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An Anatomical, Biochemical, Biophysical and Quantum Basis for the Unconscious Mind[1]

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This article suggests that it may now be possible to develop some theoretical and experimental bases for organic substructures involved in psychological phenomena including the unconscious. Our inquiry arose from mutual interest in the mechanisms involved in peak athletic and artistic performances and in deep therapeutic encounters. We are referring to a state of consciousness is often described by performers as "the zone." This is a state in which individuals or groups function at an extraordinary level of perception and coordination; or a state in which therapists develop a deep connection with their clients' repressed feelings or traumatic memories. Here we suggest possible mechanisms for Freud's "conversion disorders" based on the concept that there are two or more interconnected systems that can sense and respond to the environment and that can also convert repressed emotions into chronic muscle tension or other somatic issues. One connection between sensation and action is the well-established neurophysiological mechanism and another involves semiconduction through the living matrix. This is one type of "hardware" system that functions more or less in parallel to the nervous system and possibly in concert with the "wetware" or biochemical systems described by Dennis Bray (2009). It is proposed that one aspect of the unconscious —its capacity to absorb and process vast amounts of sensory information—involves rapid signal processing through a combination of ultra-fast biological processes that are present in all cells and tissues, including but not limited to neurons. Semi-conduction, wetware, electromagnetic-photonic communications and quantum coherence are examples of such processes.

Keywords: ***consciousness, unconscious, subconscious, brain, mind, conversion disorder, Freud, living matrix, wetware, coherence, microtubule***

Sigmund Freud popularized the concept of the unconscious mind, following on the pioneering work of Wilhelm Wundt, William James, William Carpenter, Charles Sanders Pierce, and Josef Jastrow, who laid the foundation for our modern scientific methodology and thinking about the subject. For example, in his classic treatise entitled *Principles of Mental Physiology*, William Carpenter (1874) suggested that our brains process information through two parallel tiers, one conscious, and the other unconscious. Freud (1895/1957) is credited with a major advance in the understanding of the unconscious mind through his work with a patient referred to as "Dora" who had a paralyzed arm (Breuer & Freud, 1895/2000) . To Freud's great surprise, the paralysis was relieved when Dora recalled, under hypnosis, her childhood memory of having her father sleeping on the couch with his hand in the crook of her arm. The story was that she wanted to go dancing, but to keep from waking her father, she could not move her arm. This was distressing, and eventually she had a thought that was reprehensible to her, "Oh, I wish he would die already." She hated herself for that thought and repressed it, only to have it surface again in the form of a paralyzed arm. The paralysis was relieved after she had sufficiently remembered with abreaction (pouring forth and draining of) the memory.

This was the beginning of Freud's understanding that the mind has content that is not available to consciousness, yet can affect physical structure, function and behavior. Such issues are now referred to as "conversion disorders," based on Freud's doctrine that anxiety can be converted into physical symptoms. While such conditions are widespread, conversion symptoms do not conform to any known anatomical or physiological pathways, and no neuropsychological model has been clearly established. Freud expressed the situation:

> I cannot, I must confess, give any hint of how a conversion of this kind is brought about. It is obviously not carried out in the same way as an intentional and voluntary action. It is a process which occurs under the pressure of the motive of defense in someone whose organization or a temporary modification of it has a proclivity in that direction. (Breuer & Freud, 1895/2000, p. 237)

Freud pointed out that much of our mental activity is unconscious. In the province of the mind, consciousness is the visible sentient tip of the iceberg (Figure 1). *Preconscious* is a term used in Freudian psychoanalysis to describe thoughts that are unconscious at a particular moment, but are not repressed and therefore are readily available for recall and easily "capable of becoming conscious"—a phrase attributed by Sigmund Freud to Joseph Breuer (Freud, 1991 p. 175). The unconscious mind consists of dynamic mental processes that occur automatically and are not usually available to introspection. They include, for example, thought processes, as opposed to thoughts, intuitive insights, and procedural knowledge that enables the highly skilled and rapid and virtually automatic aspects of human performance.

The vast unconscious reservoir below the surface is functioning all of the time. In essence, one sees and interact with the world through the "eyes" of their unconscious assumptions, usually without realizing it. The unconscious strongly influences the directions of our activities as well as our feelings and perceptions.

Freud understood that the language of the unconscious is different from the language of consciousness, but did not appreciate that under many circumstances unconscious processes are vastly faster and more efficient at integrating sensory inputs and adaptive actions than conscious processes. The unconscious mind enables humans to survive in a world that requires massive information intake and rapid processing. This aspect is commonly referred to as the adaptive unconscious, to distinguish it from the unconscious that contains repressed memories and emotions that are too disturbing to be thought about consciously—the stuff of Freudian psychotherapy. The unconscious mind can also integrate life events happening over a long or short period of time. The unconscious and conscious minds function simultaneously with psychological barriers between them. Traumatic memories and repressed feelings can become conscious when barriers, called resistances or defenses, are lifted.

The unconscious delivers to consciousness images and thoughts that integrate and interpret current as well as stored information (memories, traumatic memories, personality structure, archetypes). This was documented by neurologist Jason W. Brown (1977, 1988, 1989, 1991) on the basis of his studies of aphasias, leading to his fascinating but rarely discussed concept of microgenesis. In his early years, Freud was also an aphasiologist—he studied linguistic problems caused by brain damage (Freud, 2011). He noticed that a person

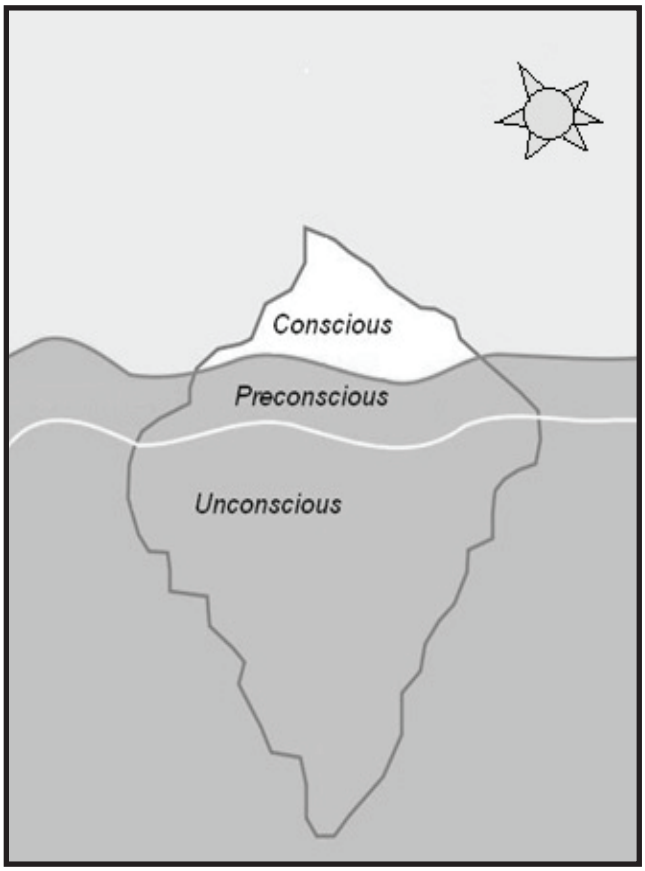


Figure 1. *An iceberg is often used to represent Freud's theory that most of the human mind operates unconsciously.*

typically does not consciously pick the words and grammatical structures that they are going to use. All of that is done unconsciously and automatically, and one just speaks. A person may know the gist of what they are going to say but they often do not know precisely what they are going to say until they say it. This involves astonishingly complex processing and exemplifies what the unconscious accomplishes in every-day experience. Freud (1914/1957) recognized that his provisional ideas

in psychology would one day be based on an organic substructure.

This essay explores possible organic substructures for the unconscious mind. To our knowledge, no scientific basis has previously been suggested to explain the connections between repressed emotions and physical issues such as Dora's paralysis. To anticipate, we are going to suggest that chronic muscle contraction in so-called conversion disorders can be triggered by several definable interacting pathways in addition to the well-established neuromuscular system. We also suggest that these pathways may also be involved in peak performances and in penetrating psychotherapeutic sessions.

