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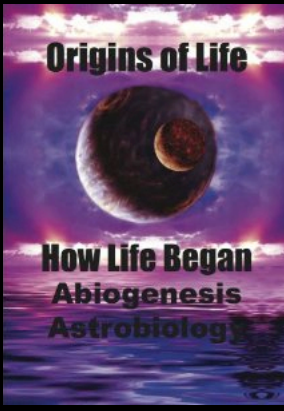


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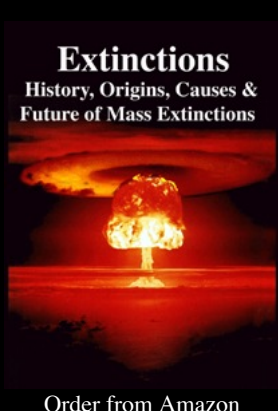
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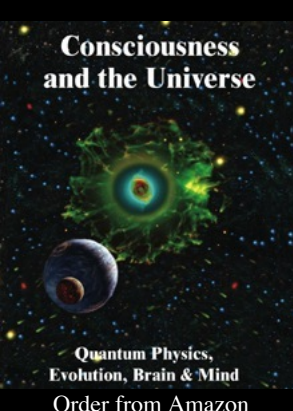
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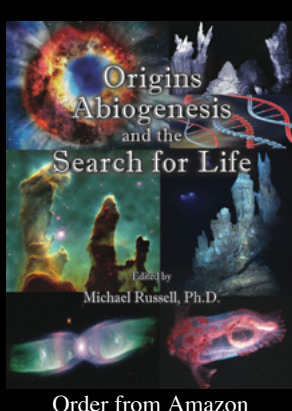
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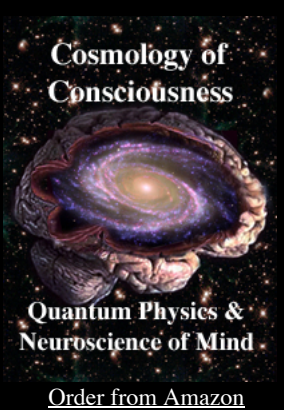


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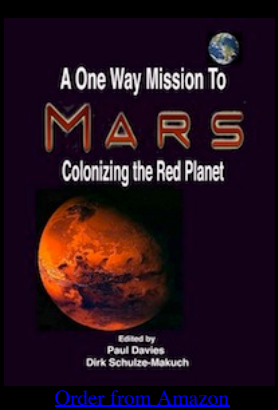
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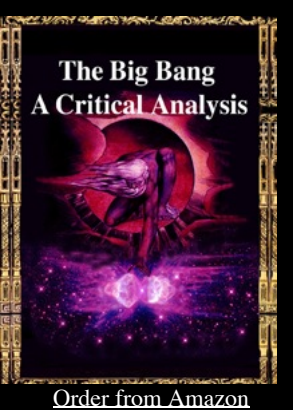


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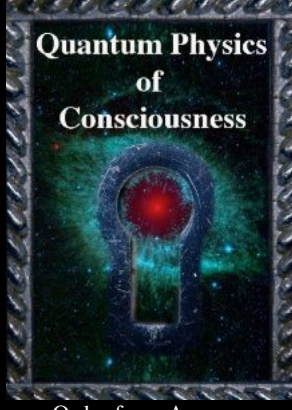
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Synchronicity, Quantum Information and the Psyche

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Abstract

In this paper we describe synchronicity phenomena. As an explanation of these phenomena we propose quantum entanglement between the psychic realm known as the "unconscious" and also the classical illusion of the collapse of the wave-function. Then, taking the theory of quantum information as a model we consider the human unconscious, pre-consciousness and consciousness as sets of quantum bits (qu-bits). We analyze how there can be communication between these various qu-bit sets. In doing this we are inspired by the theory of nuclear magnetic resonance. In this manner we build quantum processes that permit consciousness to "read" the unconscious and vice-versa. The most elementary interaction, e.g. between a pre-consciousness qu-bit and a consciousness one, allows us to predict the time evolution of the pre-consciousness + consciousness system in which pre-consciousness and consciousness are quantum entangled. This time evolution exhibits Rabi oscillations that we name mental Rabi oscillations. This time evolution shows how, for example, the unconscious can influence consciousness and vice-versa. In a process like mourning the influence of the unconscious on consciousness, as the influence of consciousness on the unconscious, are in agreement with what is observed in psychiatry.

