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The Brain-Mind Conundrum: The Rise of Quantum Biology

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Abstract: All present-day neuroscience is cortico-centric. It's all about the brain. The mind is left to philosophers or theologians to debate. Yet proponents of pre- and perinatal psychology know that we are more than just cells and hormones. While there is no doubt that the brain is material—that is, it can be seen, touched, and measured, and as such obeys Newtonian laws of physics (Classical Physics)—this materialistic approach is contradicted by hard scientific data from the cutting edge of academic scholarship on Quantum Physics. Quantum Physics stipulates that all matter is made of particles and waves, and in-between states called *wavicles*. It has taken us from "common sense" to "quantum non-locality"– revealing an ever more baffling reality. In view of very recent research in quantum biology particularly, by the phenomena of entanglement and non-locality, psychosomatic medicine, the placebo effect, and telepathy, prenatal communication between mother and child, as well as prenatal and birth memories can be understood.

Keywords: neurobiology, research and theories, pre- and perinatal psychology, brain, mind, consciousness, Quantum Biology, microtubules

The universe is not only stranger than we think,
but stranger than we *can* think.

Werner Heisenberg, Nobel Prize, 1932, "for the creation of quantum mechanics"

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In this paper I want to address central issues of consciousness, free will, and the brain-mind relationship and how this applies to pre- and perinatal psychology. The modern scientific worldview is predominantly grounded in classical Newtonian physics. It considers matter the only reality. This scientific view is referred to as *materialism*. A related assumption is the notion that complex things can be understood by reducing them to the interactions of their parts, usually smaller, simpler, or more fundamental bits, such as atoms and electrons. This is called *reductionism*. Materialism and reductionism are science's Tweedledee and Tweedledum.

Biological phenomena, such as electrical charges, neurotransmitters, and hormones are considered responsible for, and fully explanatory of, the choices we make—even our beliefs, likes, and dislikes. Most neurologists, philosophers, and psychologists are of the opinion that if all of the myriad factors that contributed to the construction of our bodies (including the brain) were known, we could precisely predict how a person would act in any situation at any time. In other words, we have been programed like a computer. The mind arises from the operations of the brain. Free will is an illusion.

Similarly, using the language of neurons and cortical excitation, these scientists hold that the brain produces consciousness. When the brain suffers injury, consciousness deteriorates; when a person dies, the brain dies, and consciousness ceases.

Scientists armed with ever more precise fMRIs, EEGs, and other material tools of the materialist and determinist position have mapped our brains successfully and located areas responsible for sight, hearing, executive functions, and many others. In spite of all these efforts, they are not even close to discovering how the brain produces conscious experience. Will, reason, or the mind do not currently have precisely identified neural correlates. How can the firing of billions of neurons give rise to thoughts, imagination, art, and complex feelings like love or happiness? Somehow, brain processes acquire a subjective aspect, which at present seem impenetrable to classical science. Enter Post-Materialism Science and Quantum Biology.

Consciousness

The cortico-centric view by old-school neuroscientists has ascribed to the brain a singular and dominant importance, a fact that has for a long time discouraged research into differences between brain and mind, as well as the origins of consciousness and free will.

The presently accepted view among neuroscientists is that consciousness occurs after-the-fact, as an e*piphenomenon*, a function of the brain. Initiated by Dan Dennett in 1991, epiphenomenalism is the party line in mainstream cognitive science and philosophy. In this view, *arousal* and *awareness* are two critical components of consciousness.

Arousal is thought to be regulated by the brainstem, which is responsible for basic life functions such as the sleep/wake cycle, hunger, sex, and heart and respiratory rates. Awareness, another critical component of consciousness, has long been considered to reside somewhere in the cerebral cortex.

Now, a team of researchers led by neurologist Michael D. Fox at Beth Israel Deaconess Medical Center, has pinpointed the regions of the brain that may play a role in maintaining awareness. Their analysis revealed two areas in the cortex that were significantly connected to the coma-specific region of the brainstem. One sat in the *left, ventral, anterior insula*, and the other, in the *pregenual anterior cingulate cortex*. Fox said, "A lot of pieces of evidence all came together to point to this network playing a role in human consciousness" (Beth Israel Deaconess Medical Center, 2016).

In 1992, Sir John Carew Eccles, an Australian neurophysiologist and philosopher who won the 1963 Nobel Prize in Physiology and Medicine for his work on the synapse, proposed that consciousness likely occurs in dendrites. Two decades later, Karl Pribram (2012), the eminent brain scientist, psychologist, and philosopher, called by his colleagues the "Magellan of the Mind" for his pioneering research into the functions of the brain's limbic system, frontal lobes, temporal lobes, and their roles in decision making and emotion, added his support to this theory.

Many scientific studies suggest that consciousness emerges from the brain and body acting together (Popper & Eccles, 1977/1983). The brain never works alone. It functions only as it is inseparably linked to the body and the environment. In addition, a growing body of evidence now points to the heart as playing a particularly significant role in this process.

Similarly, the child in utero, is inseparably attached to the mother's body. The baby develops inside the watery environment of the uterus, sensing and listening to his/her mother's heartbeat and other bodily functions. Therefore, anything the mother experiences is passed to her unborn child, and not just by the umbilical cord.

