UNIVERSITY OF NORTH CAROLINA at ASHEVILLE

DO YOUR THOUGHTS MATTER? BECAUSE THEY ARE MADE OF MATTER? AN EXPLOATION ON THE MIND BODY PROBLEM THROUGH THE LENSES OF PHILOSOPHY, NEUROPSYCHOLOGY, AND QUANTUM PHYSICS

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Do Your Thoughts Have Matter? Because They Are in States of Matter?
Exploration on the Mind-Body Problem through the Lenses of Philosophy,
Neuropsychology, and Quantum Physics

by

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Abstract

In the late 21st century, the concept of Quantum Consciousness arose, joining theories and concepts from the disciplines of Philosophy, Neuropsychology, and Quantum Physics. The Preface of *Mind, Matter, and Quantum Mechanics* (Henry P. Stapp. 1993) states, "Nature appears to be composed of two completely different kinds of things; rock-like things and idea-like things. The first is epitomized by an enduring rock, the second by a fleeting thought. A rock can be experienced by many of us together, while a thought seems to be long to one of us alone" (Stapp, 1993 p. vii). Stapp refers to the mind-body problem, not as a problem, but as a connection; the mind-body connection. Descartes believed the mind and body could be separate and act separately. Stapp embellishes Descartes philosophy of "I think, therefore I am" through Quantum Physics by connecting the mind to the body; calling it the mind-body connection. Stapp states that nature is composed of two different things, rock-like things and idea-like things. I believe that rock-like things and idea-like things do not differ, but are one and the same.

This paper explores the philosophies of Descartes, the contents of a thought and the ways in which neuropsychology and Quantum Physics help illuminate the question: do thoughts contain matter?

I. Introduction

Seventeenth-century French philosopher René Descartes unknowingly started a discussion about the separation of body and mind that continues today. Descartes stated that the mind and the body can exist separately from one another. This discussion is now known as the “mind-body” problem. Throughout the centuries, physicists, psychologists, and philosophers have exchanged ideas and findings concerning the topic, each possessing a unique view concerning the problem.

The purpose of the encompassing research that is centered on the mind-body problem is an attempt to answer another question: do our human thoughts contain matter? Through research, a thought is defined as a particle of matter stored in a neuron (or many neurons) which will be transmitted between other neurons. The concept of a human brain functioning as a natural system of nature that consumes free energy and distributes it throughout the brain and body derives from the second law of thermodynamics and the processes of entropy.

The question also causes one to examine the ways in which Neuropsychology and Quantum Theory contribute to the discussion concerning the mind-body problem. Neuropsychology combines the study of human brain function with the studies of behavior, emotion, and cognition to better decipher the mind-body problem, as opposed to Descartes’ separation of functions. Quantum Theory offers a different perspective on brain function through the lens of Physics and connects many laws of nature and science to the discussion. Joining the disciplines of philosophy, neuropsychology, and Quantum Theory is essential to both discerning the mind-body problem and the aspect of human thoughts containing matter.

a. Thesis Statement

Do our human thoughts contain matter? As odd as it seems, there are many great philosophers, physicists, neuroscientists/neuropsychologists, and Quantum theorists that believe the answer to this question is, yes, it is very possible. Finding viable proof to answer the question brings about great difficulty due to the fact it is a question within a question. The concept of thoughts containing matter connects to the greater concern of the mind-body problem. To properly assess this "question within a question" requires comprehensive study concerning: the mind-body problem (metaphysics), scientific history, philosophy, neuroscience (neuropsychology), and Quantum Theory. On a larger scale, studying the human brain is similar to studying the universe, such that both are uniquely mysterious and complex in their own respects. These combining disciplines contribute to a field of study that arose in the 20th century, Quantum Consciousness. Within the field of Quantum Consciousness the human brain is explored by using the same tools and concepts physicists use to explore the universe.

b. An Introduction to the Philosophies of Descartes

Descartes is well known for his Philosophy on the mind-body problem which later gave new meaning to the deep concepts of metaphysics. The question of the mind-body problem that arose for Descartes was answered by his viewpoints of the human soul and God. Descartes believed that the mind and body could exist separately from one another, but must remain intact to create and sustain human life. Without the mind, the body cannot function and without the body, the mind is just free energy. These concepts soon became popular among psychologists and scientists, which caused Philosophy, Science, and Psychology to further integrate meaning that the mind-body problem was no longer just a philosophical phenomenon (Furst, 1979, p. vii).

c. *The Birth of Classical Physics*

Seven years before Descartes' death, Isaac Newton was born an age of questioning called the Enlightenment. Newton spent his childhood as a lousy farm hand and preferred to be alone. In college he avoided others and spent most of his time reading books on Philosophy and Mathematics. Above all, he searched out truth which fueled the force behind his discoveries. Newton is famous for setting the concepts of geometry in motion by inventing calculus. Newton, then by the integration of Mathematics and Philosophy, gave birth to his Three Laws of Motion and Laws of Gravity. The findings and inventions of Newton gave a crucial pathway to the discoveries of Einstein (Ferris, 2003, 103-122).

> In much the same way that Newton's account of gravitation and inertia advanced Physics to some point that could embrace a moving Earth in a heliocentric solar system, Einstein's relativity enabled Physics to deal with the much higher velocities, greater distances, and more furious energies encountered in the sider universe of galaxies. If Newton's domain was that of the stars and planets, Einstein's extended from the centers of stars to the geometry of the cosmos as a whole (Ferris, 2003, p. 177-178).

Einstein became famous for the concepts of his general and special relativity. Special Theory of relativity shows that the flow of space-time varies due to measured lengths of distances and velocities. General Theory of relativity depicts space-time as curved. The concept of curved space-time derives from the Newtonian views on the force of gravity which depict spatial curvature in Physics. Though Einstein's special and general theories of relativity were not accepted during his life time, these concepts eventually opened a door to reshaping Physics which lead to Quantum Theory (Ferris 2003, p.177-204).

d. The Birth of Quantum Theory : an Introduction

The birth of Quantum Theory occurred at the turn of the twentieth century. Of course the birth of Quantum Theory has many fathers, but the more important focus is the growing components that Quantum Theory offers to not only Physics, but to Philosophy and neuropsychology as well.

> Max Planck realized that he could account for what was called the black-body curve- the spectrum of energy generated by perfectly radiating object – only if he abandoned the classical assumption that energy is emitted continuously and replaced with the unprecedented hypothesis that energy comes in discrete unites (Ferris, 2003, p. 286).

Quantum Theory was widely disregarded by other leading scientists during the 1900's, but then was accepted near the end of the century. With the workings of Quantum Theory, cosmologists now have a way to break apart particles and space beyond a microscopic level (Ferris, 2003, p. 286-310). By the twenty first century, Quantum Theory no longer belonged solely in the realm of Physics; Quantum Theory also contributed to Philosophy and Neuropsychology.

Roger Penrose, a philosopher of science and mathematician is well known for his contributions to the modern understanding of our universe. Alongside his research concerning the cosmos, Penrose also contributed a great deal of research on the mind-body problem. Penrose's research combined brain function and modern Quantum Physics and stated that classical Physics is not advanced enough to accurately describe brain function.

These assumptions derive from the belief that the nervous-system controls the body rather than the body controlling the nervous-system.

In his book *The Emperor's New Mind* (Penrose, 1989) Penrose propose the question, "Can a computer have a mind?" This question, similar to the question, "Do thoughts contain matter?" also deals with some select issues in philosophy. First one must assume that the mind does exist. Once the existence of the mind is established, another question arises: "Is the mind subject to the laws of Physics". Penrose ask these questions in his book and attempts to persuade the reader that to understand the function of the human brain, one must first examine: Quantum Theory, Einstein's special and general theory of relativity, black holes, the big bang, and the second law of thermodynamics, along with Newtonian mechanics. Penrose's argument concludes that the computer cannot have a mind as adequate as a human mind. The assertions connect to the conscious mind being non-algorithmic. Even though Penrose attest that computers cannot have the inner workings of a human mind, this does not mean that human thoughts do not contain matter: it asserts the difficulties to create the unique interlaces of the human brain (Penrose 1989).

Penrose's work brought about much controversy among many well respected physicists and scientists: Stephen Hawking, Henry Stapp, Abner Shimony, and Nancy Cartwright. Collectively, these highly knowledgeable experts believe that Penrose left some questions unanswered; all of which are vital to the mind-body problem. For example: How are structural features of our conscious thoughts related to structural features of brain function? Can conscious thought reroute brain activity? Stapp picks up where Penrose left off concerning these questions.

Throughout the history of science, great men and women sought out the answers to the many questions concerning humanity and our universe. Each philosophical and scientific discovery gave the word "energy" a new definition. Descartes defines energy as the human soul whereas scientists have a much more narrow definition of energy, however, it can be agreed upon that energy is a life force. The law of conservation (energy) states that energy can be neither created nor destroyed, but can transform from one form to another. Energy and mass are equivalent, but differ in states within a cycle of transformation. Understanding the evolution of scientific, philosophical, and psychological history that brought about Quantum Theory is vital to in determining whether thoughts have matter. History contributes to the integration of philosophy, neuroscience, and Quantum Theory.