Character of the Unconscious

> ***The conscious mind only holds a small amount of information at any given time.***
>
> ***Murphy, 1982***
>
> ***Each second, our consciousness reveals to us a tiny fraction of the 11 million bits* of information our senses pass on to our brains. Most of the information from our senses goes to our unconscious…Trust your hunches and intuitions — they are closer to reality than your perceived reality, as they are based on far more information.***
>
> ***Nørretranders, 1999***

Note that in the above quote, Nørretranders (1999) referred to the millions of bits of information that pass from our senses to our brains each second. "Bits of information" refers to digital information, the word being a contraction of "binary" and "digit." In the discussion that follows we suggest that information taken in by our senses is initially in analog form, and that the sensory receptors convert some but not all of that information into digital signals that are processed by the nervous system. Note also that a review of the book by Nørretranders asserted, "Although we are unaware of it, our brains sift through and discard billions of pieces of data in order to allow us to understand the world around us" (Casti, 1999). The perspective presented here is that these "billions of pieces of data" are not discarded, as Casti suggested, but are taken into the unconscious, as Nørretranders proposed.

A variety of phenomena point toward the unconscious as an aspect of consciousness that is able to sense and process large amounts of information and synthesize creative or intuitive or successful actions or behaviors or solutions to complex problems. Here we refer to such behaviors as *authentic* to distinguish them from actions based on conscious "thoughtful" analysis of a situation. Some psychologists make a distinction between procedural knowledge: when your body knows how to do something, and declarative knowledge: when your conscious mind knows how to do something (Allard & Burnett, 1985). It is recognized that the conscious mind can usually only focus on a few items at a time, whereas the unconscious mind can deal with many items simultaneously.

Some refer to left brain function as opposed to right brain function, rather than unconscious as opposed to conscious. This is based on the recognition that functions involving logical or sequential analysis generally reside in the left hemisphere, while the right hemisphere seems to control processing of spatio-visual information and creative activities such as art and music. Hellige (2001) argues that this view may be far too simplistic.

If one has to make a decision between two alternatives, conscious thought may give a reasonable result. However, if one has to make a decision between many alternatives, the unconscious often leads to more satisfactory solutions. Such solutions may emerge as sudden flashes of insight, intuitions, in dreams, or extremely rapid adaptive actions. In his popular book *Blink: The Power of Thinking without Thinking*, Malcolm Gladwell (2007) offered examples of individuals giving effective answers to complex questions without conscious awareness of how they did it.

We begin our discussion of these phenomena with a description of athletic, artistic, and martial arts performances that seem to involve sensation and information processing and actions that occur too rapidly to be explicable by the well-established properties of nerves and synapses. We also have interest in the possible mechanisms involved in psychotheraputic sessions in which the therapist accesses deeply held traumatic memories or interpretations of experiences that prevent authentic behavior. We ask: Could the same energetic/informational pathways utilized in profound psychotherapy be the basis for peak athletic or artistic performances? We also consider a number of biological processes that may be ten or more times faster than nerve transmission. There is no reason in principle that non-neural processes should not be utilized by biological systems and contribute to the information storage and

processing of the unconscious mind. Processes to be explored include:

1. Semiconduction in the fabric of the body known as the living matrix or ground regulation system.
2. Biochemical processes as described by Dennis Bray in his 2009 book, Wetware: A computer in every cell.
3. Various quantum processes including quantum coherence as described by Herbert Fröhlich; spin resonance as described by Mae Wan Ho and Emilio Del Giudice; biophotonic communications as described by Fritz Albert Popp (2000) and Marco Bischof (1995); and wavelike energy transfer that takes place in chloroplasts of green plants as documented by Fleming and colleagues (see Engel et al., 2007), and conduction pathways in microtubules (Hameroff, Nip, Porter, & Tuszynski, 2002).

Human performance

The role of the unconscious in peak performance is validated by the work of one of the authors (MDP) in his experiences with Olympic ice skaters, beginning in 1972. This was the first use of a combination of psychotherapy, hypnosis and visualization by athletes, with a focus on using the powers of the unconscious mind to prepare for a perfect program. The results were startling (Pressman, 1977, 1979, 1980a, 1980b). With appropriate preparation, the near-perfect athletic performance emerges as a near-meditative and open state in which, e.g., the skater becomes one with the music and the audience. The performer looks completely relaxed and un-self-conscious. The brain and nervous system are essentially on automatic. With this surrender comes virtually effortless speed and coordination and power. And it is beautiful to watch! Performers refer to this state of consciousness as "the zone." Experience has shown that conscious thought can disrupt this state and compromise the quality of the performance. Extensive research has confirmed that individuals training for athletic events, dance, theater, music, combat, and for healing work benefit significantly from mental rehearsals or mental imaging, without physically practicing anything (Suinn, 1985; Warner & McNeill, 1988, Meyers, Whelan, & Murphy, 1996).

The repeated observation that psychotherapy can enhance an athlete or other performer's performance is indicative that the same unconscious pathways could be involved in psychotherapy and peak performance.

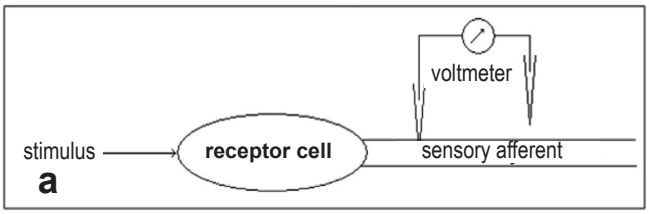
From sensation to action

Nerve impulses are triggered by changes in environmental energies: heat, light, sound, smell, taste, gravity and touch, interacting with sensory receptors. Receptors, in turn, initiate patterns of nerve impulses in afferent neurons that propagate to other parts of the nervous system. For example, a change in the intensity, wavelength (color), or pattern of intensities of light striking the retina sets up characteristic nerve impulses in the optic nerve, which delivers this information to the visual cortex and other parts of the brain.

Each receptor has a particular threshold for some specific form of energy (Figure 2). Psychophysics investigates the quantitative relationships between the strength of physical stimuli and the sensations and perceptions they produce (Gescheider, 1997). To accomplish this, the researcher applies stimuli of increasing strength to a receptor until a subject acknowledges that they can sense the stimulation. At first, the strength of the stimulation is subliminal or below the level of detection, but there comes a point where the stimulation is consciously sensed, referred to as supraliminal stimuli or above threshold for the individual. Visual and auditory stimuli may be flashed so quickly or at such low intensity that an individual is not consciously aware of them. A review of functional magnetic resonance imaging (fMRI) studies showed that such subliminal stimuli activate specific regions of the brain even though subjects are not consciously aware of them (Brooks et al., 2012). The following discusses the possible significance of the distinction between subliminal and supraliminal stimuli.

In contrast to psychophysics, neurophysiology studies the neural correlates of subliminal and supraliminal stimulation by using microelectrodes to record the electrical activity in a receptor nerve (afferent) while increasing the stimulation intensity until an action potential is produced (Figure 2a). Stimuli below threshold can produce a small depolarization of the nerve membrane, but no action potential is triggered until threshold is reached (Figure 2b).

The well-documented sequence of events between the perception of a stimulus and an adaptive action such as a muscular activity is illustrated in Figure 2c. Information is conducted via the sensory nerve to the brain where it is combined with other information to determine if an action is appropriate. If so, various



