influence ion-gated protein channels in neurons resulting in changes in neurosynaptic level signaling and connectivity. The resulting conformational changes in tubulin also give rise to *bio-mechanical* communication and transport in the form of *solition waves*. These waves are caused by pattern-integrities that propagate though the tubulin network by displacing matter and energy..."

"[N]euro-active proteins -- neurotransmitters, neurohormones and neuropeptides -- can arise due to signal-induced protein production and folding patterns, and combine to make complex molecular signaling profiles that are responsible for emotions, motor movement, perception, memory, thoughts, etc. Temporal coding patterns can also be accomplished by adjusting the frequency and grouping (interspike intervals) of electrochemical impulses...on the neurosynaptic level...[T]hese multileveled and elaborately interconnected pattern-processing mediums give the human neural-net and its interconnecting pattern-making systems the ability to fully incorporate, represent, translate, and transfer all inputs to a given neuron or neural network, and hence the entire organism [in a holistic manner]." (Furman and Gallo, pp. 74-75)

13.8.2. MICROTUBULES, QUANTUM COHERENCE, AND "ORCHESTRATED OBJECTIVE REDUCTION" (Orch OR") THEORY OF CONSCIOUSNESS

Hameroff provides this view of Microtubules in an interview by Horrigan (1997, pp 72-73):

"A cell has a skeleton, somewhat like our body has a skeleton. It's called the "cytoskeleton." Look out the window at those trees. If you put a big sheet over a bunch of closely grouped trees, that would be like a cell. The sheet would be the membrane, but the trees would be the structure inside the cell. The main trunks would be the microtubules and the connections would be microtubule-associated proteins, actin, and so on. But, unlike a forest, the cytoskeletal branches are moving cooperatively, like arms and hands, passing things along from place to place inside the cell. They

rearrange themselves to change cell shape, and grow extensions like axons or dendrites. The actual microtubule structure is quite interesting. They are hollow cylinders whose walls look something like hollow ears of corn with kernels in a hexagonal lattice. It occurred to me that the states of each of these kernels in microtubules could represent information, and that microtubules were ideal computers. That was how they were running the show."

"...[M]icrotubules and the cytoskeleton are ...structural, like the body's bony skeleton. However,... microtubules are also the cell's nervous system and circulatory system. They move everything around the cell, organize shape and function, and communicate with membranes and the nuclear DNA. For example, immune cells depend on cytoskeletal microtubules for recognition and response. In neurons microtubules first establish cell shape and synaptic connections, transport materials, regulate those synapses, participate in axonal neuro transmitter release, and transduce membrane receptor effects. They are everywhere, and seem to organize almost everything...[I]f you look at the microtubules that spatially organize the cytoplasm...you see perfectly designed information processing devices..."

"The model of consciousness based on microtubules that Roger Penrose and I have developed has been criticized because we have microtubules in our earlobes and microtubules in our butts. 'Why aren't earlobes and butts conscious?' The answer is that the microtubules in the brain's neurons, besides being denser and more plentiful, are arrayed in parallel, whereas in other cells they radiate outward from the centrosome, or centrioles, next to the cell nucleus. Centrioles, which organize mitosis, are mysterious and elegant organelles made up of microtubules. Because neurons don't divide, the centrioles have disappeared or are hiding, and the microtubules are all arrayed in parallel. The highly parallel arrangement can facilitate computation and quantum coherence. In our model, consciousness requires a critical degree of quantum coherence in parallel arrayed microtubules in neurons. This critical degree allows a prediction as to what evolutionary level of neural complexity will result in consciousness....[T]he work I've done with Roger Penrose predicts a threshold for emergence of conscious experience at a level of microtubule complexity and quantum coherence in roughly hundreds of neurons...."

"In his books Roger [Penrose] talks about Platonism--the idea that mathematical truth, aesthetics, ethics, the perception of beauty, are somehow built into the universe. The implication is that however these are built into the universe, this is what influences the collapse in the objective reduction. So when our thoughts collapse, we're influenced--or we can be influenced--by these Platonistic factors engrained at the Planck scale." (Hameroff, 1997, p 77)

Hameroff and Penrose (1996a abstract): "What is consciousness? Some philosophers have contended that "qualia," or an experiential medium from which consciousness is derived, exists as a fundamental component of reality. Whitehead, for example, described the universe as being comprised of 'occasions of experience.' To examine this possibility scientifically, the very nature of physical reality must be re-examined. We must come to terms with the physics of space-time--as is described by Einstein's general theory of relativity--and its relation to the fundamental theory of matter--as described by quantum theory. This leads us to employ a new physics of *objective reduction*: ' **OR'** which appeals to a form of quantum gravity to provide a useful description of fundamental processes at the quantum/classical borderline (Penrose, 1997). Within the **OR** scheme, we consider that consciousness occurs if an appropriately organized system is able to develop and maintain quantum coherent superposition until a specific 'objective' criterion (a threshold related to quantum gravity) is reached; the coherent system then self-reduces (objective reduction: **OR**). We contend that this type of objective self-collapse introduces non-computability, an essential feature of

consciousness. **OR** is taken as an instantaneous event--the climax of a self-organizing process in fundamental space-time--and a candidate for a conscious Whitehead 'occasion' of experience. How could an **OR** process occur in the brain, be coupled to neural activities, and account for other features of consciousness? We nominate an **OR** process with the requisite characteristics to be occurring in cytoskeletal microtubules within the brain's neurons ...."