Emil Ficher, German chemist, believed that science was more than interdisciplinary, but international, in a way that contributes to the only universal language known to humankind, math. This paper will not be explaining the depths of equations that contribute to the concepts relayed in this paper, but it is important to note that math in an important factor that helped scientific ideas become tangible theories and laws (Fischer, 1922, p.19). Einstein stated,

> Everything that men do or think concerns the satisfaction of the needs they feel or the escape from pain. This must be kept in mind when we seek to understand spiritual or intellectual movements and the way in which they develop. For feeling and longing are the motive forces of all human striving and productivity – however nobly these latter may display themselves to us (Einstein, 1930, p. 231).

The mind-body problem is a humanistic issue because it appeals to the spiritual and intellectual concerns of humankind.

The structure of this paper will first separate philosophy, neuropsychology, and Quantum Theory. However, before moving on from Quantum Theory to the collaboration section, there will be a section dedicated to roughly explaining theoretical concepts used in Quantum Physics that further explain the possibilities of our human thoughts containing matter. This is to aid the reader in understanding how these concepts later connect when explaining Quantum Theory and the collaboration with neuropsychology and philosophy. This paper will focus on the integration of philosophy, neuropsychology, and Quantum Theory; but Quantum Theory will have a heavier focus due to the complexities of matter and energy.

II. **Philosophy**

Descartes made claims about the human soul that later that caused scientists to become involved with the discussion that the soul and body are separate and one could exist without the other. This phenomenon is known as the mind-body problem.

a. *Meditations on First Philosophy,* (Haldane & Ross, 1968, 144-199)

Overall, Descartes' *Meditations on First Philosophy* (Haldane & Ross, 1968, p. 144-199) depicts the image of a person meditating on all essential questions of life. This individual first strives to abstain from learned opinions and strives to form his own way of thinking, but in the end the individual fails, though continues to question reality. Concerning the mind-body problem, Descartes wrote,

> What of thinking? I find here that thought is an attribute that belongs to me; it alone cannot be separated from me. I am, I exist, that is certain. But how often? Just when I think; for it might possibly be the case if I ceased entirely to think, that I should

> likewise cease altogether to exist. I do not now admit anything which is not necessarily true; to speak accurately I am no more than a thing which thinks, that is to say a mind or a soul, or an understanding, or a reason, which are terms whose significance was formerly unknown to me. I am, however, a real thing and really exist; but what thing? I have answered: a thing which thinks (Haldane, 1968, p. 151-52).

Descartes' main argument is, "I think, therefore I am". That humans are the substance of which they think. In the realm of science, the question becomes: how do humans actually become the substance of thought? All of which relates to my question: do our human thoughts contain matter?

Essays on Descartes' Meditations, edited by Amélie Oksenberg Rorty (1986), is a compilation concerning Descartes' *Meditations on First Philosophy* (Haldane & Ross, 1968, p. 144-199) with over twenty essayists. Essayist Daniel Garber describes Descartes as a physicist and a mechanist rather than a philosopher. Garber's essay, "*Semel in vita*[1]*:* The Scientific background to Descartes' Meditations, states that Descartes' ideas are more than philosophical forethought, but are a prelude to Cartesian science which solely relates to the links between body, soul, mind, and matter (Garber & Rorty, (1986) p. 83). Cartesian science links together philosophical ideas to Physics: "…in his Physics, all of the sensible properties that bodies seem to have, all color, sound, heaviness, and lightness are to be eliminated from the physical world, leaving only geometry and the laws of motion behind…" (Garber & Rorty, 1986, p. 84). Descartes separates the mind from the body and Garber offers an explanation for such separation through the lens of Cartesian science.

[1] Once in a life time.

Essayist John P. Carriero wrote, “The Second Meditation and the Essence of the Mind” (Rorty, 1986, p. 199-221) which examines the essential understandings of Descartes’ second meditation and stresses the importance of proving ones existence. He states, “In the Second Meditation Descartes tries to do exactly what Aquinas, a thirteenth century Italian philosopher, theologian, and priest, thought could not be done: he tries not to only prove his existence but also to understand the *nature* of the human mind without assuming that the body exist” (Carriero & Rorty, 1986, p. 199-200). Furthermore, Carriero states that Descartes reshapes an infinite foundation for the sciences concerning studies on the human mind and that his ideas are indeed revolutionary due to the nature and process of his Meditations, specifically the Second Mediation (Carriero & Rorty, 1986, p. 219).

b. *The Passions’ of the Soul* (Haldane & Ross, 1969, p. 329-427).

Descartes’ *The Passions’ of the Soul* is broken up into three parts in which all the parts list various articles that frame around ideas. He states in Article II,

> – *That in order to understand the passions of the souls its functions must be distinguished from those of body.* Next I note also that we do not observe the existence of any subject which more immediately acts upon our soul than the body to which is joined… to examine the difference which exist between soul and body in order to know to which of the two we must attribute each one of the functions which are within us” (Haldane & Ross, 1969, p. 332).

Descartes separates the passions of body and soul because of his beliefs that the body and soul can exist without each other. Each article within each section elaborates on a single idea. All ideas always link back to Descartes’ initial key concepts concerning the “mind-body problem”.

Amélie Oksenberg Rorty wrote an essay concerning Cartesian sciences and Descartes' *Passions' of the Soul,* "Cartesian Passions and the Union of the Mind and Body" (Rorty, 1986, p. 513-534). The essential questions Rorty brings to light in her essay are,

> If it is *thinking* that is essential to the mind, and if the passions are not necessary to the mind's identity as a thinking thing, how ca the good or ill of this life depend on the passions? … How is it related to the ego whose existence is demonstrated by the *cogito*[2]? (Rorty, 1986, p. 513).

Rorty answers these questions by explaining the importance of Descartes' description of passion and how they function inside a human being. Distinguishing the separate functions of both soul and body is also key in understanding Descartes' thoughts on passion. Rorty concludes that the separation of body and soul contributes beyond philosophical and theological forethought, but also to Cartesian theoretical Physics: "Developing this view would move Descartes to construe the relation of mind to body as that of formal model to its instantiation… it has become the mathematical formalism of Cartesian theoretical Physics" (Rorty, 1986, p. 530). Important links between Philosophy and Mathematical Physics are subject to the connection between Descartes' philosophies and Cartesian science because the combinations of both provide a unified and deductive means for mathematical Physics (Rorty, 1986, p. 530).

Each essay carefully examines the possible reasons behind Descartes' thoughts in separating the mind from the body and from the soul. His ideas continued a conversation that sailed beyond the realm of philosophy. Physics, math, psychology, and other disciplines now share and contribute to the conversation concerning the mind-body problem.

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[2] Latin for, "I think".

III. Neuroscience

In relation to the philosophies of Descartes, those disciplined in neuropsychology joined the debate over the "mind-body" problem, by further observing human behavior, emotion, and cognition in relation to brain function. Instead of separating the body from the mind as Descartes does, neuropsychology connects each function to all other functions. For example, thoughts are transmitted from one neuron to another, which is the basic form of brain function; all of which results in a reaction that is displayed and observed through one's behavior, emotions, and general cognition. Observing human behavior is vital to better understanding the conscious which is the result of neurological activity in the brain.

a. The History of Neuropsychology

This section will provide a brief, but comprehensible history of neuropsychology. Stephen Hallett, a professor at Bristol University in the United Kingdom, contributed to a seminar series, "Seminars in Basic Neuroscience" (1993). Found in chapter five of the seminar collaboration is Hallett's contribution, "Neuropsychology" (Hallett, 1993, p. 151-185). He begins by defining neuropsychology and, thereafter, describing the differences between experimental, cognitive, and clinical neuropsychology. After giving a thorough definition of neuropsychology, Hallett states that the subject's origin dates back to the mid-19th century. Main contributors to the newly formed science are: Broca, Wernicke, and Dax who examined the relations between tissue damage and specific language loss (Hallett, 1993, p. 152). The specific study of behavior and brain damage is but one aspect of neuropsychology, though all areas of study within the field all relate to the mind-body problem.

b. Philosophy and the Brain (Young, 1987)

J.Z. Young states in the preface of his book *Philosophy and the Brain* that new biological knowledge could possibly give deep insights into old philosophical problems by examining brain function (Young, 1987, p. v). Further, he illustrates the importance in the integration of biology and psychology which later becomes an aspect of neuropsychology, in which both disciplines contribute to the understanding of brain function in connection to the "mind-body" problem: that both psychology and biology can help uncover problems concerning the mind and body.