Key Words: Synchronicity, quantum entanglement, quantum information, consciousness, unconscious.

1 Synchronicity Effects

Synchronicity phenomena are characterized by a significant coincidence which appears between a (subjective) mental state and an event occurring in the (objective) external world. The notion was introduced by the Swiss psychoanalyst Carl Gustav Jung and further studied together with Wolfgang Pauli (Jung and Pauli, 1955). Jung referred to this phenomenon as "acausal parallelism" which are linked by an "acausal connecting principle." Synchronicity effects show no causal link between the two events that are correlated.

We can distinguish two types of synchronicity phenomena. The first one is characterized by a significant coincidence between the psyche of two individuals. An example of this type is when two friends at a distance simultaneously buy two identical neckties without having consulted each other beforehand. The significant coincidence appears as a correlation between the psyche of the two subjects, suggesting some type of psychic communication. There are many examples of such long range correlations between events which are causally unrelated, or subjects who engage in identical behaviors, often simultaneously: twins, relatives, members of a couple, friends, or scientists who make the same discoveries at around the same time.

For example, in March of 1951, a new comic strip appeared in over a dozen newspapers in the United States, featuring a little blond boy wearing a red and black striped shirt. The boy was called: Dennis The Menace. In the United Kingdom, a new character, a little boy wearing a red and black striped shirt was introduced in a comic book, The Beano. He was also named, Dennis The Menace. The creators of both comics claimed it was a coincidence.

The second type of synchronicity phenomena, which is closer to what was advocated by C.G. Jung, happens when the significant coincidence occurs between a mental state and a physical state. In this case the physical state is symbolically correlated to the mental state by a common meaning. They appear not necessarily simultaneously but in a short interval of time such that the coincidence appears exceptional. Jung referred to these events as "meaningful coincidences."

Another more common example goes as follows: You are sitting at home and begin thinking about an old friend who you had not seen in months, when the phone rings, and its him.

Synchronistic events between mind and matter seem difficult to explain in terms of correlations between conscious or unconscious minds. For Jung, synchronistic events are remnants of a holistic reality - the *unus mundus* which is based on the concept of a unified reality, a singularity of "One World" from which everything has its origin, and from which all things emerge and eventually return. The *unus mundus*, or "One World" is related to Plato's concept of the "World of Ideas," and has its parallels in quantum physics. Thus, the *unus mundus* underlies both mind and matter.

As already stressed, in a synchronicity effect, there is no causal link between correlated events localized in space and time. Synchronicity effects are global phenomena in space and time. They cannot be explained by classical physics. However, in the case of a significant coincidence appearing between the psyche of two individuals one can see an analogy with quantum entanglement (Baaquie and Martin, 2005).

Moreover one can possibly see synchronistic events between the mental and the material domains as a consequence of a quantum entanglement between mind and matter (Primas, 2003). For us mental and material domains of reality will be considered as aspects, or manifestations, of one underlying reality in which mind and matter are unseparated (Atmanspacher, 2004).

Synchronicity phenomena, especially those involving a correlation at a distance between several individuals, lead us to postulate non-localized unconscious mental states in space and time. Although different regions of the brain subserve specific functions (Joseph, 1982, 1992), mental states are not exclusively localized in the human brain. They are correlated to physical states of the brain (possibly via quantum entanglement) but they are not reducible to them.

Since we study the analogy between synchronistic events and quantum entanglement, we treat mental states (conscious and unconscious) as quantum states, i.e. as vectors of a Hilbert space (Baaquie and Martin, 2005). Moreover we treat them as vectors of a Hilbert space of information (Martin, Carminati, Galli Carminati, 2009).

2 Quantum information and the Psyche

We try to apply quantum information to some functions of the Psyche. In classical information, the memory boxes are binary system, called bits, which can take only two values: 0 or 1. A quantum bit (in a shortened form qu-bit) can take all values which are superposition of 0 and 1 (more precisely all superpositions of the states $|0\rangle$ and $|1\rangle$). In other words, a qu-bit can take simultaneously the values 0 and 1. Quantum information studies the monitoring of qu-bits. It studies also the transfer of quantum information from one qu-bit to another one (especially via two-qubit quantum logic gates).