As we shall see, while there is a ton of research to support the cortico-centric view of consciousness, these studies and hypotheses leave many questions, particularly as they pertain to the mind, unanswered.

The Volitional Self

Each of us experiences ourselves as being a continuous and distinctive person over time, built from a rich set of autobiographical memories. Of the many unique experiences within our inner universes, one is the experience of *being me*, or in academic terms, the sense of *selfhood*. (This is despite the fact that there was a time when, growing inside our mothers, we were inextricably linked to *her* physical and emotional experiences.)

Conscious selfhood is best understood as a complex construct generated by different parts of the brain communicating with each other (Seth, 2017).

The *volitional* self involves experiences of intention and of agency–of urges to do this or that, and of self-control. It is the part of us that has caused the most controversy over the ages among philosophers, religious scholars, scientists, and writers (think Dostoyevsky or Camus).

Free decision-making is a cornerstone of our society. Belief in free will predicts prescribed punishment and reward behavior. Its presumptive existence impacts social conduct. Our society assumes that every person is capable of moral reasoning. In this context, free will allows people to choose between good and evil, and the law punishes antisocial behavior.

Opposed to the idea of free will is the deterministic view. An example of the research supporting that orientation is the work pioneered by Benjamin Libet in the 1980s. Libet found that when study participants were asked to perform a specific task, their brain activity preceded their actions (Libet, 1985). Later studies, using various techniques, claimed to have replicated this basic finding. Along with two colleagues, Veljko Dubljevic (Saigle, Dubljević, & Racine, 2018), an assistant professor of philosophy at North Carolina State University who specializes in research on the neuroscience of ethics and the ethics of neuroscience and technology, reviewed 48 studies, ranging from Libet and colleagues' landmark 1983 paper (Libet, Gleason, Wright, & Pearl, 1983) through 2014. Matt Shipman (2018), commenting on the meta-analysis, stated:

> We found that interpretation of study results appears to have been driven by the metaphysical position the given author or authors subscribed to–not by a careful analysis of the results themselves. Basically, those who opposed free will interpreted the results to support their position, and vice versa. (para 6)

The researchers also found that a significant subset of studies that assessed where in the brain activity was taking place was not related to will or intent to complete a task. While the Libet approach may be useful for examining how stimuli affect temporal judgments, the link between this and free will or moral responsibility is anything but clear.

In *The Emperor's New Mind* (1989), Roger Penrose suggested that *quantum mechanism* (more on this later) explains Libet's backward time effects, now shown in psychological (Bierman, 2001; Radin, Taft, & Yount, 2004) and so-called "quantum erasure" experiments (Ma et al., 2012).

Brain imaging techniques, such as fMRI, have recently provided new insights into the functional and brain mechanisms involved in intentional action. However, the literature is rather contradictory and does not reveal a consistent picture of the functional neuroanatomy of volitional behavior (Brass & Haggard, 2008).

Post-Materialism Science

Stuart Hameroff, from the Departments of Anesthesiology and Psychology, Center for Consciousness Studies, University of Arizona, Tucson, emerged from obscurity in 1994 to advance what seemed–at the time–one of the more bizarre ideas about the human brain. Supported by Roger Penrose (1989, 1994), an esteemed figure in mathematical physics at Oxford University, he suggested that quantum vibrational computations in *microtubules,* which are major components of the cell structural skeleton, were "orchestrated" ("Orch") by synaptic inputs and memories stored in microtubules, and baptised by Penrose "objective reduction" ("OR"), hence "Orch OR." They suggested that EEG rhythms (brain waves) derive from deeper level microtubule vibrations. *Most significantly, they further proposed that microtubules govern our consciousness* (Hameroff, 2014; Volk, 2018a). Microtubules may play a part in cellular memory—memories such as a baby might develop in the womb, prior to full brain development.

Microtubules are hollow, cylindrical structures—25-nanometer-wide tubes that are thousands of times smaller than a red blood cell. They are found in every plant and animal cell (Figure 1). Microtubules provide internal support for living cells and act as conveyor belts, moving chemical components from one cell to another. During cell division, microtubules transport chromosomes from one end of the cell to the other, and then position the chromosomes in the new daughter cells (Elsevier, 2014).

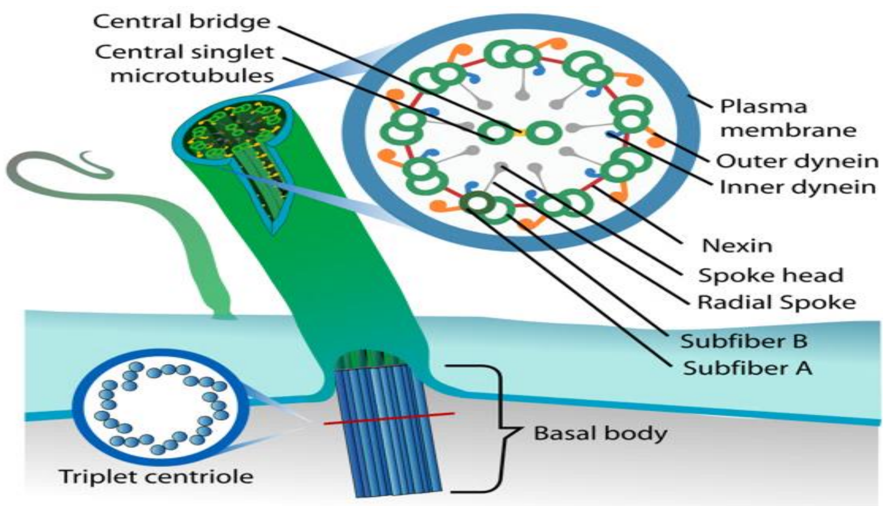

Figure 1. Cilia of paramecium showing microtubules *Credit: LadyofHats [Public domain], from Wikimedia Commons*