Body and Brain: a Trophic Theory of Neural Connections, written by Dale Purves in 1988 contributes to the "mind-body" problem by describing the Trophic Theory in relation to the nervous system and brain function. The Trophic Theory pertains to the process of neural connectivity as purely biological functions; not functions of consciousness or free will. He states, "The theory holds that patterns of nerve cell connections – which is to say, the number and disposition of axonal and dendritic arbors and the connections they make – are subject to ongoing regulation by interactions with the cell that they contract" (Purves, 1988, 4). An axon is the long threadlike part of a nerve cell has impulses that conduct from the cell body form other cells, which connect other neurons. In connection to the axon, the dendrite is a short branched extension of the nerve cell and like the axon, has impulses that are received from other cells at the synapses and are then transmitted to the cell body. The connections between biological and neurological functions throughout the brain are considered to be in relation to one another, which opposes some of Descartes' philosophy.

Under the large umbrella that encompasses neuropsychology exists philosophy, psychology, and biology. Similarly, Descartes' philosophies concerning the "mind-body" problem also involve a wide range of disciplines, all of which are also under the umbrella of neuropsychology. Descartes separates the mind from the body and examines the aspects of each separately which include the study of though, human behavior, biological matter of a human, and human emotions. Neuropsychology examines each aspect, but connects all human functions instead of separating them: this further joins the sciences with philosophy.

c. *What is a Thought?*

If we are the things of which we think, then the next question is what is a thought? Within a philosophical context a thought could be anything. However, there is an observable science that helps with defining what a thought is and how thoughts come to be. This section will describe the science and biological make-up of a thought.

The human brain is the made up of over one hundred billion neurons. These neurons are connected by trillions of synapses and each connection transmits roughly one signal per second. However, if the connections are localized or specialized, transmissions can occur nearly one thousand times per second. Truly, the activity of the brain is powerful. Charles Jennings, director of Neurotechnology at MIT McGovern Institute for Brain research, relates that these reactions in the brain are how thoughts are produced. However, when examining the actual physical complexity of what goes on in the brain, tracing a thought from beginning to end is difficult. Finding the origin of a thought would be like finding the origin of the universe.

Then how do thoughts come into being? Thoughts are triggered by external stimuli such as; the effects of something brushing the skin, seeing a bright light, hearing a preferred song, etc…All things that trigger the senses also triggers an eruption of signals within the brain. For example: gazing into a bright object, like the sun; photons connected with the patterns of beams of light hit the retina, which triggers the energy of the photons and sends an electrical signal in the light-detecting cells. The electrical signal transmits through axons, long wave-like threads that connect neurons. Once the signal comes to the end of an axon, the axon then emits chemical neurotransmitters into the synapse, allowing for transmission between another neuron. After transmission the other neuron responds with its own electrical signal and deciphers to other neurons. Nearly a few hundred milliseconds pass and the transmission has spread to billions of neurons in several dozen interconnected areas of the brain, thus, experiencing the perception of light. Transmission between neurons which create electro-chemical reactions are what thoughts are made of (Jennings 2011,http//:www. engineering.mit.edu).

IV. **Quantum Theory**

Quantum Theory uses classical Newtonian Physics as a foundation for understanding, but the further one goes into the Theory, the further one strays away from Newtonian Physics. In short, Quantum Theory is a tool for an attempt on understanding the origin of our universe. Though, as of the late 20th century, Quantum Theory became involved with the "mind-body" problem. Overall, Quantum Theory is a statistical Theory regarding the probability of locating particles. Henry Stapp gives an example that better explains the connection of Quantum Theory to consciousness for those who are not Quantum theorist:

> If a particle is in a box, and we don't know where, but we do know that every possible location is equally likely, then we can imagine dividing the box into a huge number of little cubes of equal size, and assigning an equal probability to each one…

> To represent this further information we could imagine defining little six-dimensional regions in position-and-velocity space and assigning a probability to each one. This collection of probabilities would define a "probability distribution" for the particle: it would specify, for each of these little regions in position-and-velocity space, a probability for the "particle and its velocity" to be in that little region. This probability distribution would, in general, change with passage of time (Stapp, 1993, p.14).

Stapp further illustrates that this example of Quantum Physics is called the Copenhagen interpretation; a foundation in understanding Quantum Physics and the connection to consciousness. The Copenhagen interpretation will be explained more in depth later in the paper, but in short, the interpretation is an understanding of Quantum mechanics. Quantum mechanics postulates that the state of every particle can be described by a wave-function, which is a mathematical representation used to calculate the possibility that the particle to be in a location or in a state of motion.

Roger Penrose explored the concept of connecting Quantum Physics with various types of psychology. He argued that the brain is not algorithmic and therefore no computer could function like a human brain.

a. *The Emperor's New Mind: Concerning Computers, Minds, and The Laws of Physics* (Penrose, 1989)

During the publishing of his book, *The Emperor's New Mind*, Roger Penrose served as the Rouse Ball Professor of Mathematics at the University of Oxford, England. In his book Penrose poses the question, "Can a computer behave the same as a human brain?" in which he argues that it is not possible. The singular reason for the impossible computer human brain is that human thoughts are non-algorithmic. To better convey the way of which our thoughts are non-algorithmic, one must first define the term algorithm: a process that is defined by a set of rules such as calculation or other problem-solving operations, like a computer. The brain it too complex to be simulated like a computer. All computers, even the most advanced computers, function by computed algorithms. Free thought, emotion, and behavior may have a cause and effect process, but the human mind could never purely be algorithmic. Penrose connects the Philosophy behind the “mind-body” problem to the disciplines of Quantum Theory , Physics, the second law of thermodynamics, and Einstein’s theories of relativity, all of which he uses to support his argument.

b. The Controversy – The Large, the Small, and the Human Mind (Penrose, 1997)

In his second book, *Shadow of the Mind* (Penrose, 1994), Penrose states his thesis about the mind-body problem: that there is an objective reduction of the wave-function (concerning the Schrödinger Equation), which contributes to brain function and, thus, explains consciousness (Penrose, 1994). Penrose’s book, *The Large, the Small, and the Human Mind* is a conversation between well-known philosophers of science and physicists about his thesis in *Shadow of the Mind*. He defends his bold claims about using Quantum Theory to investigate the mind-body problem against the arguments of Stephen Hawking (physicist and cosmologist), Abner Shimony (philosopher of science), and Nancy Cartwright (philosopher of science). Abner Shimony states,

> What I admire most in Roger Penrose’s work is the spirit of his investigation. . . I agree with him on three basic theses. First, mentality can be treated scientifically. Second, the ideas of Quantum mechanics are relevant to the mind-body problem. Third, the Quantum mechanical problem of the actualization of potentialities is a

> genuine physical problem that cannot be solved without modifying the Quantum formalism (Penrose, 1997, p. 144).

However, Shimony is skeptical about Penrose's explanations of the theses. He provides criticism in hopes that Penrose would be charged to improve his statements concerning the mind-body problem and Quantum Mechanics.

Nancy Cartwright, unlike Shimony, disagrees with Penrose entirely. She believes that Physics alone cannot solely provide answers about the mind-body problem and that biology would be a better route. The premise of her argument is, "Why Physics" and it is unnecessary to use Quantum Theory concerning the conscious. Cartwright states, "If one finds it promising, it must be due to the boldness and imaginativeness of the ideas, to the conviction that some now interaction of this kind is necessary anyway to sort out Quantum Mechanics. . ." (Penrose, 1997, p. 162). Cartwright's statement exemplifies the controversy concerning Penrose's statements about the brain and Quantum Mechanics. Though, the mind-body problem is naturally connected to Physics as well as philosophy, some such as Cartwright believes that Physics is only a tool for studying the universe.

Stephen Hawking and Penrose collaborated on a large-scale structure modeling space and time which included singularities and black holes[3]. Hawking states that Penrose and he agree on the concepts of general relativity[4], but have different understandings concerning Quantum gravity. Hawking agrees that,

> . . . The laws of biology can be reduced to those of chemistry. We have already seen this happening with the discovery of the structure of DNA. And I further believe that

[3] A region of space having a gravitational field so intense that no matter or radiation can escape (Penrose, 1997 p. 167).

[4] The geometric Theory of gravitation published by Albert Einstein which is also the current description of gravitation in modern Physics (Penrose, 1997 p. 167).

the laws of chemistry can be reduced to those of Physics", but he does not agree with Penrose's three theses (Penrose, 1997, p.167).

Penrose responded to each criticism, but without much grace. Hawking especially angered Penrose in stating that his views of both the Schrödinger equation and Gödel's Theorem were misused and not meant for the studies of brain function (Penrose, 1997, 183). The Schrödinger equation is a differential equation that forms the basis of the Quantum mechanical discretion of matter in terms of the wavelike properties of particles in a field. Its solution is related to the probability density of a particle in space and time. Gödel's Theorems are two specific theorems of mathematical logic that establish inherent limitation of all but the most trivial axiomatic systems capable of doing arithmetic.