As an example of a binary psychic system we have considered the phenomenon of mourning (Galli Carminati and Carminati, 2006): either mourning is achieved (qu-bit 0), either it is not (qu-bit 1). So quantum mechanics allow the existence of all superpositions of the state in which mourning is achieved with the state in which mourning is not achieved.

Quantum mechanics rests upon two fundamental properties. First it is based on the superposition principle (superposition of vector states of an Hilbert space). Second it is based on a fundamental phenomenon called quantum entanglement. This phenomenon manifests itself by the fact that a system of two, or several, quantum entangled particles is "non-separable". In technical terms this means that the wave-function of the two-particle system does not factorize into a product of a wave-function for each particle. The quantum system describing the two particle system is a global system, a non-local one. Moreover, in such a system, the particles are heavily correlated. Therefore, if we measure a certain property of one of the two particles, destroying in this way the "non-separability" of the system, we can predict with certainty the corresponding property of the other particle, even if this one is at the other extreme of the universe. However, there are caveats: the quantum specificity indicates that this property is not determined beforehand, i.e. before measurement. Quantum physics is a non-local and non-realistic theory. Quantum entanglement and the property of "nonseparability" are properties that are fundamentally quantum, that do not exist in "classical physics".

Assuming, with Belal Baaquie (Baaquie and Martin, 2005), the existence of quantum entanglement between the unconscious of two or several persons, we have proposed an explanation of correlations at a distance that appears between two (or several) individuals having affective links. This would constitute an explanation of synchronicity of the first type. It would be interesting to measure in a quantitative manner those unconscious correlations at a distance. May be those correlations could activate neural circuits that could be visible in nuclear magnetic resonance imaging (NMRI).

We propose to measure quantitatively the existence (or the non-existence) of such correlations during group therapies or group training, via "absurd" tests (Galli et al., 2008; Martin et al., 2007, 2009). Those experiments are currently in progress.

Quantum information applied to Psyche allows to explain a certain number of mental processes (Martin, Carminati, Galli Carminati, 2009). We suppose that the mental systems first proposed by Freud (1900, 1915a,b), i.e. the unconscious, pre-consciousness, consciousness, are made up of mental qu-bits. They are sets of mental qu-bits.

Specifically, Freud (1900, 1915ab), saw the mind as consisting of three mental realms; the unconscious, preconscious, and conscious mind, with the unconscious being the deepest, most inaccessible region of the psyche and which contains repressed memories and unacceptable feelings, thoughts, and ideas. The preconscious serves as a bridge, or passageway between the unconscious and conscious mind, and lies just below the surface of consciousness. Freud believed that unconscious impulses must pass through the preconscious which acts as a double doorway; one door leading from the unconscious to the preconscious, and the other from the preconscious to the conscious mind. In this way, the preconscious can censor information and prevent unacceptable impulses and ideas from becoming conscious. However, the preconscious is also the depository of information which has been pushed out of consciousness, and which may be shoved so deeply underground, so to speak, that the information becomes completely unconscious. Therefore, although separated, these mental realms interact and can influence one another.

Inspired by the theory of nuclear magnetic resonance (NMR), we have built a model of handling a mental qu-bit with the help of pulses of a mental field. Starting with an elementary interaction between two qu-bits we build two-qubit quantum logic gates that allow information to be transferred from one qu-bit to the other. For example, we build the controlled-NOT (CNOT) gate in which, under certain circumstances, the information is transferred from the control qu-bit to the target qu-bit. We also build swapping in which there is a complete exchange of information between two qu-bits. In those manners we build quantum processes that permit consciousness to "read" the