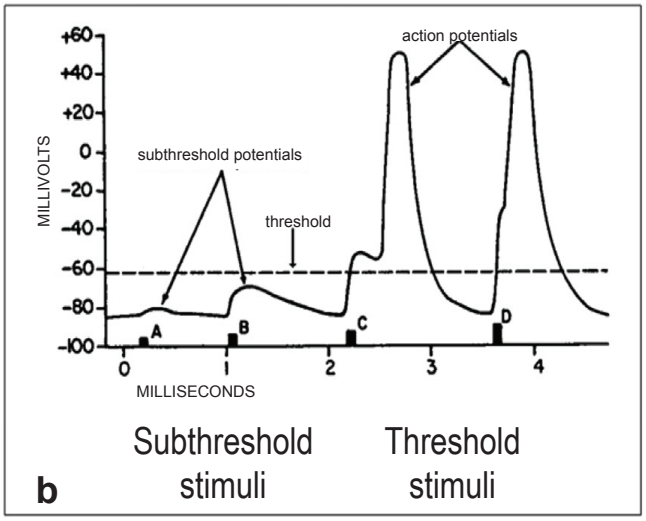
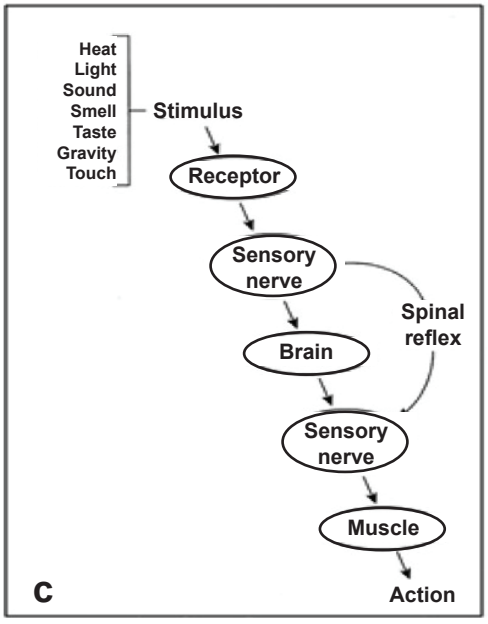
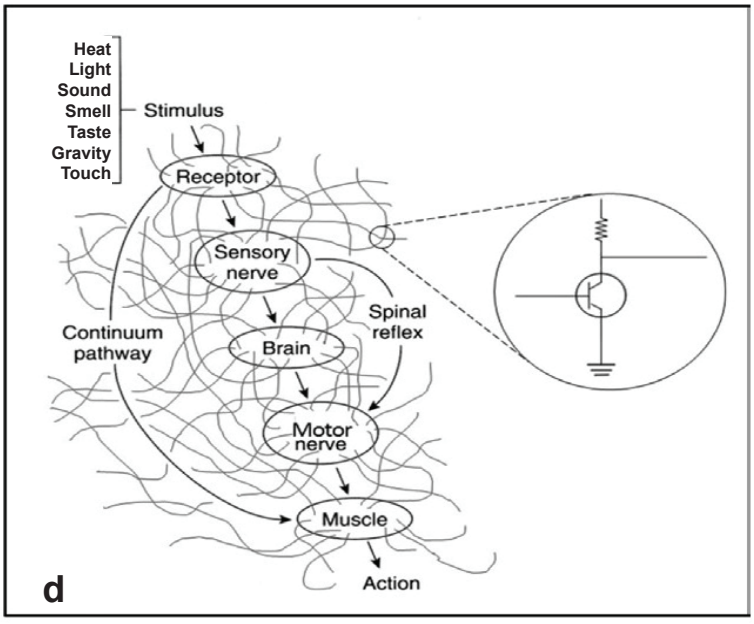


Figure 2. *Hypothesis: Sensory receptors split signals they receive from the environment into two pathways. One is the conventional neurological pathway, and the other is the living matrix/ground regulation system. It is further suggested that these two pathways separate subliminal or sub-threshold stimuli from stimuli that are strong enough (supraluminal or above threshold) to trigger an action potential in the sensory nerve. If this is correct, the matrix would be able to transfer very subtle information from the environment via semiconduction, with a sensitivity, velocity, information storage capacity, and ability to perform sophisticated processing far exceeding that of the nervous system. (a) Conventional method for study of receptors. In psychophysics, the intensity of a stimulus to a particular receptor is increased gradually until the subject reports a sensation. Stimuli too weak to elicit a sensation are termed subliminal; stronger signals are supraliminal. Neurophysiologists perform a similar experiment, increasing the strength of stimulus while recording the membrane potential of the afferent nerve. (b) The intensity sufficient to produce an action potential is termed threshold. Stimuli of lesser intensity, subthreshold or subliminal, can cause small perturbations of the membrane potential of the afferent nerve, but are too weak to trigger an action potential to develop. Supraliminal stimuli result in action potentials in the afferents.* (continued below)





(c) The well-documented sequence of events between the perception of a stimulus and an appropriate response or action, such as a muscular contraction. Information is conducted via the sensory nerve to the brain where it is combined with other information to determine if an action is appropriate. If so, various muscles will be activated. The spinal reflex can bypass the brain and produce a rapid response such as pulling the hand away from a hot stove. (d) Alternate pathway between sensation and action. The receptor is a cell with a cytoskeleton that connects across its cell surface to a continuous extracellular fiber network, the living matrix/ground regulation/or tissue tensegrity system. Signal transfer through this system could account for extremely fast and astonishingly coordinated responses that occur in the martial arts and peak athletic and artistic performances that require communication that is much faster than can be accomplished by nerve conduction, with its attendant synaptic delays. It is suggested that this is also the system that is compromised when emotional or traumatic memories lead to functional disorders, such as the case of "Dora" that led Freud to suggest the existence "conversion disorders" and of the unconscious mind.

muscles will be activated. The spinal reflex can produce a rapid response such as pulling the hand back from the hot stove before a person becomes consciously aware of the heat.

Semiconduction in the living matrix

Figure 2d describes one alternate pathway between sensation and action. This pathway is based on the fact that the receptor is a cell with a cytoskeleton that connects across the cell surface to a continuous fibrous network, the living matrix or ground regulation system that extends throughout the body. The living matrix is a term introduced by Oschman and Oschman (1993). It is also referred to as the continuum pathway in recognition of the continuity between the nuclear matrix, cytoskeleton, and extracellular matrix that extends throughout the body. This pathway is one candidate for the substrate involved in so-called conversion disorders. The matrix is the largest organ in the body, since it touches all of the other systems. We could refer to it as the "hardware" of the body, in contrast to the "wetware" that will be discussed below. The concept that the living matrix can transfer energy and information throughout the body evolved from Albert Szent-Györgyi's classic statement that proteins can be semiconductors (1941a, 1941b). This concept was further documented in his books Introduction to a Submolecular Biology (1960) and Bioelectronics (1968) and his research papers. Mark Bretscher (1971a, b) discovered that certain membrane proteins extend from the cell interior to the exterior, linking the cytoskeleton with the extracellular matrix. This was a key discovery in the development of the living matrix concept, and added another dimension to the "ground regulation" model developed by a group of German and Austrian researchers led by Alfred Pischinger (1975; 2007) and Hartmut Heine (2007) who pointed out that the fundamental unit of life is not the cell, but is a triad consisting of the cell, matrix and capillary.

In 1973, Atema pointed out that cilia and flagella are components of many mammalian and invertebrate sensory cells. These organelles contain arrays of microtubules, which are, in turn, connected to cytoskeletal elements capable of transmitting information via conformational waves. At the time Atema published his theory, it was pure speculation, as the nature of such conformational waves was unknown. However, Atema's report was soon followed by advances in our understanding of conformational and vibrational properties of protein lattices (e.g. Davydov 1973, 1987; Bai et al., 2010). The evidence, summarized in detail by Oschman (2003), supports the idea that sensory inputs into any receptor cell could be conveyed rapidly and without loss into the living matrix system and thence throughout the body. The solition and the excition are good candidates for this information transfer process.

Hameroff (1999) pointed out that individual neurons are at least as complex as nerve nets, and their cytoskeletons therefore have enormous capacity for intracellular information processing. A tiny neuron, a thousandth of an inch in diameter, has about 9 feet of cytoskeleton. Hence, there are close to a billion miles of semiconducting fibers in the brain. The microtubules, together with other semiconducting cytoskeletal structures, form a sophisticated electronic communication network within neurons and other cells. According to Hameroff, nanosecond switching in microtubules predicts roughly 10^{16} operations per second, per neuron. This capacity could account for the adaptive behaviors of single celled organisms such as paramecium, which elegantly swims, avoids obstacles, and finds food and mates without benefit of a nervous system or synapses. Since the human brain contains about 10^{11} neurons, nanosecond microtubule switching processes could accomplish about 10^{27} brain operations per second. This is 10 orders of magnitude more than can be achieved by synaptic switching. This means that the on-off switches known as synapses, which are obviously important components of neural networks, may not be the only place where information is processed and memories are stored. Hameroff stated that the "neuron doctrine" ignores the fact that neurons are living cells. The fact that many neurons are packed with microtubules opens up the possibility that that the nervous system itself could have two parallel and distinct mechanisms for the transmission of information: a fast mechanism, involving waves of conformational change in microtubules and other cytoskeletal components, and a slower, classical mechanism, involving ionic currents and action potentials.

For example, Sir Charles Sherrington (1951) stated that a single-celled paramecium swims gracefully, avoids predators, finds food, mates, and has sex, all without a single synapse. "Of nerve there is no trace. But the cell framework, the cytoskeleton might serve." Also, The molecules that form synapses and even the oscillations that are critical to consciousness are present in "primitive" sponges and yeast cells (Lieff, 2012).