Hameroff (2014) came to believe that microtubules play a defining role in consciousness. He points to the single-celled paramecium as evidence (Figure 2). In an interview with Steve Volk (2018b), he says:

> The paramecium has no central nervous system. No brain, no neurons, but it swims around, finds food, finds a mate and avoids danger. It seems to make choices, and it definitely seems to process information. (para 30)

And since microtubules are *nanoscale* structures, Hameroff also began thinking that quantum physics might play a role in consciousness (Volk, 2018a).

Figure 2. Paramecium *Credit: Barfooz [CC BY-SA 3.0], via Wikimedia Commons*

The prevalent scientific view presumes that consciousness and the mind emerge from complex neuronal computations and developed during biological evolution of living organisms. Spiritual and contemplative traditions, as well as some scientists and philosophers, consider the mind to be intrinsic or "woven into the fabric of the universe." In these views, precursors of consciousness and the mind preceded biology, existing all along in the universe.

Hameroff suggests that consciousness arises from quantum vibrations in microtubules inside the brain's neurons and connects ultimately to *deeper order* ripples in space-time geometry. "Consciousness is more like music than computation," he writes in *Interalia*, an online magazine dedicated to the interactions between the arts, sciences, and consciousness (Hameroff, 2015). Roger Penrose has remained committed to what the pair has co-published over the years.

New findings suggest that some of Hameroff's claims are more credible than previously assumed. Furthermore, microtubules–the tiny structures that Hameroff considers the locus of quantum operations in the brain–are suddenly a hot subject. And some researchers are finding that Hameroff might be right: *Quantum physics might be vital to our awareness, cognition, and even memory*. Imagine what this might mean for a baby developing inside of his/her mother. Could quantum physics explain how a baby's awareness in utero might lead to prenatal and birth memories?

The chemical machinery that powers biological systems consists of complicated molecules structured at the nanoscale and sub-nanoscale. At these small scales, the dynamics of the chemical machinery are governed by the laws of quantum mechanics. Recently, strong evidence has emerged that *shows the existence of quantum coherence in plant photosynthesis, bird brain navigation, and human sense of smell* (more on smell further down) (Elsevier, 2014; Lloyd, 2011).

Physicist Neill Lambert (Lambert et al., 2013) of the Advanced Science Institute in Japan researching photosynthesis has found supportive evidence that quantum effects can happen in biological systems at room temperature. That is to say, in our bodies. "I was always quite skeptical of Stuart's claims about microtubules," says Anthony Hudetz, a neuroscientist in the anesthesiology department at the University of Michigan (Hudetz & Pearce, 2010). "But now there is data. And I have to say, I think Stuart does have some momentum now" (Volk, 2018a).

Riding this momentum, Hameroff and Penrose, together with a group of scientists from a variety of fields such as neuroscience, biology, medicine, psychiatry, and psychology, initiated a new science they call Post-Materialist Science. These scientists (Schwartz, Miller, & Beauregard, 2014) emphasize that science is first and foremost a non-dogmatic, open-minded method of acquiring knowledge about nature through the observation, experimental investigation, and theoretical explanation of phenomena. Its methodology is not synonymous with materialism and is not committed to any particular belief, dogma, or ideology. I support this stand one hundred percent. We should follow the evidence and rely on the data; but remember what Einstein once said: "Everything that can be counted does not necessarily count; everything that counts cannot necessarily be counted."

The Rise of Quantum Biology

Having given much thought to the subject of this paper, I have concluded that the only way to approach it is to provide at least a rudimentary understanding of quantum physics, also called quantum mechanics. Therefore, I offer here my own simplified understanding of quantum mechanics, with the caveat that I am not a physicist.

Quantum physics deals with the study of particles at the atomic and subatomic levels; Max Born coined the term in 1924. Quantum physics or Quantum mechanics (QM) is complex, paradoxical, and hard to fathom if one is tethered too closely to classical Newtonian physics. The theory sets fundamental limitations on how accurately we can measure particle locations and velocity, replacing classical certainty with probabilistic uncertainty. The theory describes just about every phenomenon in nature, both organic and inorganic, ranging from the color of the sky to the molecules and ions in living organisms. What makes QM confusing is that the laws governing it differ drastically from classical physics.