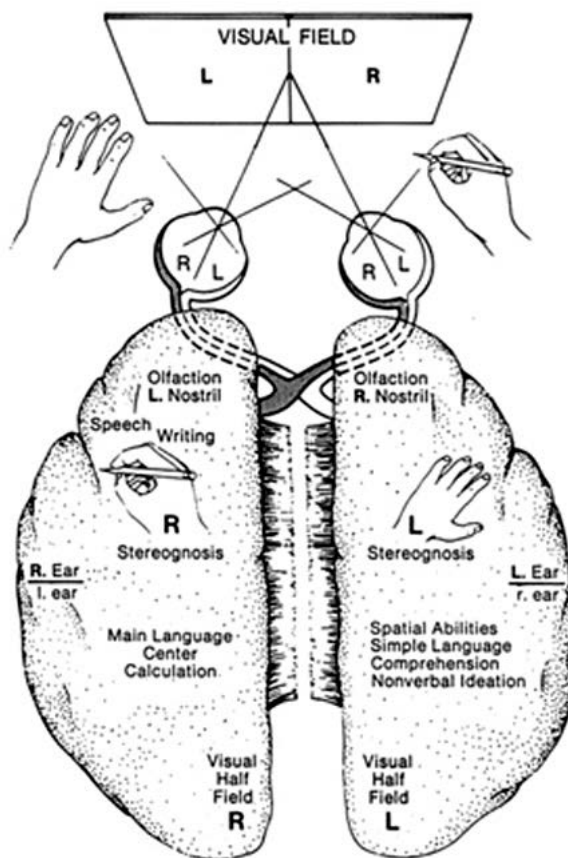
unconscious and vice-versa. The most elementary interaction, e.g. between a pre-consciousness qu-bit and a consciousness one, allows us to predict the time evolution of the pre-consciousness + consciousness system in which pre-consciousness and consciousness are quantum entangled. This time evolution exhibits Rabi oscillations that we name mental Rabi oscillations. This time evolution shows how, for example, the unconscious can influence consciousness and vice-versa.

The pulses of the mental field can be emitted either by consciousness (effects of will or freewill) or by the unconscious (individual, group or collective). As we said, together with quantum entanglement, they can explain the awareness of unconscious components. In this case we can say that consciousness measures the unconscious like an experimental physics device records a microscopic process. As we said, quantum entanglement explains also the influence of the unconscious on consciousness and the reciprocal influence of consciousness on the unconscious. We have studied these two types of influences in the case of mourning and we have seen how they could allow mourning to be achieved with time.

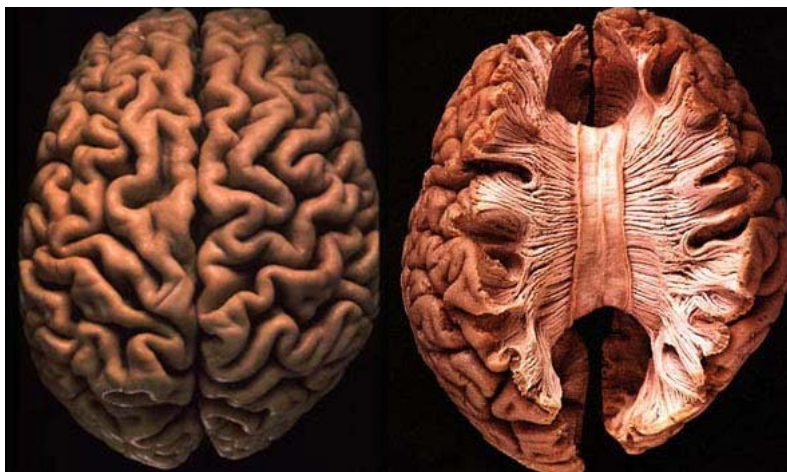
A third mental process, already mentioned above, is the quantum entanglement between two (or several) unconscious psyches. The evolution in time of the state of the two quantum entangled unconscious shows the reciprocal influence of each unconscious on the other one. Then through the interaction of their two unconscious, a psychoanalyst named Alice can help Bob to achieve relief from his mourning.

The fundamental characteristic of the most elementary interaction between two mental qubits, e.g. between a qu-bit of pre-consciousness and a qu-bit of consciousness, is to highlight, as a function of time, oscillations between two quantum states made of two correlated qu-bits; i.e. the states $|I1\rangle|C0\rangle$ and $|C1\rangle|I0\rangle$ (I for "Insight" or pre-consciousness and C for "Consciousness").

Let us notice that at the level of the brain, there is evidence of an alternating activity of the two hemispheres (Joseph 1982, 1988). This oscillation expresses itself in the phenomenon of binocular rivalry (Blake, 1989). When two images are presented to each of the two eyes of a subject, they enter in "competition" so that one image is visible while the other is not. The same happens when the subject is presented with two superposed images, a nice metaphor to represent the superposition of two quantum states.