Oschman (2003) hypothesized that sensory receptors transfer signals they receive from the environment to two anatomically distinct pathways. This concept arose during an attempt to understand the mechanisms involved in the effects of optometric phototherapy or Syntonics, in which a patient observes certain colors of light to relieve various disorders (Oschman, 2001). Syntonics was developed by Harry Riley Spitler (1941), who stated that, "There exists a relationship which is largely predictable between light frequency, environment, and the restoration of health following departures from normal, which are still within the physiologic limits…"

Recalling the histology of the retina, Figure 3, there is a densely staining line called the outer limiting membrane (a) lying between the photoreceptor layer and the outer nuclear layer of the retina. Under the electron microscope, this "membrane" is revealed to be a precisely aligned planar array of densely spaced plaque-bearing junctions with bundles of actin filaments attached to them (b). This row of adhering junctions attaches the photoreceptor cells to Müeller cells, which are neuroglial connective tissue cells. It was suggested that subliminal or sub-threshold stimuli create waves of conformational change or solitons that are conducted or semi-conducted through the cytoskeletons of the photoreceptor cells, across the junctional complexes and into the Müeller cells, and thence throughout the living matrix of the body (Oschman, 2003). If the sensory stimulus is strong enough to depolarize the cell membrane of the receptor, the synapses at the base of the photoreceptor cells are activated and the signal jumps to the bipolar and other neurons, through the optic nerve, to the visual cortex and other brain areas. This second pathway is the well-established neurological pathway that transfers nerve impulses digitally (all or none) at velocities of 100 or more meters per second (Figure 2c).

The living matrix/ground regulation system forms an analog network operating at hundreds or perhaps thousands of meters per second, as described above (Figure 2d). From this perspective it can be hypothesized that there is a separation or split between subliminal or sub-threshold stimuli and stimuli that are strong enough to trigger an action potential in the sensory nerve. If this is correct, the matrix could transfer and process very subtle information from the environment at velocities far exceeding those taking place in the nervous system—characteristics often attributed to the unconscious. This

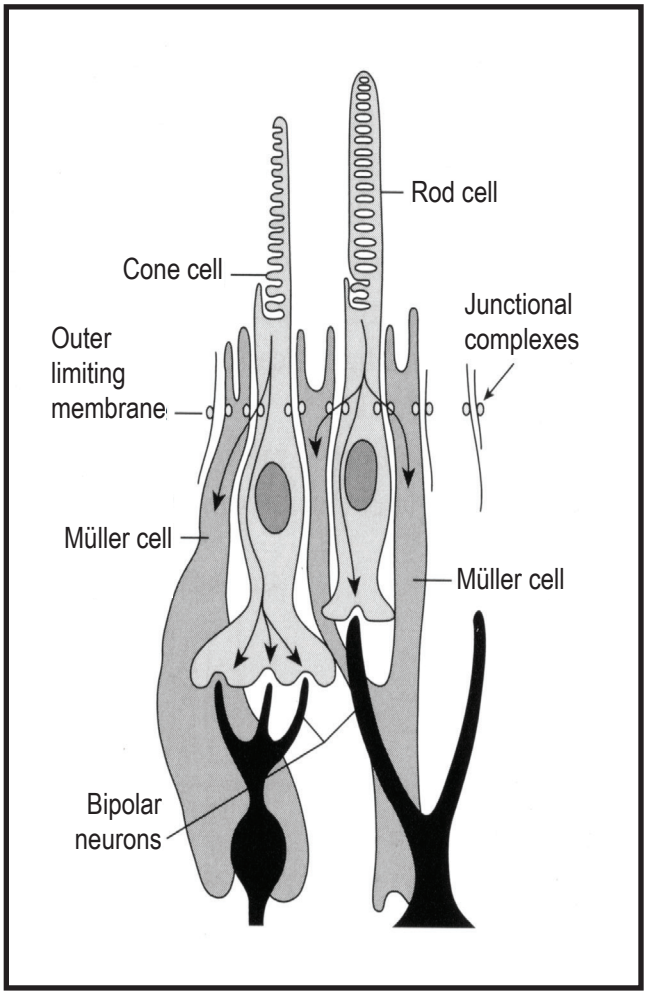


Figure 3. Histologists have identified a dense staining line called the outer limiting membrane lying between the photoreceptor layer and the outer nuclear layer of the retina. With the electron microscope, this "membrane" is revealed to be precisely aligned planar array of densely spaced plaque-bearing junctions with bundles of actin filaments attached to them. This row of adhering junctions attaches the photoreceptor cells to the Müeller cells, which are neuroglial connective tissue cells. It is suggested that subliminal or sub-threshold stimuli create waves of conformational change that are semi-conducted through the cytoskeletons of the photoreceptor cells, across the junctional complexes and into the Müeller cells, and thence throughout the living matrix/ground regulation system. This is an analog network operating at hundreds or thousands of meters per second, as described above (Figure 2d). If this is correct, the matrix could transfer and process very subtle information from the environment at velocities far exceeding those taking place in the nervous system – characteristics often attributed to the unconscious. If the sensory stimulus is strong enough to depolarize the cell membrane of the receptor, the synapses at the base of the photoreceptor cells are activated and the signal jumps to the bipolar and other neurons, through the optic nerve, and into the brain. This second pathway is the well-established neurological pathway that transfers nerve impulses digitally (all or none) at velocities of 100 or more meters per second (Figure 2c).

scheme recognizes a distinction between conscious awareness and thoughtful actions mediated by the nervous system and unconscious processing leading to authentic or automatic actions mediated by the living matrix or ground regulation system.

While this concept is speculative, it could account for astonishingly fast and perfectly coordinated responses that occur in the martial arts and in peak athletic and artistic performances that require communication that is much faster than can be accomplished by nerve conduction, with its attendant synaptic delays. At the same time, the scheme also provides a means for producing painful chronic muscle contraction (conversion disorders) because of subconscious phenomena such as repressed emotions. From the psychotherapeutic perspective, we would like to know if this is also the informational pathway that is opened in deep or near-meditative sessions in which the therapist accesses hidden or repressed memories or traumas. A key point of this article is that looking beyond nerves and synapses can move the discussion to testable biophysical hypotheses on the nature of the subconscious mind.

Semiconductors

A semiconductor is a material with electrical conductivity that is intermediate between that of an insulator and a conductor. Importantly, the conductivity of a semiconductor can be modified in precise ways by introducing impurities in a process known in the electronics industry as "doping." The ability to control conductivity in small and well-defined regions of semiconductor materials has led to the development of a broad array of miniaturized electronic devices that have become the basis for nearly all modern electronics. This is mentioned because most if not all biomolecules have semiconductor properties, and this fact is key to the development of the flourishing molecular electronics industry (e.g. Cuevas & Scheer, 2010). Moreover, the properties of organic semiconductors in living tissues can vary from place to place, allowing for the possibility that the structural fabric of cells and tissues can form a kind of biological electronic circuit with the ability to carry out processes that are directly analogous to those built into commercial transistors and integrated circuits. Specifically, the micro-circuitry of living cells and tissues may be capable of conducting, storing and processing energy and information and transforming energy from one form to another, using efficient high speed electronic and quantum processes comparable to those found in transistors, integrated circuits, computers, opto-electronic systems, cellular telephones and other miniaturized technologies. Barnett (1987) described how molecules can act as string processors.

The Primitive String Transformer (PST) is an abstract computing device to process analog or digital information algorithmically by transferring electrons from a donor to a polymer and switching a non-conjugated chain to a conjugated form, thereby delocalizing some of the electronic orbitals along the chain.

This is a profound concept! If living tissues can accurately be described in terms of micro-circuitry, string processors, or integrated circuits comparable to those used in the electronics industry, new understandings of the nature of life and consciousness open up.

The Mind of the Cell—"Wetware"

One of the major questions in biology is how living cells can carry out hundreds of thousands of processes per second with extremely high speed and efficiency, seemingly without errors. In a book entitled Wetware: a computer in every living cell, Dennis Bray (2009) proposed that all cells are built of molecular biochemical circuits that process information from the environment and perform logical operations, comparable in sophistication to those taking place in electronic devices. Bray defines Wetware as the sum of all of the information-rich biochemical processes and "computations" taking place inside a cell – the interactions of dissolved molecules or arrays of molecules forming complex webs or circuits. For example, the bacterium Escherichia coli has a cluster of trans-membrane receptors and associated molecules that detect chemical attractants and repellents. The cluster amplifies the signal about 35-fold (Goldman, Levin, & Bray, 2009). Once a stimulus has been detected, information can propagate through protein complexes within the cell via conformational waves. The authors suggest that this could be a universal mechanism for functional integration within living cells. The spread of conformational waves has been reviewed by Bai et al. (2010).