"In this model, quantum-superposed states develop in microtubule subunit proteins ('tubulins'), remain coherent and recruit more superposed tubulins until a mass-time-energy threshold (related to quantum gravity) is reached. At that point, self-collapse, or objective reduction (**OR**) abruptly occurs. We equate the pre-reduction, coherent superposition ('quantum computing') phase with pre-conscious processes, and each instantaneous (and non-computable) **OR**, or self-collapse, with a discrete conscious event. Sequences of **OR** events give rise to a 'stream' of consciousness. Microtubule-associated-proteins can 'tune' the quantum oscillations of the coherent superposed states; the **OR** is thus self-organized, or 'orchestrated' (**'Orch OR'**). Each **Orch OR** event selects (non-computably) microtubule subunit states which regulate synaptic/neural functions using classical signalling."

"The quantum gravity threshold for self-collapse is relevant to consciousness, according to our arguments, because macroscopic superposed quantum states each have their own space-time geometries... These geometries are also superposed, and in some way 'separated,' but when sufficiently separated, the superposition of space-time geometries becomes significantly unstable, and reduce to a single universe state. Quantum gravity determines the limits of the instability; we contend that the actual choice of state made by Nature is non-computable. Thus each **Orch OR** event is a self-selection of space-time geometry, coupled to the brain through microtubules and other biomolecules."

"If conscious experience is intimately connected with the very physics underlying space-time structure, then **Orch OR** in microtubules indeed provides us with a completely new and uniquely promising perspective on the hard problem of consciousness."

Hameroff and Penrose, (1996b) summary): "Approaches to understanding consciousness which are based on known and experimentally observed neuroscience fail to explain certain critical aspects. These include a unitary sense of binding, non-computational aspects of conscious thinking, difference and transition between pre-conscious and conscious processing, (apparent) non-deterministic free will and the essential nature of our experience. We conclude that aspects of quantum theory (e.g. quantum coherence) and of a newly proposed physical phenomenon of wave function self-collapse (objective reduction, OR, Penrose, 1997) offer possible solutions to each of these problematic features. We further conclude that cytoskeletal microtubules, which regulate intra-neuronal activities and have cylindrical paracrystalline structure, are the best candidates for sites of quantum action and OR, and of 'orchestrated OR' (**Orch OR**). Accordingly, we present a model of consciousness based on the following assumptions:"

> *"Coherent excitations (Frîhlich pumped phonons) among microtubule subunits (tubulins) support 'cellular automaton' information processing in both classical (conformational) and quantum coherent superposition modes. Classical processing correlates with non-conscious, autonomic activity; quantum processing correlates with pre-and sub-conscious activity."
>
> *"The microtubule quantum coherent computing phase is able to be isolated from environmental interaction and maintain coherence for up to 500 msec (pre-conscious processing)."

*"A critical number of tubulins maintaining coherence within MTs for 500 msec collapses its own wave function (objective reduction: **OR**). This occurs because the mass-energy difference among the superpositioned states of coherent tubulins critically perturbs space-time geometry. To prevent multiple universes, the system must reduce to a single space-time by choosing eigenstates. The threshold for **OR** is related to quantum gravity; we calculate it in terms of the number of tubulins coherent for 500 msec to be very roughly 109 tubulins. Larger coherent sets will self-collapse faster, and smaller sets more slowly. Coherent sets which evolve over different time scales and in different brain distributions may be bound in an effectively simultaneous collapse which creates instantaneous 'now.' Cascades of these events constitute the familiar 'stream of consciousness'".

*"Microtubule Associated Proteins (MAPs) and other tubulin modifications act as 'nodes' to tune microtubule coherence and help to orchestrate collapse. We thus term the specific **OR** proposed to occur in microtubules and intrinsic to consciousness as "orchestrated objective reduction" (**Orch OR**).

*"The **Orch OR** process, which introduces non-computability (Penrose, 1997), results in eigenstate patterns of tubulin conformational states which help direct neural function through the actions of microtubules."

"In providing a connection among 1) pre-conscious to conscious transition, 2) fundamental space-time notions, 3) non-computability, and 4) binding of various (time scale and spatial) superpositions into instantaneous 'now,' we believe **Orch OR** in MTs [MicroTubule] is the most specific and plausible model for consciousness yet proposed."

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