For centuries any conversation concerning the mind-body problem is not without great controversy. The controversy in dealing with the mind-body problem in the realm of Quantum Theory is due to the fact that it makes well respected physicists and scientists uncomfortable when discussing the possibilities that the same tools used to explore space and the behavior of sup-atomic particles can also aid in a deeper exploration of the brain.

c. *Henry P. Stapp Compares His Ideas to Penrose's Ideas*

Regarding Penrose's *The Emperor's New Mind* (Penrose, 1989), Henry Stapp took interest in the way Penrose describes Quantum Theory in relation to brain processes. Stapp states that Penrose offers two explanations as to how the Quantum system can evolve. The first explanation deals with the basic Quantum law of motion illustrated by the Schrödinger equation. The second is explained by Penrose's terminology in explaining Quantum jump states; being that the smooth process is called "unitary" (**U**), and the abrupt process is called the "reduction" (**R**). "Each Quantum jump affects a "choice" or a "decision" that picks out and actualizes one of many "linearly superposed possibilities" previously generated by the unitary process U" (Stapp, 1993, p. 28). The combination of both explanations leads to Penrose's conclusion; that conscious thinking is connected to resolving alternative probabilities that were formally in linear superposition. If Penrose's conclusion is correct, then there are many unanswered questions: How are structural features of our conscious thoughts related to structural features of brain function? Can conscious thought reroute brain activity? (Stapp, 1993, p. 29). Stapp offers answers to these questions, whereas Penrose does not.

Henry Stapp addresses Penrose's theories in his book, *Mind, Matter, and Quantum Mechanics* (Henry P. Stapp, 1933). Stapp and Penrose agree that the Quantum character of reality and the occurrences of consciousness share a "global" character concerning conscious thoughts and Quantum states. The term "global" refers back to the Einstein-Podolsky-Rosen paradox which reveals that when given two particles that are far apart in distance is "global" because what affects one particle will affect the other.

> … It became clear only after John Bell had prepared the way with his famous "Bell's theorem". The basic message of Penrose's book, as of mine, is that the enormous changes that have been wrought by Quantum Theory in our ideas about the fundamental nature of matter have altered radically the problem of the connection of mind to mater (Stapp, 1993, 30).

Clarity on the "global" concept concerning particles was an evolution of ideas that connects matter to the mind.

After analyzing Penrose's two arguments concerning as to whether a computer can behave as if it thinks, the first point of the argument assumes the existence of black holes in which space disappears inside them then the space surrounding the black hole compensates for the void. Stapp states, “This is an awkward assumption that I find artificial and uncompelling” (Stapp, 1993, p. 31). Penrose’s second point of his argument links his theories about human consciousness to Platonic thinking; that human consciousness connects to the Platonic realm of abstract mathematical truth. The abstract mathematical truth that Penrose refers to is that human thoughts are non-algorithmic, but in the process of finding this truth Penrose shallowly asserts that thoughts could have some sort of algorithm. Penrose may have intended to use the comparison of algorithmic and non-algorithmic thoughts to stress his belief that human thoughts are without algorithms; however, as Stapp stated, Penrose leaves many questions unanswered because he offers vague assumptions. There is much truth to be found in Penrose’s theories and perhaps some questions are without answers as of yet, but there needs to be at least an attempt to answer them.

Mentioned earlier, Stapp offers answers to the questions how are structural features of our conscious thoughts related to structural features of brain function? Can conscious thought reroute brain activity? He uses the foundational ideas of Penrose concerning the Schrödinger equation and combines the Heisenberg model of reality, Einstein-Podolsky-Rosen paradox, Bell’s theorem, and the Copenhagen interpretation. Connecting the combination of these Quantum theoretical concepts with Neuropsychology and Philosophy thus, connects the concepts of thoughts containing matter.

V. **Connecting Concepts**

This section is dedicated to explaining the models, equations, etc… in a way that is friendly to all readers, especially for those without a base knowledge of Physics or Quantum Theory.

a. The Schrödinger Equation

The sole purpose of the Schrödinger equation is to reveal the most basic Quantum state of an atom. Erwin Schrödinger was an Australian physicist who in 1929 published an equation that can be used to predict the energies of any given system along with calculating the probability of a single particle within a specified region of space. Physicists the state of a particle as the wave-function. A wave-function repersents a Quantum mechanical wave equation that can be used to predict the outcome of measurements on a physical system. Further explaining the use of Schrödinger's equation cannot go without the comparison with Newtonian Physics; it is an essential part of the evolution of Quantum mechanics. Similar to Newton's laws, Schrödinger's equation uses the parameters of a given situation in which a particle moves under the influence of an external force. Newton's laws provide the exact route of a particle whereas; Schrödinger's equation does not, but rather reveals the wave function of a Quantum system[5]. Quantum mechanics does not assume exactness of a particle's position and momentum within any given system, which is the primary distinction between classical Physics and Quantum Physics. The wave-function of a particle in a Quantum system reveals a particle's essential wave nature; all of which provide the probability of finding the same particle in different regions of space (Oxford University, Course Notes, 1-2). The wave –nature of a particle explains the duality that particles exhibit both wave and particle properties. The duality addresses the inability of classical concepts like "particle" and "wave" to fully describe the behavior of Quantum-scale objects (Stapp, 1993, p. 39).

[5] A physical system is the portion of the physical universe chosen for analysis. Everything outside of the system is known as the environment, which in analysis is ignored except for its effects on the system (Stapp).

b. The Heisenberg Model of Physical Reality

Heisenberg's model of physical reality is also referred to as Heisenberg's picture of the world. The focal concept in this model is that atoms are not things; rather, atoms represent a set of "objective tendencies" of certain kinds of "actual events" which equals a "variable". Nature displays two processes rather than just one. It is better to use the words and interpretations of Henry Stapp to explain these two processes in nature, because the concept is far from the view of nature in classical Physics.

> One of these processes is a continuous, orderly, deterministic evolution. This process is controlled by fixed mathematical laws that are direct generalizations of the laws of classical Physics. However, this process does not control the actual things themselves. It controls only the properties, or objective tendencies, for the occurrence of the actual things. The other dynamical process consists of a sequence of unruly "Quantum jumps". These jumps are not individually controlled by any know law of Physics. Yet collectively they conform to strict statistical rules. These Quantum jumps are considered to be the "actual" this in nature. They are Heisenberg's actual events (Stapp, 1993, p. 39).

Nature concerning humanity is then surrounded and trapped by the physical world due to variables. Accessing the physical world through these variables are the essence of applying Quantum Theory (Stapp, 1993, p. 39-40). Heisenberg's model of physical reality directly links to his concept, the Three Levels of Reality.

c. Einstein-Podolsky-Rosen Paradox

The Einstein-Podolsky-Rosen Paradox (EPR) is a paper published by the three physicists in 1935. The paradox contributes to a debate concerning the interpretation of

Quantum Theory. EPR conveys the idea of two Quantum particles that react in a way that spins have a definite relationship; this is referred to as “entanglement”. Further, the concept of entanglement illustrates that the spin of one particle affects the other.

“Within the mathematical structure of Quantum Theory the position and the velocity of an electron cannot both be well defined simultaneously: if one of these quantities has a definite value the other cannot” (Stapp, 1993, p. 235). The EPR paper states that through Quantum Theory an experimental situation could allow one to predict the certainty of either the position of the velocity of an electron, but not at the same time (Stapp, 1993, p. 235).

d. *The Copenhagen interpretation*

As mentioned earlier, the Copenhagen interpretation is the foundation of Quantum Theory which governs how the Theory is to be used and understood. Stapp uses the words of Bohr to clearly explain the Copenhagen interpretation, “… note that the focus is not ‘our experience’, rather than on nature herself: that the task of science is to understand the structure of our experience, in relation to the structure of some unexperienced “external reality” (Stapp, 1993, p. 234). Quantum Theory replaces classical Physics, but still allows for classical Physics to apply in a restricted domain. The purpose of Quantum Theory is to predict the statistical character of an event. Similar to the Theory of an atom, Quantum Theory is considered to be a highly established Theory in the history of science; it provides tools to the scientific explorer to predict the outcome of a vast number of experiments which give insight to the behavior of atomic objects. However, the Copenhagen interpretation not only explores the statistical character of events, it also challenges the imagination.