Bray also suggested that the computational properties of cells provide the basis for the distinctive properties of living systems, including the ability to embody in their internal structures "images" of the world around them. This concept was supported by

the work of Albrecht-Buehler (1992) who described a rudimentary form of cellular "vision" based on the light-sensing properties of a cytoskeletal component known as the centriole. After some 30 years of observation, Albrecht-Buehler concluded that single tissue cells have their own data- and signal-processing capacities that help control their movements and orientation (Albrecht-Buehler, 1985, 1992). These concepts, supported by the information that follows, could help explain the adaptability, responsiveness, and intelligence of cells and organisms. These cellular attributes probably extend into the extracellular or connective tissue terrain surrounding all of the cells within us.

High Speed Processing in Cells and Tissues

Note that the "circuits" envisioned by Bray exist in "biochemical space" – they are based on enzymes, genes and small sets of genes acting as switches, logic gates, oscillators and other computational elements, with information conveyed through the cell in the form of small enzymatic products such as glucose or amino acids. Enzymatic products can move at very high velocities, as documented with techniques developed by Ahmed H. Zewail, who received the Nobel Prize in Physics in 1999 for creating the world's fastest camera. Using ultrafast lasers, Zewail was able to show that reactants can move at speeds of the order of 1000 m/second or 0.6 miles/second – about as fast as a rifle bullet. Hence, the biochemical "circuits" Bray described could allow for extremely fast flow of information and signal processing – one of the attributes of unconscious processing that has been difficult to explain in terms of neurophysiology. The fastest neurons propagate signals at 100-150 meters per second, with each synapse introducing a delay of 0.5 to 4 msec (Katz & Miledi, 1965), greatly limiting the speed with which neural circuits can transmit and process sensory information and produce meaningful actions.

Zewail's discoveries mean that we might actually be able to use sophisticated molecular cameras to image a material basis for unconscious processes taking place within individual neurons or other kinds of cells and tissues. Imagine biophysical study of psychological phenomena occurring at speeds 10 or more times faster than nerve transmission, using the "4D ultrafast diffraction and microscopy" developed by Zewail, which would make it possible to image transient sub-cellular and tissue correlates of unconscious processes in space and time with atomic-scale resolution! Perhaps studies of this kind will be part of the neuroscience and psychobiology research in the future.

The diameter of a typical human cell is about one-tenth of the diameter of a human hair (about 10 microns). If one takes the size of a typical cell and the velocity of chemical processes as determined by Zewail, one can see that a chemical signal could be propagated back and forth throughout a single cell literally millions of times in a second. If the unconscious mind supports extremely rapid responses, as some have proposed, Zewail's observations imply that there may be virtually no inherent limit to the speed of unconscious signaling and information processing in cells and tissues. As a clinical correlate, think of the savant who can summon up the exact day of the month, i.e. Mon., Tues., Wed. etc., given the date, for decades in the past. Think also of feats of mathematical genius in some of the savants. Recent explorations of the quantum properties of such systems provide a basis for extremely fast signaling and, remarkably, simultaneous processing in multiple pathways (eg. Engel et al., 2007). By going beyond the brain, one can envision unconscious mechanisms that extend throughout the body and that can parallel process information ten or more times faster than neural networks.

Interactions of hardware with wetware

Bray's main focus was on "wetware" with little discussion of the properties of the hardware – the possibilities that emerge from the study of the more solid cellular fabric with the methods of solid-state physics and soft-condensed-matter physics. Many if not all of the proteins and other molecules in the cytoskeleton, extracellular matrix and connective tissues have semiconductor properties, with the capability of carrying out electronic, photonic and other submolecular operations comparable in speed and subtlety to those taking place in integrated electronic or photonic circuits. In principle, such hardware systems may be able to compete with or surpass wetware or neural networks in terms of velocity and sophistication of information flow and processing.

In the 1970s biochemists introduced the concept of the metabolon: a structural-functional complex formed between sequential enzymes of a metabolic pathway, held together by non-covalent interactions and structural elements of the cell such as integral membrane proteins or the cytoskeletal fabric. The concept was first conceived by Kuzin (1970) in the USSR and adopted by

Srere (1972) of the University of Texas for the enzymes of the Tricarboxilic Acid (Szent-Györgyi-Krebs) Cycle. This hypothesis was accepted in the former USSR and further elaborated for the complex of glycolytic enzymes (Embden-Meyerhof-Parnas Pathway) by Lyubarev & Kurganov (1986) and Kurganov & Lyubarev (1988a,b). The name "metabolon" was published in 1985 by Srere.

Metabolons enable rapid and efficient channeling of an intermediary metabolic product from an enzyme directly into the active site of the subsequent enzyme of a metabolic pathway. In terms of the unconscious, the hardware concepts of the living matrix and the wetware of Bray could converge at the cytoskeleton-associated metabolon.

Quantum Coherence

Another way energy and information can move from place to place within the body involves groups of electrons, protons, atoms and molecules vibrating in synchrony to create electromagnetic fields that operate at the speed of light. Physicists refer to free electrons as being present as a "cloud" or "gas" composed of mobile electrons in a material such as a crystal or a metal. The human body contains many structures that are best described as liquid crystals – materials that are intermediate between solids and liquids (Ho, 2010).

Quantum electrodynamics provides the most reliable and accurate understandings of the behavior of liquid crystals. The reason for this is that the standard chemical perspective focuses on atoms and molecules interacting with one another, dominated by atom-atom, atom-molecule or molecule-molecule collisions. The perspectives of physics, quantum physics, quantum chemistry and biophysics enable study of the forces and motions involved in chemical reactions at much smaller and more fundamental scales, the subatomic or electronic levels.

In the past, it was thought that the term "quantum fluid" applied only to clusters of atoms or subatomic particles that condense under extreme conditions of pressure and temperature. Much research has been done to demonstrate the existence of unusual properties such as superconduction, superfluidity and quantum coherence that take place in such extreme conditions. Under such conditions, electrons, atoms and even molecules can be condensed into unusual states of matter known as Bose-Einstein condensates. One of the leading theorists in the field of superconduction, Herbert Fröhlich, demonstrated that the Bose-Einstein condensation can take place in living tissues at body temperatures and pressures because of the high degree of order or crystallinity (identified by Ho as liquid crystals) in certain cellular and tissue components (Fröhlich, 1988). It had been thought that Bose-Einstein condensation could only take place at extremely low temperatures, as was demonstrated by Cornell and Wieman in 1995 using a gas of rubidium atoms cooled to 170 nanokelvin (nK). Under such conditions, a large fraction of the atoms collapsed into the lowest quantum state, at which point quantum effects become apparent on a macroscopic scale (Cornell & Wieman, 2001). Research in this field is driven, in part, by the need to reduce the size and increase the efficiency of electronic technologies. Engineers are constantly looking for applications that take advantage of the extraordinary quantum properties of materials so they can develop and manufacture efficient circuits composed of atoms or molecules.

Fröhlich (1968) concluded that giant dipolar molecules such as proteins, nucleic acids and lipids in cellular membranes, which have enormous electrical fields of some 10^7 V/m across them, should vibrate intensely and coherently at characteristic frequencies and create a physical situation analogous to a Bose-Einstein condensation at body temperature. These molecular vibrations can build up into collective modes of both electromechanical oscillations (phonons or sound waves) and electromagnetic radiations (photons) that extend over large distances within the organism and that can also be radiated into the space surrounding the cell or tissue or the organism as a whole.

We are learning about energy transfers from the study of the energy harvesting systems in green plants (chloroplasts) and the energy utilization systems in animals (mitochondria). It is suggested here that all of these processes could be part of unconscious processing. Recent research from the Fleming group at the University of California in Berkeley has revealed remarkable quantum processes taking place in the leaves of green plants: The "wavelike characteristic of the energy transfer within the photosynthetic complex can explain its extreme efficiency, in that it allows the complexes to sample vast areas of phase space to find the most efficient path" (Engel et al., 2007, p. 782).

Discussion

It is nearly a century since Freud suggested that his provisional ideas in psychology would one day be

associated with organic substructures. This article begins to describe the possible nature of these organic substructures. Figure 4 is a summary.

Many of the hypotheses introduced here are speculative, but they are made with the confidence that emerging technologies will eventually be able to validate or refute them. For example, Pienta and Coffey (1991) discussed harmonic information transfer through a tissue tensegrity-matrix system: "Cells and intracellular elements are capable of vibrating in a dynamic manner with complex harmonics, the frequency of which can now be measured and analyzed in a quantitative manner by Fourier analysis." In the decades since that statement was made, other technologies have been developed that can characterize activities in the molecular fabric of the living matrix/ground regulation systems and wetware. One valuable resource is a series of symposia on ultrafast phenomena in semiconductors and nanostructure materials, including living tissues. For example, the development of powerful ultra-fast laser pulsing technologies has led to the use of terahertz scanning near-field infrared microscopy of biological materials (Schade, Holldack, Martin & Fried, 2005). A second application of terahertz technologies involves spectroscopic methods for measuring the interactions between water and proteins at a very small time scales (Havenith, 2010). Atomic force microscopy can provide topographical information and measurements of mechanical stiffness, electrical conductance, resistivity and magnetic properties at micro- and nano-scales in living material (Darling & Desai, 2012). The fascinating ideas of Bray, i.e. a biochemical basis for "a computer in every cell," may be testable by the use of the methods introduced by Zewail in 1999.