So, dear reader, jettison your attachments to high school physics and take a walk on the wild side. Here is a bit of historical background. During the 1920s and early 1930s, physicists discovered empirical phenomena that could not be explained by classical physics. This led to the formation of a revolutionary new branch of physics called quantum physics or quantum mechanics. QM has confirmed that atoms and subatomic particles are not really solid objects—they do not exist with certainty at definite spatial locations and definite times. Remarkably, researchers discovered that the particles being observed and the observer—the physicist, the apparatus, and the method used for observation—are linked. The scientists hypothesized that *the consciousness of the observer affects the physical events being observed, and that mental phenomena influence the material world.* Recent studies support this interpretation and suggest that *the physical world is no longer the primary or sole component of reality, nor can it be fully understood without making reference to the mind* (Ma et al., 2012).

Through the 1990s, Dr. Masaru Emoto (2005), a Japanese author, researcher, photographer, and entrepreneur, performed a series of experiments observing the physical effect of words, prayers, music, and environment on the crystalline structure of water. Emoto exposed water to different variables and subsequently froze it so that crystalline structures formed.

In one series of experiments, Emoto taped different words, both positive and negative, on containers filled with water. The water container stamped with positive words produced more symmetrical and aesthetically-pleasing crystals than the water in containers stamped with dark, negative phrases. "Water is the mirror of the mind," according to Emoto (2005). If our words and thoughts affect water crystals, think of the effect they may have on living creatures, including us humans.

Pointing in that direction are Emoto's rice experiments, as featured in the film *What the bleep do we know!?* (Arntz & Arntz, 2004). The concept is admittedly bizarre, but the evidence is rather persuasive. Emoto's research demonstrates that human vibrational energy—spoken or written words, feelings, and music—affect the molecular structure of water.

Many people have replicated Emoto's rice experiments including two of my friends (Endnote 4, Rice Experiments). You can see the results of their experiments here (Figures 3a, b, c, and d).

Figure 3a. *Here is where we kept the two labeled jars of cooked rice, on top of our piano, not too far apart so that they would have the same light and room temperature, etc.*

Figure 3b. *Toward the rice on the left, we directed our voices daily, saying, "Thank you! You're beautiful!" Toward the rice on the right, we directed our voices daily, saying, "You fool! You stink!" After three months, here is what the rice looked like.*

Figure 3c. *Here they are in better lighting, turned around.*

Figure 3d. *And here are two pictures of our rice, taken today, Aug. 24, 2009.*

Water makes up 80 percent of rice as well as of our bodies. So, what effect do words with an emotional charge have on humans? While there is much psychological evidence for the power of words, there is a dearth of biological research on this subject. Let us also keep in mind that the unborn child spends nine months surrounded by water navigating their amniotic universe; imagine the impact words, thoughts, and feelings might have on a developing baby.

An example of the former approach is the research of David Chamberlain (1988), a San Diego psychologist and one of the early pioneers of pre- and perinatal psychology. According to Chamberlain, "Birth memories that come up in the course of psychotherapy illustrate how babies can be stung and poisoned for decades by short-sighted remarks such as, 'What's wrong with her head?' or, 'Wow, this looks like a sickly one.'"

Several years ago, I visited a large NICU in a university hospital. There were 36 incubators with babies in the room (Figure 4). About half of them had their names displayed on the side of their incubators. The other half had no names. I asked the nurse who was showing me around why it was that these babies did not have names. She said, "That's because their parents do not want to get too attached to them, in case they die." I wish a post-doc would write a research paper comparing the physical and psychological health of these two groups of children over a good length of time. I have absolutely no doubt that the children whose parents addressed them by their given names would have fewer health issues and live longer compared to the nameless group.

Figure 4. Newborn in NICU *Image: Creative Commons CC0.*

Moving now from the effect that words, emotions, or even unspoken thoughts can have to a related subject, consider the experience of drinking a cup of coffee at a coffee shop when suddenly, you have this feeling that someone is looking at you from behind. You turn around and you meet the eyes of the person who was looking at you. How did you apprehend that?

Further instances of communications that presently neither classical physics nor psychology can explain are occurrences in which a twin experiences an overwhelming feeling of dread that they strongly believe is somehow connected to their twin who lives many miles away. They call and discover that in fact their twin was involved in an accident or was in some other kind of serious trouble. How does that work?

Even more mysterious are reports of Out-of-Body Experiences (OBEs). Many OBE reports come from individuals who experienced clinical death. When revived, these people tell us what it was like for them to exist poised between life and death. Usually, they relate perceiving themselves from a perspective above or to the side of their physical body and describe accurately the conversations of the medical staff present in the room as well as the medical interventions that were performed on them. This is sometimes also reported when individuals recall prenatal or birth memories; for example, clinicians working in this field will sometimes share that adult patients can recall their own traumatic experience of being born by seeing it happen as if they are elsewhere in the room, instead of being inside the baby's body.

There is the astonishing work of professor of medicine, Ian Stevenson, published in six volumes by the University Press of Virginia, on children from various parts of the world remembering with incredible fidelity their former lives. His paper on the past life memories of children is *American children who claim to remember previous lives* (Stevenson, 1984).

Japanese obstetrician, Dr. Akira Ikegawa, conducted surveys at clinics, child-care facilities, and schools, interviewing children aged one to six years. The results were astonishing. More than 40 percent of children said they remembered being in their mother's womb. More than 50 percent had memories of their own birth. Dr. Ikegawa also confirmed these circumstances with the mothers (Ikegawa, 2016).