The founding fathers of the Copenhagen interpretation are Niels Bohr and Werner Heisenberg which the Copenhagen interpretation connects to other important findings of other physicists concerning the surrounding atomic world. The term “complementarity” is key in understanding Quantum Theory concerning the Copenhagen interpretation. Complementarity is a vital element in the philosophy of Bohr; it contributes to the idea of a system being probed in different complementary ways. “…that the properties that emerge under the action of different probing, while all equally essential to a full characterization of attainable knowledge pertaining to the system, may not be representable as properties simultaneously possessed by the system” (Stapp, 1993, p. 234). The action of probing a system could make the property concrete.

e. Bell’s Theorem

Bell's Theorem collectively depicts the results of impossibility concerning the concept of Local Realistic interpretations of Quantum mechanics; the theorem varies in conveying the meaning of “Local Realism”. Bell published a paper in 1964 stating that the concept of Local Realism consisted in postulating in addition to the Quantum state a “complete state”, which determines the results of measurements on the system, either by assigning a value to the measured quantity that is revealed by the measurement regardless of the details of the measurement procedure, or by enabling the system to elicit a definite response whenever it is measured, but a response which may depend on the macroscopic features of the experimental arrangement or even on the complete state of the system together with that arrangement. Locality is a condition on composite systems with spatially separated constituents, requiring an operator which is the product of operators associated with the individual constituents to be assigned a value which is the product of the values assigned to the factors, and requiring the value assigned to an operator associated with an individual constituent to be independent of what is measured on any other constituent. From his assumptions Bell proved an inequality (the prototype of “Bell's Inequality”) which is violated by the Quantum Mechanical predictions made from an entangled state of the composite system. In other variants the complete state assigns probabilities to the possible results of measurements of the operators rather than determining which result will be obtained. Nevertheless, inequalities are derivable; and still other variants dispense with inequalities. The incompatibility of Local Realistic Theories with Quantum Mechanics permits adjudication by experiments, some of which are described here. Most of the dozens of experiments performed so far have favored Quantum Mechanics, but not decisively because of the “detection loophole” or the “communication loophole.” The latter has been nearly decisively blocked by a recent experiment and there is a good prospect for blocking the former. The refutation of the family of Local Realistic Theories would imply that certain peculiarities of Quantum Mechanics will remain part of our physical worldview: notably, the objective indefiniteness of properties, the indeterminacy of measurement results, and the tension between Quantum nonlocality and the locality of Relativity Theory.

f. Gödel’s Incompleteness Theorems

Concerning modern logic, Gödel's two incompleteness theorems are among the most important because they have deep effects on various issues. These theorems deal with the limits of proof concerning formal axiomatic theories. Gödel’s incompleteness theorems state that in any consistent formal system (F) with certain amounts of arithmetic are carried out, then (F) may not be proved or disproved; this is the first incompleteness. The second incompleteness states: in connection with the formal system which cannot prove its consistency intern affects the Philosophyof Mathematics and logic.

In order to understand Gödel's theorems, one must first explain the key concepts essential to it, such as 'formal system', 'consistency', and 'completeness'. A formal system is a system of axioms fortified with rules of inference, which allows the generations of new theorems. Axioms are required to be finite, meaning that there must be an algorithm that enables the observer to know if the presented and given statement is an axiom or not. If the condition of the statement is verified, the Theory is then called 'recursively axiomatizable. For a formal system, the rules of inference are also effective operations, meaning that it can systematically decide as to whether the application of a rule of inference is legitimate. Consequently, it is also possible to decide for any given finite sequence of formulas, whether it constitutes a genuine derivation, or a proof, in the system—given the axioms and the rules of inference of the system.

> A formal system is *complete* if for every statement of the language of the system, either the statement or its negation can be derived (i.e., proved) in the system. A formal system is *consistent* if there is no statement such that the statement itself and its negation are both derivable in the system (www.plato.stanford.edu/entries/goedel-incompleteness/).

Gödel established two different, but related incompleteness theorems; typically called the first incompleteness theorem and the second incompleteness theorem.

First incompleteness theorem

Any given consistent formal system *F* within which a certain amount of arithmetic can be carried out is incomplete; meaning there are statements concerning *F* which can neither be proved nor disproved in *F*.

Gödel's theorem not only claims such statement exists: Gödel's method produces a particular sentence that is neither probable nor refutable in *F*. The sentence in question is a relatively simple statement of number Theory, a purely universal arithmetical sentence.

It is sometimes assumed that Gödel's first theorem conveys truths that cannot be proved. This assumption is incorrect because the incompleteness theorem does not deal with absolute truth, but the derivability in some particular formal system or another. For example, "…statement *A* unprovable in a particular formal system *F*, there are, trivially, other formal systems in which *S* is provable (take *A* as an axiom)" (www.plato.stanford.edu/entries/goedel-incompleteness/). However, there is the extremely powerful standard axiom system of Zermelo-Fraenkel set Theory (denoted as ZF, or, with the axiom of choice, ZFC; see the section on axiomatic set Theory in the entry on set Theory), which is more than sufficient for the derivation of all ordinary mathematics. Though, in Gödel's first theorem there are arithmetical truths that are not provable even in ZFC. Proving these truths would require a formal system that incorporates methods that goes beyond ZFC. Even using modern ordinary mathematical methods and axioms, such truths are not provable nor can be proved by mathematicians that would today regard them as unproblematic and conclusive.

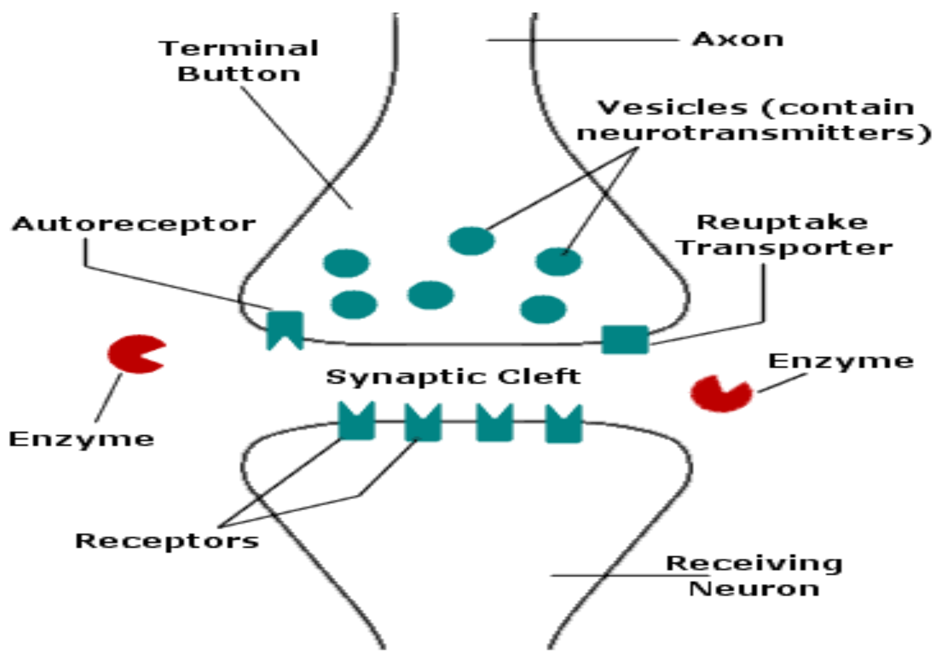
Gödel's second incompleteness theorem concerns the limits of consistency proofs. A rough statement is:

Second incompleteness theorem

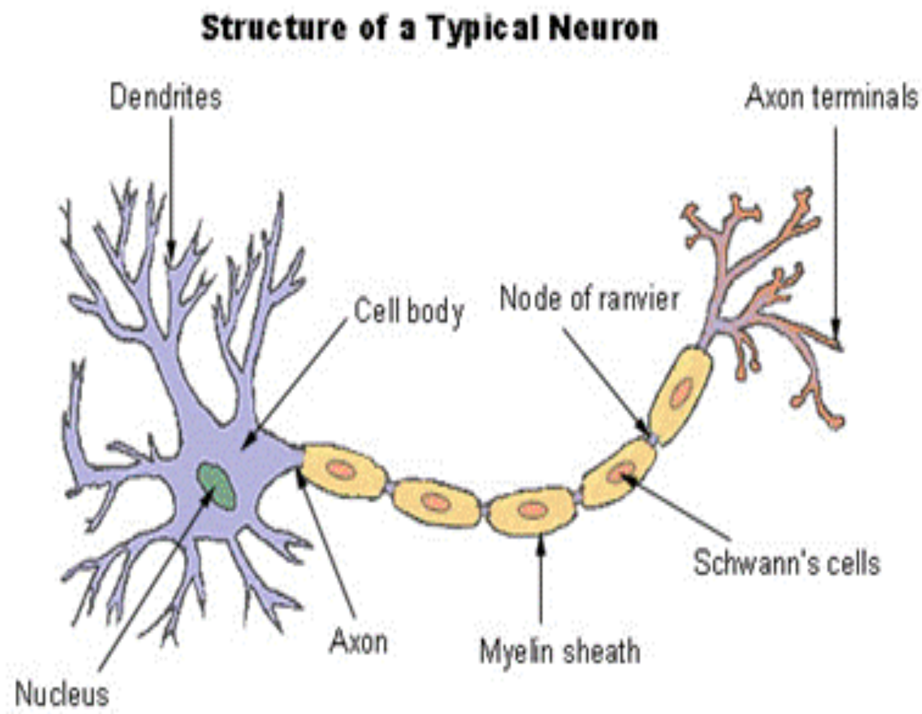
For any consistent system *F* within which a certain amount of arithmetic can be carried out, the consistency of *F* cannot be proved in *F* itself. Thus, the second theorem, *F* must contain a little bit more arithmetic than the first theorem. It is important to note that this result, like the first incompleteness theorem, is a theorem about formal provability, or derivability, which is always relative to some formal system (in this case, to *F* itself). It does not say anything about whether, for a particular Theory T satisfying the conditions of the theorem, the statement "*T* is consistent" can be proved in the sense of being shown to be true by a conclusive argument, or by a proof generally acceptable for mathematicians. For many theories, this is perfectly possible (www.plato.stanford.edu/entries/goedel-incompleteness/).

g. *Images on the Structure of a Neuron and the Transmission between Neurons*

The figures below illustrate the typical structure and function of a neuron. Each part of the neuron contributes to the function of thoughts and passing thoughts from neuron to neuron(s). Understanding the function of a single neuron is complex because there are various types of neurons. For the purpose of simplification, this section will explain the overall function of a neuron.