Raman and infrared spectroscopic techniques are now enabling rapid and sensitive chemical characterization of samples based strictly on the vibrational signatures of the molecules present in a sampling volume. When applied to biological systems, the techniques provide highly complex spectra that

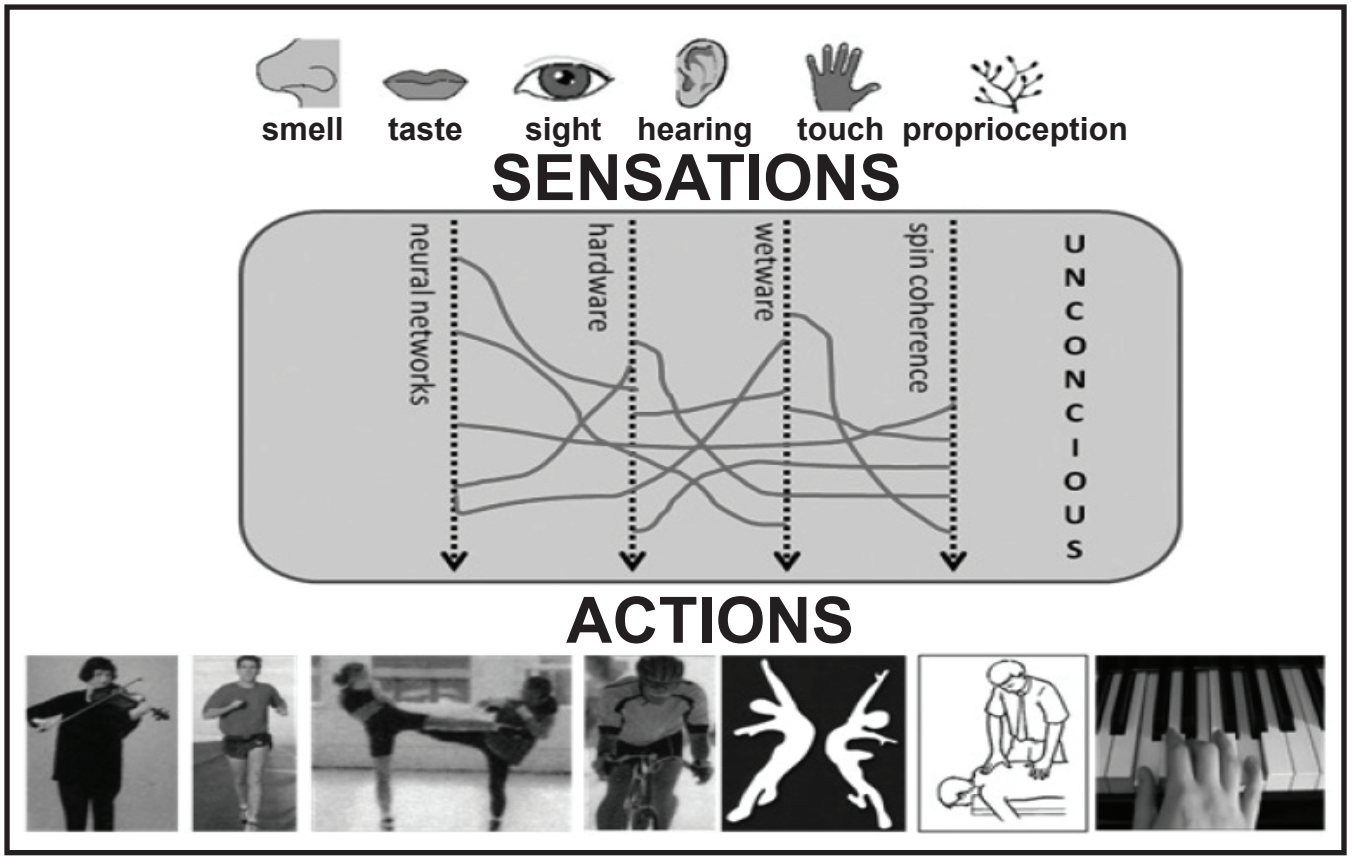


Figure 4. *A summary of the concepts presented in this report. It is suggested that sensory information is processed by the unconscious mind in various ways (dashed lines) that influence behavior (actions). Neural networks, hardware (the living matrix or ground regulation system), wetware (biochemical pathways) and quantum spin coherence are some of the information pathways that may be involved. These informational pathways interact with each other in various ways (solid lines). The behavioral outcome is the result of both conscious and unconscious processes.*

document changes taking place in the entire genome, proteome and metabolome; real time in-vivo applications are possible. The first 2013 issue of the *Journal of Biophotonics* is devoted to the most recent developments, with a commentary of possible future directions. (Krafft & Bird, 2013).

We can now point to the need for multidisciplinary and holistic approaches to the study of consciousness and the unconscious. Continuation of this inquiry with the modern research tools that have been mentioned could begin to identify cellular and tissue changes produced by physical or emotional trauma. Or the health-restoring effects of the abreaction or draining of these emotional traumata. This is a key issue for all branches of therapeutics.

Traditional approaches to consciousness and psychology have involved searching for mind and traumatic memories within the brain and nervous system. Neuroscientists have long been convinced that consciousness, the unconscious, learning, and memory will eventually be localized to specific structures within the brain, although definitive locations for these phenomena have not been found in spite of an enormous amount of research. Scientists have searched the brain and nervous system in part because they know how to study their electrical properties.

There is no question that the brain is involved in many aspects of conscious as well as unconscious processing. However, the traditional neuroscience approach may be akin to taking a television set apart to find the sources of the images on the screen, when the real source is in a faraway TV studio, for example. Those who have described links between consciousness and the fine-scale structure of space, and quantum holography, have sought explanations for a larger or cosmic mind (e.g., Penrose, Hameroff, & Kak 2011). That such explorations are necessary is supported by the extraordinary studies in near-death and even after-death experiences, as promulgated by Pim Van Lommel, or numerous studies of paranormal phenomena such as remote viewing, thought-transference, Psycho-Kinesis, as described by Claude Swanson, Robert Jahn and Brenda Dunne and many others.

At this point, it is useful to look at a rarely mentioned statement by one of the most prolific leaders in neuroscience in the 20th Century, F.O. Schmitt (1903-1995) who founded the Neurosciences Research Program at MIT and served as its Chairman from 1962 to 1974.

> Contrary to widespread belief, the problems of memory and consciousness are not likely to be resolved by further elaboration of electrophysiological techniques, however detailed. It is possible that much of the higher activity of the brain eludes detection by conventional electrophysiological methods. Only in giant macromolecular polymers is the diversity possible that is required for the specificity manifested in fundamental life phenomena. A polymer composed of 1,000 monomers of 4 monomer species (e.g., RNA) could have 4^{1000} variants; with 20 monomer species (e.g. collagen) there could be 20^{1000} variants! (Schmitt, 1961, p. 34)

Hence, giant arrays of liquid crystalline macromolecular polymers such as collagen (Figure 5), found throughout the body, are even better candidates for the location of memory and consciousness as are traditional neural networks! We are referring to the all-pervasive fascia and connective tissues (Figure 6) including the perineural sheathes of the nervous system. Moreover, the collagen liquid crystals organize liquid crystalline arrays of water molecules. Recent research of Gerald Pollack (2013a,b) from the University of Washington has revealed the extraordinary properties of the liquid-crystalline water layers in fascia and other tissues. Taken together, the giant arrays of collagen and water and their extensions into every cell and cell nucleus potentially provide a dynamic resource for many of the processes previously viewed as taking place only in nerve nets.

As noted, each neuron has about nine feet of cytoskeleton, which means there may be a billion miles of semiconducting fibers in the brain. These may form a sophisticated intracellular electronic communication network that functions independently or parallel to neural transmission. One can envision the living matrix system informing the organism of sensory inputs such as visual cues ¼ to ½ second before nerve impulses have reached the visual cortex, and before the performer is consciously aware of significant events in the environment. Perhaps the matrix is even able to process the information and initiate musculo-skeletal responses before conscious processing has begun. This split-second could be the difference between winning and losing in a close athletic competition, for example.