These are just a few examples of what I call *sympathetic communication*. At this time, the majority of classical neuroscientists reject these phenomena as pseudo-scientific, unproven, New Age gibberish. I think they are wrong. I think sympathetic communication is real and well supported by research.

Where does sympathetic communication originate? No doubt the brain and all its connecting networks must be involved, but these cannot totally account for it. The only possible answer is the *mind*. Which brings on more questions. Is the mind separate from the body? If so, where does it dwell? What is it made of?

Scientists familiar with QM have taken a run at this puzzling conundrum. Let's take a closer look. Early pioneers of quantum physics (Figure 5) saw applications of QM in the biological sciences. In 1944, Erwin Schrödinger (1967) discussed applications of QM to biology. Schrödinger suggested that mutations are the result of *quantum leaps*. In 1963, Per-Olov Lowdin at Uppsala University, Sweden proposed *proton tunneling* as another mechanism for DNA mutation. In his paper, he stated that there is now a new field of study called *quantum biology* (Lowdin, 1965).

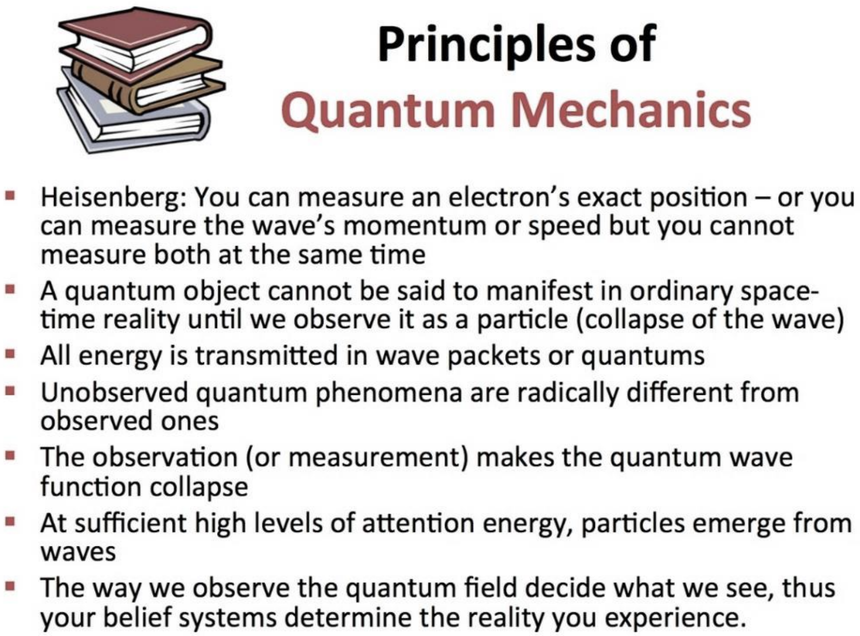

Figure 5. *Credit: Dr. Erik Hoffmann*

The idea of atoms goes back to Ancient Greece where philosophers like Leucippus, Democritus, and Epicurus proposed that nature was composed of what they called ἄτομος (*átomos*) or *indivisible individuals*. They thought that if you took an object, for example a watermelon, and kept cutting it in half and then again in half into infinity, you would eventually end up with a particle that was so small that it was "uncuttable." Nature was, for them, the totality of discrete atoms in motion. If you think about it, this is downright brilliant, considering they lacked any of the bells and whistles of modern science. Today, we recognize that the atom is not the smallest particle in existence. In fact, the atom is packed with a whole array of moving subatomic particles such as photons, electrons, neutrinos, quarks, etc. (Figure 6).