(Source: About.com, http://bipolar.about.com/cs/neurotrans/l/aa0007_msngrs.htm)



(Source: U.S. National Cancer Institute's SEER Program, http://training.seer.cancer.gov/module_anatomy/unit5_2_nerve_tissue.html)

All neurons contain four distinct regions that function in systematic, but different ways. The four regions are: the cell body, the dendrites, the axon, and the axon terminals. Within the neuron, the cell body contains the nucleus which fuses together all neural proteins and membranes; however, some proteins are fused together in the dendrites. The cell body also contributes to renewal of proteins and membranes, all of which is essential for health neuron function. Proteins and membranes that are required for renewal of the axon and nerve termini are processed in the cell body and transformed into multi-protein particles. These transformed materials then go through a process called anterograde transport, the means of which materials are transported through microtubules to the axon and terminals. Once these materials pass through the axon and terminals, they are then inserted into the plasma membrane and/or organelles. Axonal microtubules are also the pathways that damaged membranes/organelles travel to the cell body; this is called retrograde transport.

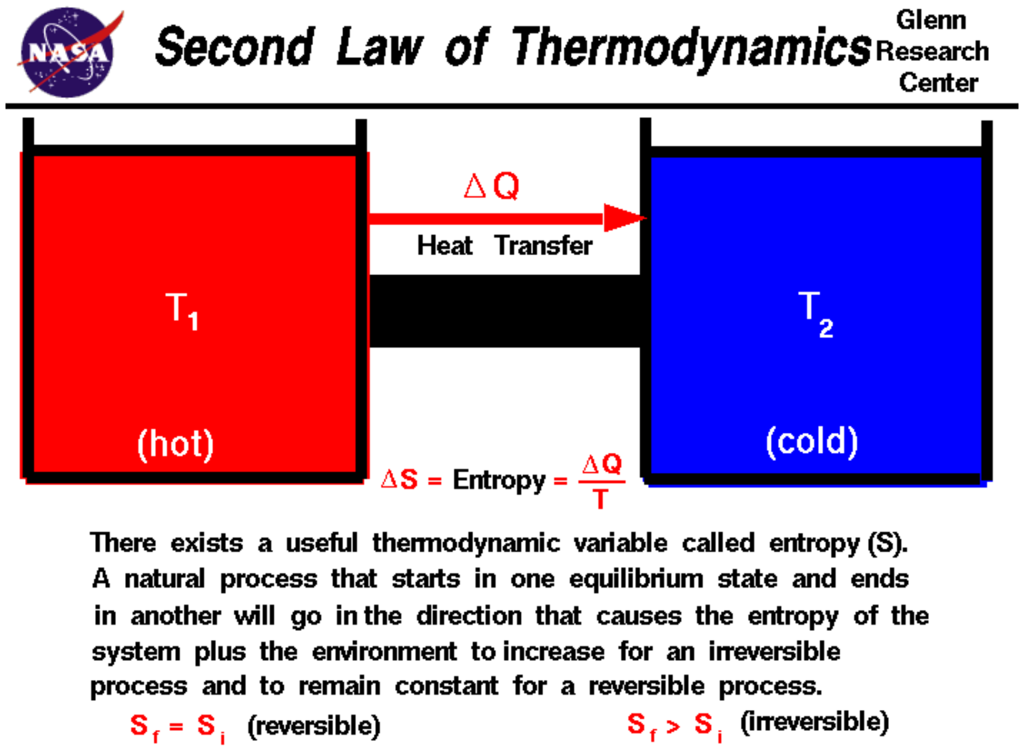
The functional purpose of an axon is to conduct a specific type of electrical impulse; this is called an action potential[6]. These electrical impulses travel away from the cell boy going toward the axon terminus. Within a typical human brain, axons measure to be about a meter long. Despite the length of an axon, action potentials move at the rapid rate of 100 meters per second. The axon hillock is where the action potential originates which is at the junction of the axon and cell body which is conducts down the axon to the axon terminals, small branches of the axon that form synapses, and connects with other cells. One single axon within the central nervous system can synapse[7] with many neurons and induce responses in all of them simultaneously. The axon terminal connects to the axon. Its function is to aid the axon in making synaptic connections to other nerve cells or with effector cells. Axon terminal is shaped like a club and contains various kinds of neurotransmitters.

A dendrite is a short branched like extension of the cell body. Most neurons contain multiple dendrites. The dendrite function is to receive chemical signals from the axon termini of other neurons and then convert these signals into small electrical impulses to be transmitted to the cell body. Within the central nervous system, neurons have long dendrites with complex branches which allow them to form synapses with and receive signals from nearly thousands of other neurons (Lodish, Berk, Zipursky, 2000, http//:www.ncbi.nlm.nih.gov/books/NBK21535/).

[6] A series of sudden changes in the voltage, or equivalently the electric potential, across the plasma membrane (Lodish, Berk, Zipursky, 2000, www.ncbi.nlm.nih.gov/books/NBK21535/).

[7] A junction between two nerve cells, consisting of a minute gap across which impulses pass by diffusion of a neurotransmitter (Lodish, Berk, Zipursky, 2000, www.ncbi.nlm.nih.gov/books/NBK21535/).

h. The Second Law of Thermodynamics: Entropy



www.grc.nasa.gov

The image above helps simplify a complex concept within the second law of thermodynamics; entropy. Aside from explaining the various amounts of complex equations the aid in explaining entropy with a system, the purpose of this section is to further simplify entropy.

The second law of thermodynamics deals with the measurement of heat energy. Entropy is the measurement of chaos with in a system. Through the process of measuring chaos, it is the measuring that creates organization within a system. There are three types of systems: an isolated system, a closed system and an open system. For an isolated system, the quantitative measure of thermal energy is not available. Therefore, entropy is the opposite of available energy within an isolated system. Entropy in an isolated system can neither increase nor decrease (www.panspermia.org/seconlaw.htm). Matter and energy can pass in and out of an open system which differs from a closed system because only matter can pass in and out of it.

The image above demonstrates the flow of heat from hot things to cold. An example of heat transfer is dropping a hot stone into a bucket of cool water in which the stone cools and the water warms until both the stone and water become the same temperature. During this process the entropy of the system increases (www.panspermia.org/seconlaw.htm).

VI. Thoughts and Matter: the Collaboration

The State of matter consists of an arrangement of atoms. For example: water, gas and ice contain the same atoms, but their different states of matter are due to the arrangement of atoms. Thoughts too have different states of matter just like water, gas, and ice.

Between the seventeenth century and the twenty-first century a trail of philosophical, scientific, and psychological discoveries were found and have become connected to each other. Beyond his philosophical background, Descartes, was also a contributor to the world of Physics. His philosophies sparked a long and interconnected conversation between many disciplines. However, for the purpose of this review and thesis, the concept of a single human thought must be defined and examined. Understanding the spin of a Quantum system is vital to understanding the wave-function.

a. *Human Thought*

Saara Varpula, Arto Annila, and Charles Beck collaborated on an academic paper titled, "*Thoughts about Thinking: Cognition According to the Second Law of Thermodynamics* (2013)" as part of a series, "Advanced Studies in Biology" (HIKARI ltd, 2103 p. 135-149) using their different backgrounds in order to holistically account for the human brain. Their backgrounds include; Physics, biotechnology, biosciences, and psychology (Varpular, Annila, & Beck, 2013, 135). Varpula is part of the Department of Physics at the University of Helsinki, Finland, Annila is from the Departments of Physics, Biotechnology, and Bioscience at the University of Helsinki, Finland, and Beck is from the Department of Psychology at the University of Helsinki, Finland. The argument states, "The human brain, despite its complexity, is no different in its operational principle from any other system in nature" (Varpular, Annila, & Beck, 2013, 136). By viewing the brain as a system in nature, the second law of thermodynamics [8]implies that the brain is an open circuit and that thoughts are governed by the laws of entropy[9]. For this purpose of understanding brain function, a thought is defined as a state of matter stored in a neuron (or many neurons) which will be transmitted between other neurons. This is assumed from the collaboration of research regarding brain function which states, "Considering the irrefutable imperative to consume free energy in the least time, it is hardly a surprise that the human brain also exhibits this universal characteristic" (Varpular, Annila, & Beck, 2013, 136).