An ever-widening circle of modern scholars is embracing the idea that mind, learning, memory, the unconscious, and consciousness are not confined to

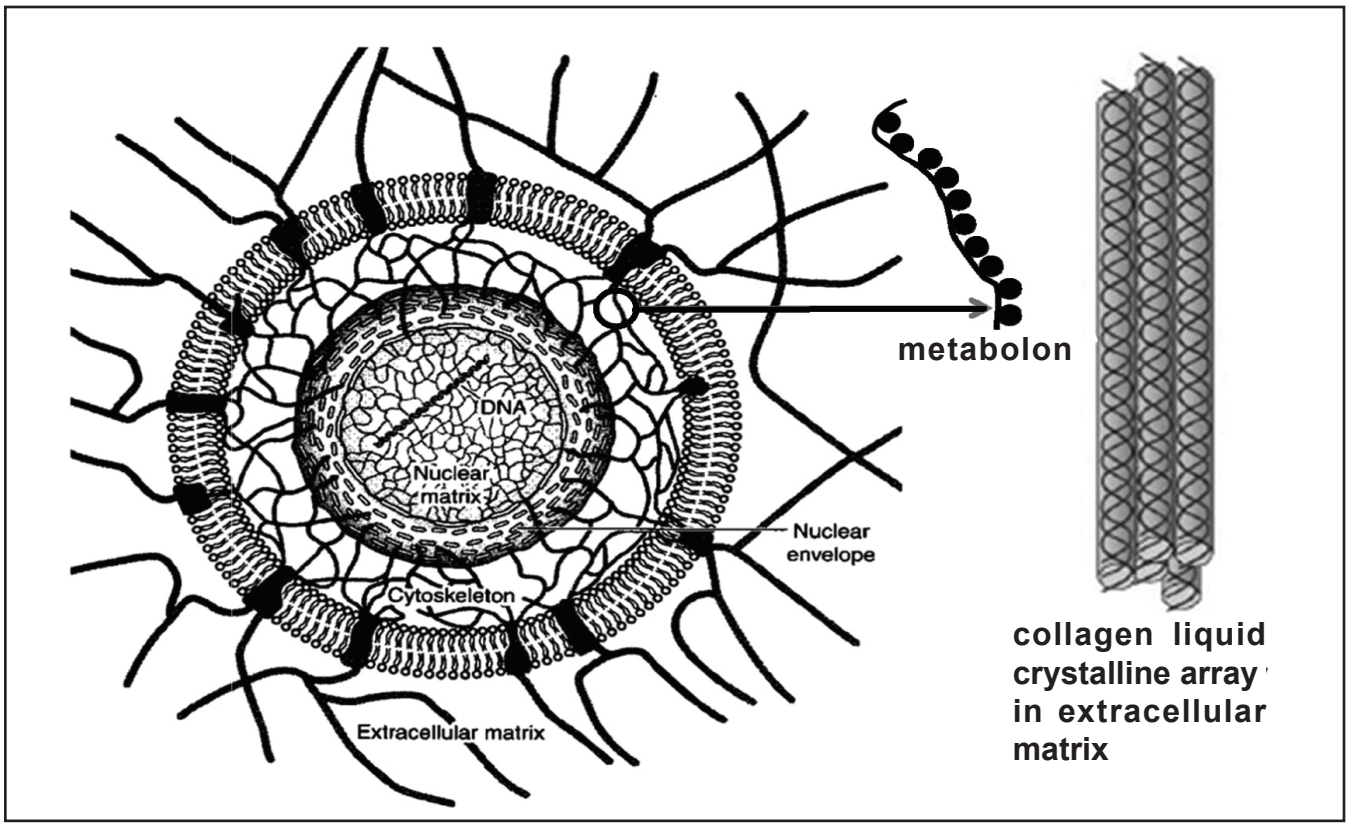


Figure 5. *The living matrix consists of the various matrices within the cells, including the nuclear matrix, mitochondrial matrix (not shown here) and cytoskeleton, which connect to the extracellular matrix via the integrins that span the cell surface. The metabolon is an assembly of enzymes for a particular metabolic pathway. Here we show 10 enzymes in sequence, represented as dots, as, for example, in glycolysis. Metabolons are structural-functional complexes formed between sequential enzymes of a metabolic pathway, held together by non-covalent interactions and structural elements of the cell such as integral membrane proteins and the cytoskeletal fabric. Metabolons allow rapid and efficient channeling of an intermediary metabolic product from an enzyme directly as substrate into the active site of the subsequent enzyme of the metabolic pathway. In terms of the unconscious, the hardware concepts of the living matrix and the wetware of Bray converge at the cytoskeleton-associated metabolon. The extracellular matrix connects to the arrays of collagen molecules, each surrounded by a hydration shell, that form the various tissues as shown in Figure 6.*

the brain. These are leading authorities in mathematics, physics, quantum physics, cosmology, brain science, cognitive psychology, medicine and philosophy (e.g. Karl H. Pribram, David Bohm, Stuart Hameroff, Roger Penrose, Rupert Sheldrake, Edgar Mitchell, Hiroomi Umezawa, Depak Chopra, Richard L. Amoroso, Ervin László, Rudolf E. Schild, Francisco di Biase, and John Veltheim). For example, Carl Jung (1952): "We must completely give up the idea of the psyche's being somehow connected with the brain, and remember instead the 'meaningful' or 'intelligent' behavior of the lower organisms, which are without a brain." Sir Charles Scott Sherrington focused on the cell cytoskeleton as a candidate for the "brain" of the cell. Neuroscientist Candace Pert (2004) stated that, "Your body is your subconscious mind."

Hence, while the dominant assumption in neuroscience is that consciousness is a byproduct of the operations of the human brain, many established scholars with outstanding credentials are extending the inquiry beyond the brain and even beyond the body. For example, Stuart Hameroff collaborated with quantum physicist Roger Penrose to develop a model of memory and consciousness in which molecular arrays of microtubules in brain neurons are capable of storing information and regulating neuronal activities. Their model suggested a connection between biomolecular processes in brain microtubules and the fine-scale structure of the universe (Penrose, Hameroff, & Kak, 2011). If these phenomena are confirmed, it is probable that they apply equally to the extracellular macromolecular collagen arrays that form the bulk of the anatomical structure of the human

body (e.g. tendons, ligaments, fascia, bone, cartilage, superficial fascia, etc.).

It is possible to push the idea of additional media for the functioning of consciousness yet another level. The notion of a relationship between consciousness and the physical properties of the fine-scale fabric of space has arisen again and again in scholarly circles. Some quantum physicists trace these concepts to ancient Buddhist and Vedic teachings, as summarized, for example, by Fritjof Capra in *The Tao of Physics* (1975) and in his subsequent writings. For a recent summary of these ideas, see a compilation of classic papers on Consciousness and the Universe: Quantum Physics, Evolution, Brain & Mind published in the *Journal of Cosmology* (Penrose, Hameroff, & Kak, 2011). This compilation contains a series of articles by leading thinkers on the connections between the fine-scale structure of the cosmos and consciousness, including the roles of information fields in the origins of life and form. For example, in The Quantum Hologram and the Nature of Consciousness, Apollo astronaut Edgar Mitchell, in collaboration with Robert Staretz (2011) presented a quantum holographic model to explain how all of creation learns, self-corrects and evolves as a selforganizing, interconnected holistic system. In their words, they

> present a new model of information processing in nature called the Quantum Hologram, which we believe is supported by strong evidence. This evidence suggests that quantum hologram is also a model that describes the basis for consciousness. It explains how living organisms know and use whatever information they know and utilize. It elevates the role of information in nature to the same fundamental status as that of matter and energy. We speculate that quantum hologram seems to be nature's built-in vast information storage and retrieval mechanism and one that has been used since the beginning of time (Mitchell & Staretz, 2011, n.p.).

In a related proposal, cosmologists Rudolf Schild and Darryl Leiter (2010) have developed the remarkable hypothesis that black holes, because of their continuous contraction and acquisition of mass, might serve as "nature's hard-drives" holding copies of the quantum holograms generated by each new moment of human experience, as well as by each new event occurring to non-living objects. While these ideas do not appeal to some, they are worthy of consideration, and are resonant with the theoretical explorations and the experiences of the authors of this article.