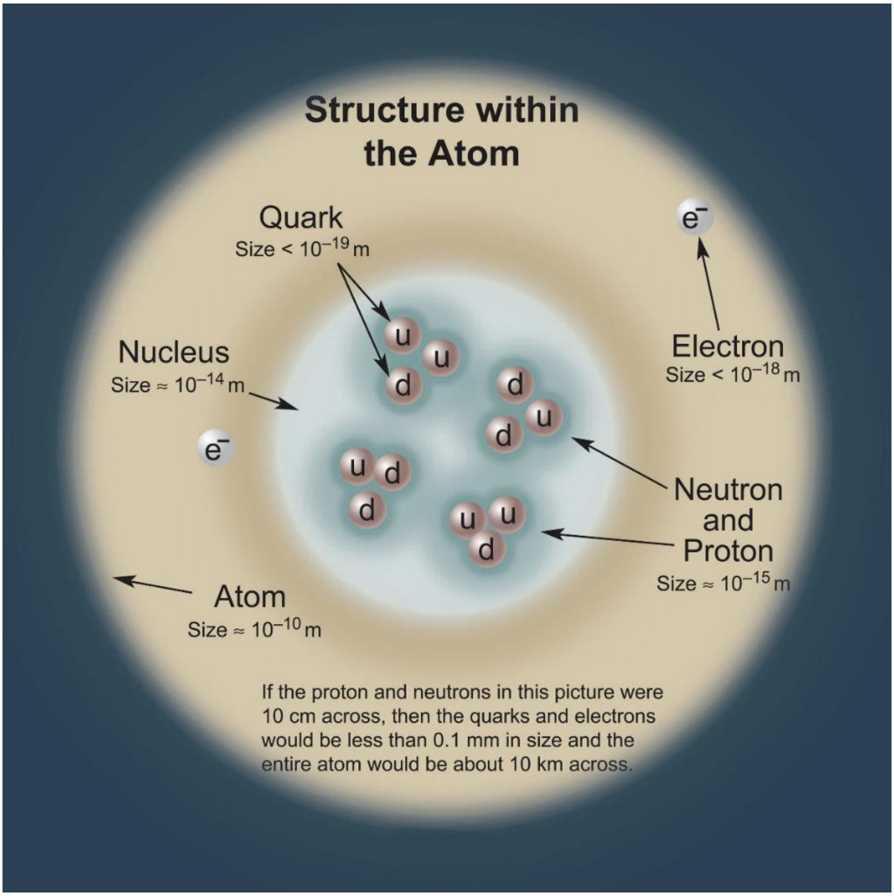

Figure 6. Image of an Atom *Credit: Contemporary Physics Education Project*

Subatomic particles, atoms, or even entire molecules, can exhibit *interference*, a classical property of waves in which two peaks reinforce each other when they overlap. Quantum effects such as interference rely on the *wave functions* of different entities being coordinated, or *coherent*, with one another. That sort of coherence is what permits the quantum property of *superposition*, in which particles are said to be in two or more states at once. If the wave functions of those states are coherent, then both states remain possible outcomes of a measurement (Ball, 2017). Again, think of the potential connections one might suggest between superposition and the ability to remember a traumatic birth as if watching the birth from above.

Being in two states at once is not an unknown phenomenon in human psychology. Who has not had the experience of debating in their minds two contrary options such as, "Shall I write this letter of complaint or not?"

One part of you says, “Give them hell!” and advocates in favor of writing the letter, the other, cautions you, “Think of the consequences.” This discussion can last a few seconds, minutes, or hours. Finally, you decide on a course of action. We often say, “I was of two minds,” to describe this kind of a situation.

You may have heard of lucid dreaming. In Eastern thought, cultivating the dreamer’s ability to be aware that he or she is dreaming is central to both the Tibetan Buddhist practice of dream yoga and the ancient Indian Hindu practice of *yoga nidra.* For those unfamiliar with the term, a lucid dream is having a dream while asleep and developing the ability to control the dream in some way. The dreamer must let the dream continue but be conscious enough to remember that it is a dream. This can be achieved with preparation and practice. For example, you dream that a stranger is chasing you and you feel scared. Rather than give in to your anxiety and habitual pattern of fleeing, you turn around–still in your sleep–and confront the person. Doing so can be very therapeutic, especially if you have been a fearful person. Many psychotherapists use lucid dreaming as an integral part of therapy (Collier, 1996).

And, of course, everyone has seen, or at least heard of, the classic film about multiple personalities–*The three faces of Eve* (Johnson, 1957). Suffering from headaches and inexplicable blackouts, timid housewife, Eve White (Joanne Woodward) begins seeing a psychiatrist, Dr. Luther (Lee J. Cobb). He’s stunned when she transforms before his eyes into the lascivious Eve Black, and diagnoses her as having multiple personalities. It’s not long before a third, calling herself Jane, also appears. The film was based on a book by psychiatrists, Corbett H. Thigpen and Hervey M. Cleckley (1957), which in turn was based on their treatment of Chris Costner Sizemore, also known as Eve White.

Cases of multiple personality are rare today but they are not unknown. They are listed in the DSM-5 of the American Psychiatric Association (2013) under Dissociative Identity Disorders. They are defined as, “Disruption of identity characterized by two or more distinct personality states.” Once again, we are confronted by an enigma and need to turn to QM for a plausible explanation.

If one quantum particle interacts with another, they connect and become linked into a composite *superposition*: In a sense, they become a single system. The two objects are then said to be *entangled* (Figure 7). Einstein, no friend of QM, referred to entanglement as “spooky action at a distance.”

Figure 7. Entangled particles *Image Credit: Katie McKissik*

Entangled particles are intimately joined from the day they are created. Regardless the distance separating them, be it the width of a lab bench or the breadth of the universe, they mirror each other. Astonishingly, whatever happens to one instantaneously affects the other and vice versa.

Jian-Wei Pan, a physicist at the University of Science and Technology of China in Shanghai, dramatically demonstrated this recently in a new study (Physicsworld.com, 2016). Pan and his team produced entangled photons on a satellite orbiting 300 miles above earth and beamed these particles to two different ground-based labs 750 miles apart, all without losing the particles' strange linkage. The previous distance for what's known as *quantum teleportation,* or sending information via entangled particles, was about 140 kilometers, or 86 miles. At this time, scientists still can't explain how the particles are separate but connected. Does that not remind you of twins communicating with each other "telepathically," or to use my term, "sympathetically," or of the other cited examples of sympathetic communication?