Regarding the brain as any other system in nature the second law of thermodynamics allows for a different perspective on the development and function of the brain; concepts concerning: perception, sensation, memory, learning, sleeping, emotions, and consciousness. Though this paper gives a general overview of re-defining thoughts and cognition, there is specific formalism contingent upon statistical Physics concerning open systems which deals

[8] The relations between heat and other forms of energy (such as mechanical, electrical, or chemical energy).
[9] A system of organization.

with conversation of quanta to a precision of a signal Quantum particle[10] (Varpular, Annila, & Beck, 2013, 136).

> Life at each and every level of the natural hierarchy manifests itself as an interaction of thermodynamic process. Thus, according to the scale-free naturalistic tenet, the human brain, like any other system, has evolved over the eons just as it develops over an individual's life time to attain balance, known as the free-energy minimum, with respect to its surroundings (Varpular, Annila, & Beck, 2013, p. 137).

Thus, all processes of the brain are subject to the concept of least-time free energy consumption. Even if any changes in the brain occur due to genetics, aging, or neural network changes the brain will benefit from the consumption of free energy. Yes, the brain undergoes neural and behavioral changes in development, which is a process of natural selection; but the sole reasoning behind natural selection is contingent upon the second law of thermodynamics which governs the consumption of free energy.

The rise in energy contributes to the processes of evolution and development in all systems.

> According to the variational principle, the flows of energy themselves will search for the paths of transduction and naturally select those that consume free energy in the least time… it will manifest itself e.g., when a neuron acts as a target for neurosynapes. Likewise, a bacterium will chemotax along nutrient gradients and a human individual will seek more resources… (Varpular, Annila, & Beck, 2013, p. 137).

[10] A discrete quantity of energy proportional in magnitude to the frequency of the radiation it represents (Varpular, Annila, & Beck, 2013 p. 137).

This passage conveys that neurons require feeding off of free energy so that development and evolution can happen.

As mentioned earlier, thoughts are the electrical exchange/transmission between neurons. The second law of thermodynamics provides a structure for studying energy within all types of systems. Entropy is a measure of chaos, thus, also provides a measurement of order for the observer of a system. The system in this context is the human brain. According to the law of conservation of energy, nothing can be neither created nor destroyed, but transformed from one state of matter to another or becomes energy. Matter has the potential to become energy and energy become matter. However, a small amount of matter creates a large amount of energy. If the brain does consume free energy and transforms this energy to matter, then the conscious must have physical substance. Many things within the brain contribute to the make-up of consciousness, but the conscious containing substance must therefore contain matter.

VII. Quantum Consciousness

a. Henry Stapp's Insight on Physics and Consciousness

In the late 21th century, a concept called "Quantum Consciousness" arose, joining theories and concepts from the disciplines of philosophy, neuropsychology, and Quantum Physics. The Preface of *Mind, Matter, and Quantum Mechanics* (Henry P. Stapp. p. 1993) states, "Nature appears to be composed of two completely different kinds of things; rock like things and idealike things. The first is epitomized by an enduring rock, the second by a fleeting thought. A rock can be experienced by many of us together, while a thought seems to be long to one of us alone" (Stapp, 1993 p. vii). Stapp refers to the mind-body problem, not as a problem, but as a connection; the mind-body connection. Descartes, as earlier stated, believed the mind and body could be separate and act separately. Stapp embellishes Descartes Philosophy of "I think therefore I am" though Quantum Physics by connecting the mind to the body. In his book, *Mind, Matter, and Quantum Mechanics* (Henry P. Stapp, 1993), Stapp sought to answer the following questions: what sort of brain action corresponds to a conscious thought? How is the content of a thought related to the form of the corresponding brain action? How do conscious thoughts guide bodily actions? (Stapp, 1993, p. 3).

The first step in connecting the mind-body problem to the mind-matter connection is to respectfully redefine matter through the lenses of Quantum Physics. Stapp admits,

> In attempts to understand the mind-matter connection it is usually assumed that the idea of matter used in Newtonian mechanics can be applied to the internal workings of the brain. However, that venerable concept does not extrapolate from the domain of planets and falling apples to the realm of the subtle chemical processes occurring in the tissues of human brains. Indeed, the classical idea of matter is logically incompatible with the nature of various processes that are essential to the function of brains. To achieve logical coherence one must employ a frame work that accommodates these crucial processes. A Quantum framework must be used in principle (Stapp, 1993, p. 3).

As described earlier, Quantum Theory is a statistical Theory; however, some view the Theory to solely be for atomic Theory. "However, the peculiar form of Quantum effect entails that ordinary classical ideas about the nature of the physical world are profoundly incorrect in ways that extend far beyond the properties of individual atoms" (Stapp, 1993 p. 3). Stapp illustrates the competing theories regarding the mind-brain connection tend to have deficiencies in explaining the connection. However, Heisenberg's model of physical reality completes the connection to mind and brain, canceling out many gaps therein between. Heisenberg's model of physical reality the Heisenberg's model of physical reality is used to explain processing of the brain and the point at which consciousness enters; and further explains the content of conscious thought and its purpose.

Connecting the mind-body problem to the mind-matter connections, first Stapp outlines some vital key points from 20th century psychologist and philosopher, William James. The revolutions and evolutions for psychology and Physics became parallel nearing the end of the nineteenth century and continuing on to the twentieth century. Revelations within the realm of psychology concerned the areas of: the behaviorist movement, the cognitive revolution, and the trend of materialism.

b. Max Tegmark's Insight on Physics and Consciousness

Tegmark's paper *Consciousness as a State of Matter* (Tegmark, 2014) classifies consciousness as a state of matter called "perceptronium"; a new state of matter which is defined as a substance that subjectively feels self-aware and has the ability to store and unify information. He states,

> We examine the hypothesis that consciousness can be understood as a state of matter, "perceptronium", with distinctive information processing abilities. We explore five basic principles that may distinguish conscious matter form other physical systems such as solids, liquids, and gases: the information, integration, independence, dynamics, and utility principles" (Tegmark, 2014, 1).

However, the purpose of Tegmark's paper is not to only covey the conscious as a state of matter; this concept is a piece to a bigger puzzle that he is attempting to solve. Tegmark believes that by examining his five principles concerning the consciousness, he can then begin to solve the Quantum factorization problem[11]. Tegmark asks several questions, but the main questions he seeks to answer is,

> If such principles can identify conscious entities, then they can help solve the Quantum factorization problem: why do conscious observers like us perceive the particular Hilbert space [12]factorization corresponding to classical space (rather than Fourier space, say), and more generally, why do we perceive the world around us as a dynamic hierarchy of object that are strongly integrated and relatively independent? (Tegmark, 2014, p. 1).

The introduction of *Consciousness as a State of Matter* (Tegmark, 2014) begins with questioning the relation between internal reality of the mind and the external reality conveyed by the many equations in Physics. He argues that consciousness corresponds to complex patterns in space-time [13]due to the way the conscious feels when processing information. Using Giulio Tononi's *Consciousness as Intergraded Information: a Provisional Manifesto,* Tegmark illustrates that an information processing system could be conscious. Though, in order for an information processing system to be conscious it needs two specific entities; the ability to store substantially large amounts of information and the ability of integration into a unified whole meaning that it is impossible to decompose the system into independent parts. Eloquently, Tegmark is rewriting the definition of matter; that matter is more than what we see, it is also what we feel (Tegmark, 2014, p. 1).

[11] A mathematical process of breaking down large entities. In Quantum Physics these entities are centered on large ideas (Tegmark, 2014, 1).
[12] An infinite-dimensional analog of Euclidean space (Euclidean space is three dimensional) (Tegmark, 2014, 1).
[13] The concepts of time and three-dimensional space regard as fused in a four-dimensional continuum.

When studying copious amounts of atoms one finds that their behavior depends on their arrangement.

> … The key difference between a solid, a liquid, and a gas lies not in the type of atoms, but their arrangement. In this paper, I conjecture that consciousness can be understood as yet another state of matter. Just as there are many types of liquid, there are many types of consciousness (Tegmark, 2014, p. 1).

One of the states of consciousness as matter is memory[14]; as a substance useful for storing information. Tegmark describes memory as a substance that is distinguished from basic solids. Memory is easy to read as well as write to; thus, memory as a substance meets one of the requirements when thinking of the conscious as an information processing system; the ability to store massive amounts of information. Tegmark explains the Physics of the memory's capacity to store information with a base-2 logarithm which shows the potential energy function has a large number of separated minima; all of which equals the entropy of the ground state if all minima are equally deep (Tegmark, 2014, p. 2).

> For example, solids have many long-lived states where as liquids and gases do not: If you engrave someone's name on a gold ring, the information will still be there years later, but if you engrave it on the surface of a pond, it will be lost within seconds as the water surface changes shape (Tegmark, 2014 p. 2)

When broken down, memory truly is a type of processing system, similar to a computer, but with behavior and free will. Human memory soaks up information like a sponge and stores it for as long as life exits; even if one cannot recall certain memories, it still exists. Even cells carry information that is passed from generation to generation.