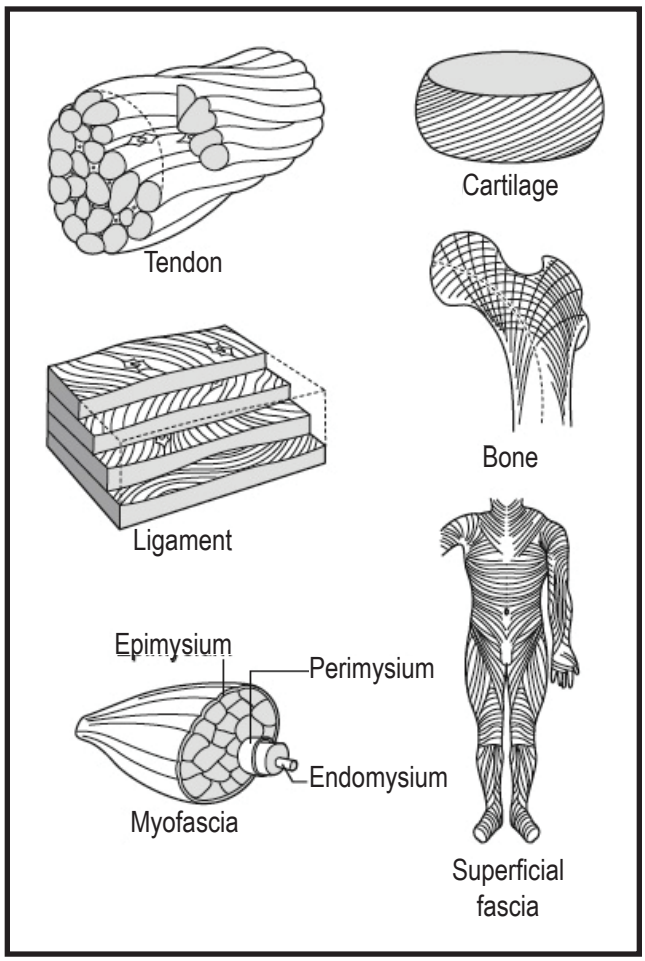


Figure 6. *The various connective tissues are formed from arrays of collagen molecules and associated ground substance gel. These tissues, along with muscles (also composed of liquid crystals) form some 75% of the body by weight. (From Oschman, 2012)*

This essay has explored some novel and speculative interdisciplinary hypotheses to explain the properties of the unconscious mind in relation to consciousness, the nervous system, and the physical body. Included are some plausible and testable concepts that could account for some of the seemingly anomalous phenomena that are widely recognized as taking place in a variety of therapeutic settings and during peak athletic and artistic performances. What seems anomalous is the great speed and accuracy of sensory processing and functional integration accomplished by the unconscious mind, and its capacity to "sweep in" all aspects of the environment or context relevant to a particular course of action.

Another anomalous property is that unconscious beliefs and memories can influence bodily structure and function—the observation of so-called "conversion disorders" that originally led Freud to suggest the existence of an unconscious mind.

Because their molecular and tissue components have been so widely studied, the living matrix and ground regulation systems provide detailed models for exploring holistic interventions of all kinds. The living matrix and ground regulation systems are good candidates for part of the "organic substructure" of the unconscious mind referred to by Freud. We predict that measurable activities taking place in the matrix will eventually account for intuition and for the successes of programming intentions, as in the use of mental rehearsals in refining human performance. These activities may also provide a substantive basis for the connections between emotional issues, body structure/function issues and organic diseases.

A number of sophisticated technologies have been developed to detect the phenomena being discussed here. These same technologies may eventually provide direct tests of some of these ideas, with the further possibility of demystifying the subliminal interpersonal cues and spontaneous insights that many performers and therapists rely on in one way or another. Detailed information on the physics, biophysics and quantum physics of unconscious processes would obviously impact the various schools of psychotherapy. Alan Haas (2011) has recently published a thoughtful essay in this journal summarizing some of the history of applying physical science approaches to transpersonal psychology.

The sensitive observations of William Redpath (1995), and the concepts he described as Trauma Energetics are profound. He sensed that his trauma work was reaching into the places where the elusive energetic signatures of trauma are stored, and even into the formative mechanisms that continuously manifest and re-manifest the living body itself. We are suggesting that modern research tools will be capable of tracing the pathways therapists use in their subtle invisible interpersonal exchanges that identify the emotional and physiological condition of a patient.

This article proposes that non-neural systems within cells and tissues have a vast, possibly unlimited, capacity for sensing and storing environmental information and for rapidly processing and interpreting and acting on this information. Hence we have exposed the possibilities for a "High Mind" or "Super Mind" (Pressman, 1999, 2011) that functions beyond words by taking in all things, the entire context of a conscious moment, all at once, like a photographic memory or holographic image.

There are four key entrances or portals in this transpersonal network.

1. One gateway consists of the familiar sensory systems. The scheme illustrated in Figure 4 implies that sensory information enters and moves through the body via two routes. One is the well-known neurological system, and the other is the interconnected semiconductor fabric known as the living matrix or ground regulation system. The sensory nerves are digital (all or none) and propagate signals that have exceeded a specific intensity threshold. In contrast, the matrix is an analogue system, and can sense and process all stimuli, from the minutest subliminal, sub-threshold, quantum perturbations to the strongest.
2. A second access route consists of the acupuncture points and other sensitive points at the skin surface that connect the environment to the connective tissue/myofascial "meta-system" extending throughout the body. These points allow for bidirectional transpersonal information flow across the skin surfaces of both patient and therapist.
3. Integrins at cell surfaces are the "acupoints of the cell"—the primary bidirectional links between the vast array of processes taking place within the fascial meta-system and the cytoskeletons of cells throughout the body.
4. Links between the cytoskeleton and the nuclear matrix and DNA provide bi-directional access to the genome, where epigenetic effects take hold. These circuits are constantly operating silently in the background of our conscious experience.

A typical neuron is wired to about 1000-2000 of its neighbors, and the pattern and properties of these connections is widely thought to enable the brain to do what it does. This is the model put forward by John C. Eccles that led to his Nobel Prize in 1963. This model dominated neuroscience research for an entire generation, but was rejected as inadequate by Eccles himself in 1992 (Eccles, 1993). Much to the consternation of many of his colleagues, Eccles concluded that his famous model was inadequate to account for non-physical and transcendent

properties of mind: feelings, thoughts, memories, intentions and emotions. It would be necessary to move to a smaller level of scale, to the quantum properties, to locate the ultimate connection between mind and brain. This is the direction a number of modern scholars have taken (e.g., Penrose, Hameroff & Kak, 2011).

Information from the study of the dynamic properties of nerve nets can provide models for processes taking place beyond the brain. For example, a recent review of Freud's (1895/1957) *Project for a Scientific Psychology* explains how Freud anticipated the model for learning and memory known as long-term potentiation —the enduring facilitation of communications between two neurons in response to the repeated activation of the synapses connecting them (Centonzea, Siracusano, Calabresi, & Bernardi, 2004). Researchers are now modeling long-term potentiation and synaptic plasticity *in silico*, a term analogous to the Latin phrases in vivo, in vitro, and in situ (Bracciali, Brunelli, Cataldo, & Degano, 2008). Such studies provide new insights into computer design, and are applicable to the study of solid-state molecular networks within cells, tissues and neurons.

In the jargon of bioinformatics, the unconscious mind as discussed in this article can be viewed as "a high-throughput system":

> During the last decades, the development of high-throughput technologies has produced a huge amount of information in the field of neurobiology, requiring the utilization of mathematical modeling to describe the complex dynamics of biological processes and stimulation new collaborations among biologists, physicists and computer scientists. (Bracciali et al., 2008)

A logical question is the location of the interface between the living matrix/ground regulation systems and the brain and peripheral nervous system. The answer is that the interface is throughout the nervous system, since the nerves and the brain are actually components of the living matrix. We envision a continuous dynamic energetic movement or flow taking place within and between all of these systems.

The living matrix is a communication system par excellence within the human body; but we also suggest that it extends beyond the body surface. Two of the Nobel Prize winning founders of quantum physics, Niels Bohr and Erwin Schrödinger, were convinced that quantum processes are at the interface between consciousness and matter. Communication waves, be they biomagnetic fields, spin waves, torsion waves, "consciousness waves," solitons, or some other unknown energetic manifestation, extend to the periphery of the body, and proceed virtually instantaneously beyond the skin into a timeless, limitless communication fabric extending to other people, other places, other things throughout the universe.

Notes

1. Portions of this article have been published in *Energy Psychology: Theory, Research & Treatment*, *5*(1), pp. 1-15 (2013), and as Chapter 2 in *The Clinical EFT Handbook*, edited by D. Church & S. Marohn (2013; Energy Psychology Press, Fulton, CA).

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