Let's return to biology and something familiar: the sense of smell. Up until the late 20th century, the accepted theory of olfaction was based on the shape of the molecules of the substance emitting the odor and how they docked with their specific receptors in the nose. This was commonly referred to as the "lock and key" hypothesis. Then in 2006, Luca Turin, presently Visiting Professor in Theoretical Physics at the University of Ulm, Germany, published his vibration theory in *The secret of scent: Adventures in perfume and the science of smell*, and all hell broke out within the scientific community.

Turin proposed that scent is transmitted by vibration, and that the human nose is so engineered that it is able to process these vibrations and interprets them as smells, ultimately leading to olfactory perception. Through an operation called *electron tunneling,* and receptors in the lining of the nose, this mechanism allows vibrations to unravel their coded content. Furthermore, each molecule's pattern of vibration–think of musical notes–plays the same way in every person's nose (Schillinger, 2003).

There are 390 functional olfactory receptors in humans (Olender, Lancet, & Nebert, 2008-2009) that can respond to 100,000 or more odorants, thus eliminating the concept of 1:1 receptor to odorant matching. Olfactory receptors are versatile and able to respond to chemicals never encountered before. I call that good planning by evolution or a higher power.

Systematic studies have shown that shape alone is a poor criterion for predicting odor (Sell, 2006). While some level of fit is clearly necessary, even a good fit is not sufficient (Brookes, Horsfield, & Stoneham, 2012). A possible alternative model is what Jennifer C. Brookes (2007) Department of Physics and Astronomy, University College London has termed the "swipe card" model of odorant recognition (Brookes, Hartoutsiou, Horsfield, & Stoneham, 2007). It proposes that while the shape must be good enough, other information characterizing the odorant is also important. In this case, the additional information on the "card" is the *vibration frequency of the molecule* in the odorant.

One important consequence of going beyond a model based on shape alone is that *quantum phenomena* become much more evident. Shape, of course, already implicitly invokes the *quantum nature* of chemical bonding. Inelastic electron transitions involve a *coherent quantum* *electron transfer* event. Using vibrational frequencies as a discriminant relies on the *quantum behavior* of the odorant's vibrational function. Brookes, Horsfield, & Stoneham (2012) write:

> Turin's proposal of vibration frequencies monitored by inelastic electron tunneling stands up well…vibration frequency is a crucial part that can dominate smell, and the swipe card description appears to be a more useful paradigm than lock and key. (p. 1514)

Simply put, the mechanisms underlying olfaction involve quantum processes. Although still in the experimental stage and not yet proven, it seems reasonable to assume that the same or similar processes operate in other receptors activated by small molecules such as neurotransmitters, hormones, steroids, and so on. *This provides added credence to viewing our bodies and minds as being governed by a confluence of classic and quantum laws of physics.*

Stuart Alan Kauffman, theoretical biologist, complex systems researcher, and currently emeritus professor of biochemistry at the University of Pennsylvania, along with Samuli Niiranen and Gabor Vattay, was issued a founding patent (Kauffman, Niiranen, & Vattay, 2014) on the *Poised Realm,* an apparently new "state of matter" hovering reversibly between quantum and classical realms, between quantum coherence and classicality (Vattay, Kauffman, & Niiranen, 2014).

Kauffman thinks that the system seen in the chlorophyll molecule (which he studied at length) raises the possibility that webs of quantum coherence or partial coherence can extend across a large part of a neuron and can remain poised between coherence and decoherence. Kaufman believes that this *Poised Realm in the human brain is where consciousness reigns* (Kauffman, 2010). And consciousness is surely one aspect of the mind.

How does all of this relate to our understanding of the nature of the mind?

Theories of the mind fall into four general categories:

1. The mind is separate from the brain and is not controlled by the laws of physics of any kind. This is essentially a religious or spiritual view that assumes that the mind has been in the universe all along. Individual minds are parts of a greater all-encompassing mind, which may or may not be God.

2. The mind is the product of complex neuronal activities of an individual's brain. It is an evolutionary adaptation. In scientific jargon, "the mind is an epiphenomenon of the brain," an emergent quality—in other words, a by-product of a functioning brain.

3. The mind obeys physical laws not yet fully understood acting on the neurons of the cerebral cortex. This is the view proposed by the philosopher Albert North Whitehead (1929, 1933) and elaborated on by Hameroff (Hameroff & Chopra, 2012; Hameroff, 2014, 2015). Hameroff believes that consciousness and the mind are epiphenomena of quantum computations of brain microtubules. To Hameroff, the mind is an intrinsic factor of the universe. To me, this seems to represent a marriage of theories #1 and #2 above.

4. Finally, there is the Kaufman hypothesis (2010, 2016) according to which the mind, consciousness, and free will are associated with the Poised Realm. Our brains with our sense organs connect us to the universe. The difference in theories between Hameroff and Kaufman is that the former locates consciousness in the microtubules and the latter in the Poised Realm. They both lean heavily on quantum physics for their hypotheses.

Newtonian physics applied to the activity of the brain can measure and predict things such as blood flow through capillaries and chemical diffusion across synapses perfectly. But the *terra firma* of materialism becomes far less firm, far shakier, when we attempt to understand with the tools and approaches of classical science the more profound mystery of the mind as well as of such phenomena as being an experiencing subject with dreams and ideas, faith, altruism, imagination, or appreciation of beauty.