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[14] A substance that has a large repertoire of possible long-lived states or attractors (physically possessing potential energy function that has a large number of minima).

The word "computronium[15]" is described as a substance that processes information just as a computer does. Tegmark compares his "gold ring" analogy to the concept of the computronium stating that unlike the immobility of the gold ring, the substance requires complex dynamics of which its future state wholly depends upon the present state. Within the substance of computronium, its atom arrangement, or rather, the entropy needs to be less ordered than a solid, but more ordered than a liquid or gas. To further illustrate the concept of computronium, Tegmark describes the actual process of computing power of computers. Whereas a computer's computing power is characterized by FLOPS [16](floating-point operations per second for 64-bit numbers) the computronium can be characterized by FLIPS because of its universal uses. FlIPS[17] are the number of logical operations that can be performed per second. The substance of computronium further illustrates Tegmark's first principle needed; to not only store information, but for that information to have the ability to perform movement (Tegmark, 2014, p. 2). The computronium needs the substance of memory to process the stored information: the movement of information.

Tegmark says of the "perceptronium[18]"; that another principle must be conveyed in dealing with the conscious as a state of mater, which deals with autonomy[19]. Tegmark states,

> …'perceptronium', the most general substance that feels subjectively self-aware? If Tononi is right, then it should not merely be able to store and process information like the computronium does, but it should also satisfy the principle that its information is intergrated, forming a unified and indivisible whole" (Tegmark, 2014, p. 2).

[15] The most general substance that can process information as a computer.
[16] Computing power; floating-point operations per second for 64-bit numbers.
[17] The number of elementary logical operations such as bit flips that it can perform per second.
[18] The most general substance that feels subjectively self-aware.
[19] The combination of two separate properties: dynamics and independence.

Tegmark believes that the conscious system is subject to autonomy because information must be processed without the influence of external forces.

> Autonomy is thus the combination of two separate properties: dynamics and independence. Here dynamics means time dependence (hence information processing capacity) and independence means that the dynamics is dominated by forces from within rather than outside the system (Tegmark, 2014, p. 2).

Though the concept of autonomy is needed to convey the conscious as a state of matter, Tegmark admits that autonomy is not sufficient enough for a system to be conscious. He gives examples of systems that operate under the laws and concepts of autonomy such as clocks and diesel generators, but these systems do not store information (Tegmark, 2014, p. 2-3).

Tegmark provides this table to further examine his principles congruent to the conscious as a state of mater.

Principle	Definition
Information principle	A conscious system has substantial information storage capacity.
Dynamics principle	A conscious system has substantial information processing capacity.
Independence principle	A conscious system has substantial independence from the rest of the world.
Integration principle	A conscious system cannot consist of nearly independent parts
Utility principle	A conscious system records mainly information that is useful to it.
Autonomy principle	A conscious system has substantial dynamics and independence.

(Tegmark, 2014, p. 3).

Tegmark states that his goal in searching out these principles listed in the table above is to both convey a better understanding of consciousness and to possibly solve some open problems in Physics by first identifying traits of conscious matter. Concepts of memory substances, computronium substances, and perceptronium substances together are vital to uncovering the traits of conscious matter.

VIII. Conclusion

The entirety of this paper thus far has illustrated the phenomena in history that has made it possible to answer this question: do our human thoughts contain matter? The answer is yes, it is possible our human thoughts not only contain matter, but are in different states of matter. This is due to deductive reasoning; if thoughts are in different states of matter, then thoughts must therein contain matter. Take water for example: a substance of matter, but when molecules are rearranged water as a liquid then becomes a solid or a gas (vapor). Water in the form of a solid or a gas is still matter, but different states of matter. Swedish physicist, professor at MIT, Max Tegmark published a paper in February of 2014 theorizing that our human thoughts are in a state of matter. However, the focus of his paper was not proving thoughts are in a state of matter. Tegmark needed this concept to be real so that he could attempt to answer what he calls "the Quantum factorization problem" which addresses how the conscious observer perceives Hilbert space in connection to classical space. If science is solely derived from how others perceive observations, then understanding the conscious is vital in understand more deeply about the "how".

How does Tegmark connect to Descartes? Yes, the connection is to the famous phrase, "I think therefore I am"; this phrase is entirely about perception. How one consciously perceives an event is their perception of reality. When we share ideas, we are actually sharing different types of reality. It is argued that not enough is known about the conscious and it is true, the conscious is still a vast mystery. However, over the centuries, much has been discovered and theorized about the conscious. How we think and understanding individual perception is vital to shaping and understanding our universe.

Descartes may have been the father of modern philosophy, but he was also a physicist. His ideas contributed to the laws of science and the tools that are used today in exploring our universe. The human brain has potential limitless power and so much about the brain is yet to be discovered. Tools used to explore the universe should also be used to explore the brain. The intergradation of psychology and Physics allows the question, do our thoughts contain matter, to be answered and perhaps one day fully proved.

The mind-body problem is truly the perfect example of the evolution of thought. However, why is it important to better understand the mind-body problem? What is so special about consciousness being a state of matter? How do these concepts benefit humanity? It is simple, “I think therefore I am”. If thoughts are truly the substance that makes us who we are, then that is important enough to be sought out. Humans often question at least once in their life who they are. Are we just a ghost in a flesh machine? Maybe, but it is more plausible to believe that our thoughts are actually matter; substance of matter – they have weight. Our thoughts are what make us human.

a. *Personal Reflections*

The idea of our human thoughts containing matter over took me and rendered me helpless: to the point where my own thoughts and consciousness became consumed with thinking about thoughts. I felt the weight of these thoughts, these ideas about thoughts containing matter. I knew that because of the weight of my thoughts, there would be little rest for me until I sought out the understanding of these concepts. For a moment of honest reflection, I feel that I have only scratched the surface of the concept of our thoughts containing matter. Of course this idea links to bigger questions, what is a soul? Purposefully, I avoided that question concerning this idea due to limited time and space. However, it is the bigger idea, the bigger concept of which I desperately seek to better understand and maybe one day answer.

The controversy of these concepts and this paper is more than apparent: understanding our human thoughts and the processes of brain function as a state of matter or to indeed be matter opens a world of unanswered questions. While researching this concept, thoughts containing matter, I was asked if this concept could be linked to uncovering the substances of the human soul. I of course replied that understanding the substance of a soul is related to this topic, but at the same time the concept is its own entity entirely. Perhaps with ongoing research one could uncover the substance of a soul; however, not at this time and not in this paper.

Time is such a complex concept that it shapes the core of all types of reality. Throughout time and space; history has progressed, evolved. A single idea grew and crossed the boarders of many disciplines of study. René Descartes' famous thought, "I think therefore I am"; such power exudes from those words. It could be interpreted as one thinking themselves into being, the power of the conscious. At the turn of the Enlightenment, a type of evolution began which involved massive amounts of thinking, doing, experimenting; no, to prove these thoughts were of worth, it took a leap of faith by many great people. Descartes is considered the father of modern philosophy, but during the seventeenth century, separating the mind from the body underwent much criticism. However, Isaac Newton befriended the philosophies of Descartes, which arguably influenced his great discoveries. Newtonian laws are mixed with the deep philosophies of Descartes. Scientists strive to develop theories, but those theories were first philosophies.

Newton is the father of classical Physics; he set calculus in motion. The need for Physics in the realms of Philosophy and Psychology has always been apparent. Philosophy asks the question, psychology studies the function of the question, and Physics provides a series of theoretical answers to the question; always hoping the answer is more than a Theory. Einstein contributed to the changes that Physics underwent. While Newtonian Physics was foundational, Quantum Theory replaced classical Physics in a foundational role. This came about because of many factors, but one large factor being Einstein's theories of general and special relativity along with the Einstein-Podolsky-Rosen paradox. Particles became more than just particles and atoms became actual things. It became important to understand quanta and various wave-functions within a Quantum system. This is the very point of which neuropsychology and Quantum Physics met, because the study of wave-functions is more than observational; the wave-function possesses within a type behavior along with spin and momentum. Of course Max Planck is the father of Quantum Theory, but Einstein and his colleagues bridged the gap between Newtonian Physics and Quantum Theory.

As humanity has evolved and developed throughout time, so has every aspect about life. The development of the human brain is a beautiful process. Neurons create pathways to other neurons allowing knowledge to be absorbed by all forms of stimuli. From generation to generation, each individual cell passed from one person to the next and contains a world of information, a system of storage, to be downloaded to generations to come. The process of a cell traveling through generations is arguably the core of evolution. That individual cell not only stores information, but gains more knowledge as it is passed down and duplicated. Evolution is the core of understanding human thoughts and the processes of developing ideas that eventually change the world. Understanding our thoughts as a substance of matter is the first step in uncovering many other mysteries in humanity. The human brain is a small personalized universe inside the human body.

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