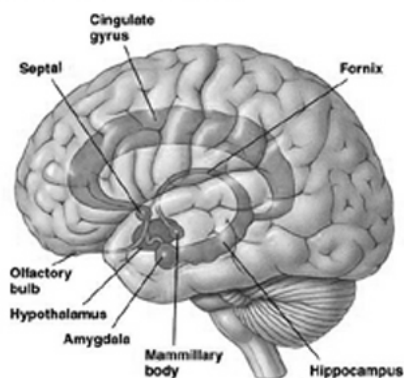


The Right and Left Hemisphere



Joseph (1982, 1988) proposed that this oscillating activity and the different functions controlled by the right and left half of the brain, could explain some mental phenomenon associated with the conscious and unconscious mind, with the corpus callosum, a major cord of nerves, linking the two brain halves and thus acting as a bridge between these two mental realms. This is similar to Freud's concept of the preconscious linking the conscious and unconscious mind. Further, Joseph (1982, 1988) linked this oscillating activity to dream recall vs dream forgetting, with the right hemisphere (the domain of visual-spatial imagery and social-emotion) producing the dream during high levels of oscillating activity, and the left (the domain of language and verbal thought) forgetting the dream due to low levels of activity.

Mental (Rabi) oscillations are still to be studied. In particular in the case of the "asleep" consciousness, the unconscious + consciousness system (or at least a part of this system) constantly oscillates between the states $/U1 > /C0 >$ and $/C1 > /U0 >$. A pendulum does not measure time. For this we need a system that keeps the memory of the number of the oscillations of the pendulum. This is a function of a clock, which measures time. In a clock the oscillations of the pendulum have a cumulative effect that allows us to keep the memory of the number of oscillations. In the case of the Rabi oscillations of the unconscious (pre-consciousness)+ consciousness system, we have to imagine a system, correlated to the first one, that is subject to cumulative effects and that allows to memorize the mental Rabi oscillations. In this case, it is only thanks to the storage of the mental Rabi oscillations that consciousness or preconsciousness or the unconscious can be modified.



The Limbic System

At the level of the brain this memorization can be actuated by the limbic system, and in particular by the hippocampus (Joseph 1992). To be more specific, the limbic system is the domain of our emotions, and is classically associated with the "four F's": feeding, fighting, fleeing, and sexual behavior. The amygdala and the hippocampus are some of the main structures of the limbic system, with the amygdala playing a major role in emotional memory, and the hippocampus in storing non-emotional memories. So, in some respects, the limbic system could be compared to the unconscious (Joseph 1992). The limbic system is part of the old brain, and is buried beneath the new brain, which consists of "new cortex," i.e. neocortex. It is the neocortex, particularly that of the left hemisphere, which we associate with human thought, language, rational behavior, and the conscious mind. However, it is the limbic system and the right hemisphere which become most active during dream-sleep (Joseph 1988, 1992).

For an asleep consciousness the perturbations coming from the environment are weak. In these conditions, the mental Rabi oscillations may extend over a time that can be long, probably of the order of several minutes, or more. The situation is totally different for an awoken consciousness. Its interaction with the environment, which operates

via the sensory system, perturbs the interaction between pre-consciousness and consciousness and therefore interferes with the oscillations that, as a consequence, cannot last very long. The time for the awakened consciousness to receive an external stimulus being of the order of half a second. The Rabi mental oscillations cannot last more than that.

From a neurological perspective, this can be explained as follows: During dream sleep the left half of the brain is at a low level of activity and it cannot perceive or respond to outside sensory impressions unless they are sufficiently arousing they trigger wakefulness. By contrast, because the right half of the brain and limbic system are at a high level of unconscious-activity during dream-sleep, they can respond to external stimuli (Joseph 1982, 1988). This explains how external stimuli can become incorporated into a dream. A typical example, the dreamer is walking down a strange street when a little boy on a bike rides by ringing a bell. The bell is so loud the dreamer wakes up to discover the alarm clock is ringing. However, upon achieving full awake consciousness, the awake-consciousness may forget the dream; that is, the awake part of the psyche (the left hemisphere) forgets the dream which may remain stored in the limbic system of the right hemisphere. However, later that day, the awake dreamer sees a little boy on a bike ringing his handle-bar bell, and the awake dreamer experiences synchronicity; he remembers his dream.

This same framework can be applied to individuals who engage in the same behaviors. They may respond, unconsciously, to the same stimuli which, for a variety of reasons may not be perceived by the conscious mind. Moreover, these unconscious realms are more closely attuned to the collective unconscious and most probably to *theunus mundus*, the unified reality from which everything has its origin, and from which all things emerge. Although not perceived by the conscious mind, the unconscious does respond, and then influences the conscious mind of different individuals, who then engage in the same behaviors or come up with the same thoughts or ideas.