We know that the mind can influence the state of the physical world. We know that the intentions, emotions, and desires of an experimenter may not be completely isolated from experimental outcomes, even in controlled and blinded experimental designs. Near-death experiences in cardiac arrest suggest that the brain acts as a transceiver of mental activity, i.e. *the mind can work through the brain, but is not necessarily produced by the brain.* When we sleep, we are not fully conscious but we are also not fully unconscious, as, for example, lucid dreams prove. If a person is under general anesthesia, should one of the doctors say something alarming like, "Oh, I think we just ruptured her stomach," the patient will react with all the physical signs of a panic attack. The brain may be underperforming, but the mind is fully operational. This can clearly be applied to what a baby experiences and remembers in utero, from conception through birth; if the mind is separate from the brain, then brain development, in terms of processing in utero memories, may not be nearly as important as scientific naysayers of this theory might believe. It seems imperative that we free ourselves from the constraints of the old materialist ideology, enlarge our concept of the natural world, and seriously consider the contributions of the post-materialist paradigm.

Conclusion

Over the past 400 years, the discovery of the telescope ushered in a new appreciation of the vastness of the universe as each successive generation of astrophysicists realized that the universe is bigger than the previous generation thought. With the introduction of the microscope into biology, a similar deepening of understanding of the human cell occurred. Here, relatively huge spaces were discovered within which many tiny organelles live and work. And now, we are expanding our knowledge of atoms, and finding once again more open spaces, more complexity, and more hidden surprises.

Materialism is an attractive philosophy—at least it was before QM altered our thinking about matter. Quantum mechanics has revolutionized the study of physics and biology and revealed an ever more baffling reality. Furthermore, quantum physics has shown that human thoughts, intentions, and emotions may directly affect our material world from the very beginning of our existence.

Today mathematicians and physicists generally accept the fact that the world is fundamentally governed by quantum rules. There is no need, they say, to regard the two as mutually exclusive, since they are not only consistent, but also inextricably linked.

Hamerroff's and Kaufman's ideas have generated much excitement among researchers toiling at the interfaces between physics, mathematics, biology, information theory, psychology, and philosophy, where mysteries and paradoxes abound. Equally significant are the contributions of Turin, Brookes, Sells and others on olfaction showing that it is partly a result of quantum operations.

In view of recent research on quantum biology, microtubules, and the Poised Realm, particularly by the phenomena of entanglement and non-locality, both telepathy/sympathetic communication and telekinesis are possible (Radin, 2006; Kauffman, 2010; Caswell, Dotta, & Persinger, 2014). More importantly, quantum biology goes a long way in explaining how the mind affects matter, which we know it does–think placebo effect, psychosomatic medicine, and the like (Hameroff & Chopra, 2012).

All of my professional life, be it by temperament, upbringing, training, and a host of other influences, I have embraced the deterministic, hard scientific view of the world. However, moved by the research on which this paper is based, I find myself prepared to at least consider the radical (for me) possibility, that perhaps a precursor of the mind not yet understood may be one of the fundamental elements such as mass, gravity, or electric charge that the world is made of (Frank, 2017). In other words, the mind is more than the brain, though what that *more* consists of, I don't know.

I have come to the conclusion that consciousness and free will are qualities of the mind. If the mind is not an emergent quality of the brain—and I suspect that it is not—then it must be both dependent and independent of it. This is similar to protons or electrons that, depending on circumstance, can be particles or waves and everything in between. If the mind is both dependent and independent of the brain, the understanding and application of pre- and perinatal psychology concepts and theories could gain additional traction in the larger scientific community. The way medical professionals are trained, parents are educated, and babies are understood around the world might all be more deeply impacted by not only examining brain development, but the experience of the mind.

Post-materialism science is pointing the way towards expanding our psychic space. While incomplete, the *mind-is-more-than-the-brain* view is supported by experimental evidence from the very cutting edges of academic scholarship. Possibly, future advancements in quantum biology will provide us with further insights into this developing new model of consciousness, mind, and free will.

Endnotes

1. Rice experiments retrieved from https://www.google.ca/search?hl=en&tbm=isch&source=hp&biw=1154&bih=728&ei=VLToWp-8IIT4jwSEp4-AAQ&q=emoto+water+rice&oq=emoto+water+rice&gs_l=img.3...1488.8373.0.9055.16.7.0.9.9.0.87.550.7.7.0....0...1ac.1.64.img..0.12.585...0.0.uKqsNGe9mMU
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   https://yayyayskitchen.com/2017/02/02/30-days-of-love-hate-and-indifference-rice-and-water-experiment-1/

2. Readers who wish to pursue ideas about *spirituality and afterlife* may find Dr. Schwartz's publications rewarding. Gary E. Schwartz, PhD is a professor of psychology, medicine, neurology, psychiatry, and surgery at the University of Arizona and director of the Laboratory for Advances in Consciousness and Health. He has published more than 450 scientific papers, including 3 books:

- *The energy healing experiments: Science reveals our natural power to heal* (2007). New York: Atria Books.
- *The afterlife experiments: Breakthrough scientific evidence of life after death* (2003). New York: Atria Books.

- *The sacred promise* (2011). New York, Atria Books. *Highly recommended.*

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