3 Conclusions

In summary, some mental phenomena are not explainable in the framework of what we call "classical" mechanics. Let us cite, among others, the phenomenon of awareness, the correlations at a distance between individuals, and more generally the synchronicity phenomena. These three types of phenomena can be explained in the framework of quantum mechanics, particularly, thanks to quantum entanglement for the correlations at a distance between individuals (synchronicity phenomena of type I) and thanks to what we can call *the classical illusion of the collapse of the wave-function* for the synchronicity phenomena of type II.

Let us notice that the existence of synchronicity phenomena prevents the mental states to be reducible to physical states of the brain. The mental states are correlated to such states, probably via quantum entanglement, but they are not reducible to those states. Therefore this invalidates the materialistic hypothesis.

The projection of our subjectivity in the environment in which we live (synchronicity phenomena of type II), in agreement with quantum mechanics, refutes the local hypothesis ("each individual is in his parcel of space-time") as well as the realistic hypothesis ("the object has a reality well defined independent of the subject who observes it").

As an end let us mention a quantum effect that can have important consequences in mental phenomena, for example for awareness (for the emergence of consciousness). It is the Bose- Einstein condensation, in which each particle loses its individuality in favour of a collective, global behaviour.

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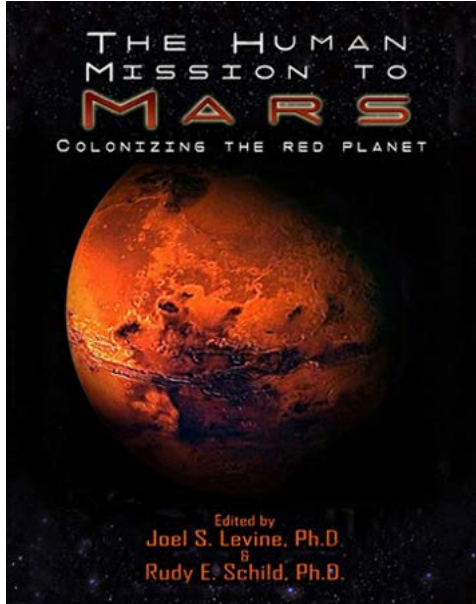
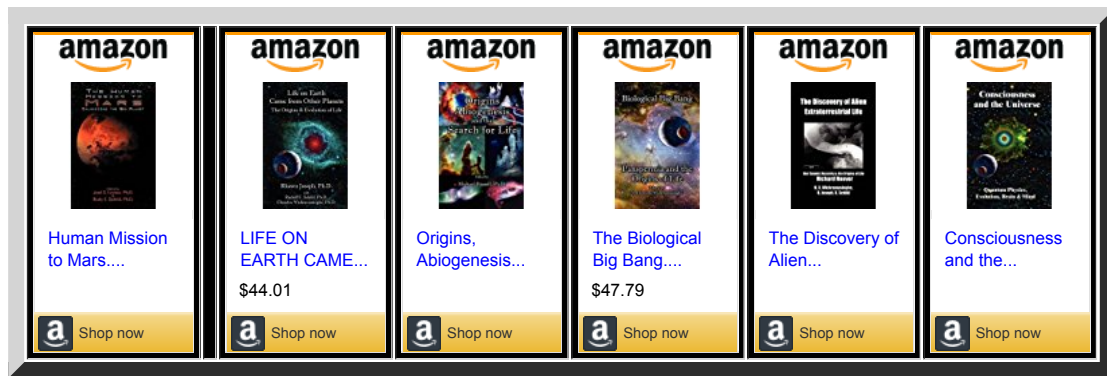
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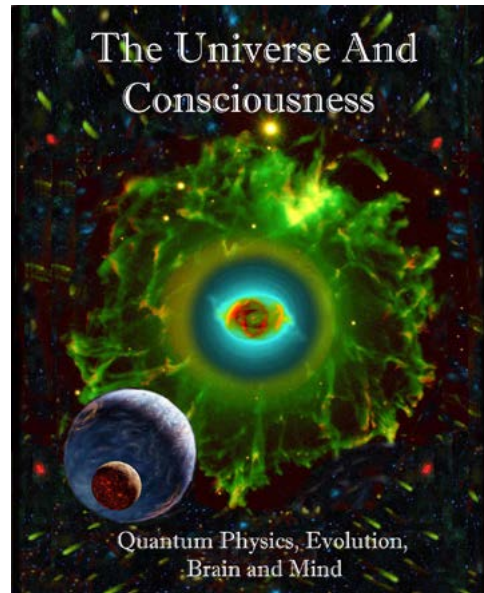
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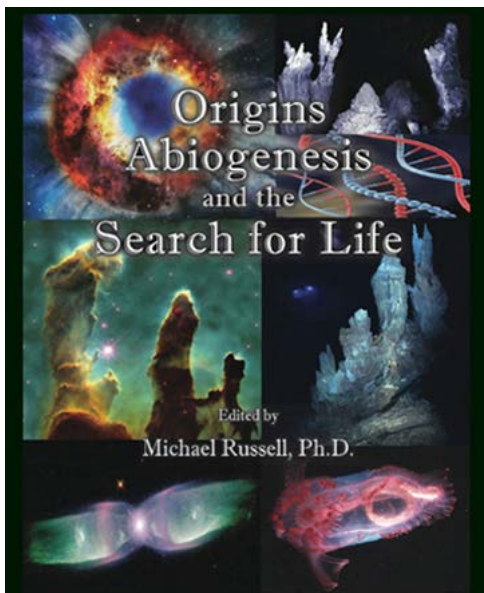
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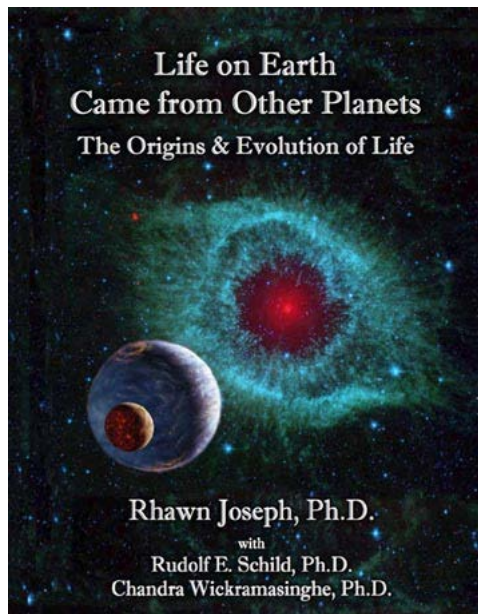
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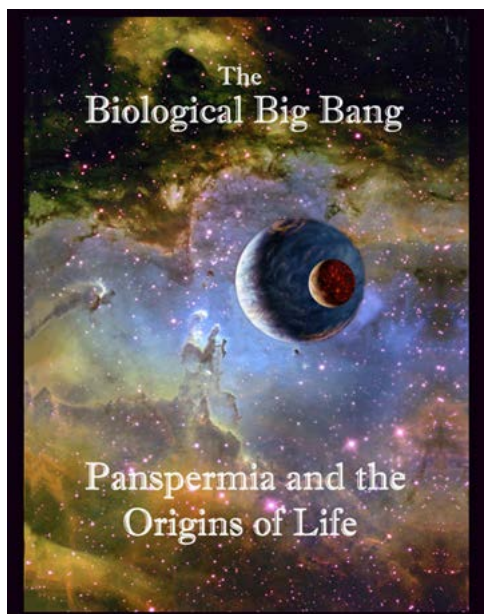
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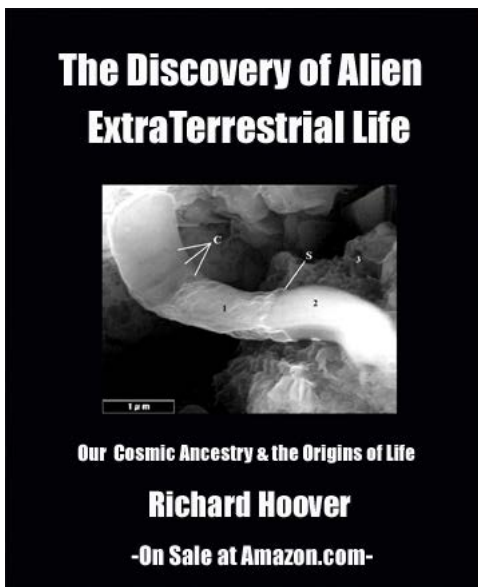
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