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A Quantum Explanation of Sheldrake's Morphic Resonance

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Morphogenesis -- the growth of form from a single cell embryo -- is a problem of biological order of unprecedented precision timing of correlated events of both spatial and temporal nature. One doesn't see anything like this in dealing with inanimate matter. Naturally, beginning with Erwin Schrodinger, an impressive group of scientists have suggested that the currently known laws of physics may not be enough to explain Morphogenesis. Many biologists have propounded the idea of a morphogenetic field -- a condition of space that retains the memory of the form that the embryo evolves towards under the guidance of the fields. But these earlier works hold on to the concept of local fields and also to the materialist belief in "upward causation" -- the supremacy of matter as the cause of everything.

But morphogenesis has overtones of **teleology** (the idea that some final purpose is driving the system) to many. And the biologist **Rupert Sheldrake** has injected new principles in the old idea of morphogenetic fields to incorporate teleology, non-locality, and downward causation. His morphogenetic fields are purposive and non-local. They are not material. They are capable of downward causation in matter through a new principle called "**morphic resonance**". According to Sheldrake, as soon as a new form comes about, it sets up its own field which is continually reinforced with its ongoing replication, thus explaining the memory exhibited in morphogenesis. However, there is the question of the source of the morphogenetic fields that resonate with matter -- an implicit dualism.

The purpose of this essay is to show that although dualistic in its original form, Sheldrake's ideas can be given sound footing on the basis of Quantum principles applied in the conceptualization of the living cell within the context of a new science -- **science within consciousness**, a science based on the primacy of consciousness.

I will first engage in a brief review and critique of Sheldrake's theory. Next, I will take up the necessity of a new formulation of biology within the primacy of consciousness and indicate how Sheldrake's theory is a precursor and a special case of this new theory. The dualist objections against this new theory (as well as against Sheldrake's) are next resolved. A quantum explanation of morphic resonance is then given. The question of experimental verification is briefly discussed.

Sheldrake's Theory: How Form is Remembered

A real problem of morphogenesis is non-locality -- how local interactions can control global development. How does a cell in the big toe know where it is with respect to the whole body so that its function in form-making is switched 'on' appropriately so that the cell can do what is required of it at its position in the toe? If the blueprint of switching is itself in the DNA (as materialist biologists would

have it), then how does the toe cell know only to activate the relevant part of the blueprint? We can see that there has to be a "**metaplan**" -- a meta-blueprint that functions in a non-local way, both spatially and temporally. Somehow the micro DNA strand of one single cell has to exert influence on a vast collection of cells spread across a Macro region of spatial volume and over the whole time that the embryo development takes.

In materialist theories (apart from the concept of particles), there is also the concept of "force fields". The difference between the 2 concepts is interesting. Whereas particles are discrete, fields form a continuum. They have a wholeness. For example, if we cut a magnet that generates a magnetic field, we get 2 of the same magnetic field -- not 2 halves of the original one. This generates the idea that perhaps the **holistic field** concept has some usefulness for discussing a holistic phenomenon such as morphogenesis in biology.

The field concept has been used in biology quite powerfully and in connection with morphogenesis by the theoretical biologist **C.H. Waddington**. Waddington had a flare for language. He created important words in his characterization of the morphogenetic field called "chreode", which is a "canalized" pathway in an "epigenetic landscape". As an illustration, consider the motion of the ball sliding down a landscape of hills and valleys. The ball follows particular valleys. Its motion downward is canalized. Similarly, the development of particular parts of the embryo is canalized toward particular end points. The canalized motion of the ball is relatively immune to perturbation because of the hills that separate it from other neighboring valleys. Similarly, says Waddington, the canalized development of the embryo is also immune to small amounts of environmental perturbations. But Waddington's fields -- interesting as they are as an idea -- will not do for morphogenesis for they are local. **[StealthSkater note: Col. Dr. Tom Bearden has remarked on Waddington's ideas often in his essays on scalar waves. Examples are archived at [doc](#) [pdf](#) [URL](#)]**

So is it the morphogenetic field that tells the particular DNA of a cell which part of the form-making plan to activate? They can if a plan is stored in the fields themselves which are non-local, said a botanist Rupert Sheldrake catching the biological world by surprise and antagonistic reaction. Suppose the DNA are just receivers (like radio receivers) rather than the generators of the information of the plan. Radio receivers can receive a signal because they resonate with the electromagnetic wave of the signal. Similarly, the DNAs receive the morphogenetic signal (the instructions for activation of a particular part) via morphic resonance.

Thus Sheldrake explicitly deviates from materialist models of biology where everything is assumed to be the product of upward causation, emergent as they may be. Morphic resonance is Sheldrake's way of introducing downward causation in biology. The purposiveness exhibited in biological form-making arises from this downward causation, so says Sheldrake.

Of course, since the plan is global and non-local, Sheldrake's morphogenetic fields also have to be non-local. And here, Sheldrake is departing from the philosophy of scientific or material realism (according to which nothing can exist outside of matter and its rules of locality). And Sheldrake (see article in this volume) is explicit about the non-locality of his "morphic" (short for morphogenetic) fields -- a non-locality, he says, that may even be of Quantum origin.

Morphic resonance is also postulated to be the basis of memory or repetition of living forms. Morphic resonance consists of influence of "like upon like" previous patterns of form on present patterns of form, reinforcing the pooled memory of the species.

In this way, Sheldrake's morphic fields are different from any other postulated in biology by virtue of his bold hypothesis of (a) downward causation and purposiveness; (b) non-locality; and (c) morphic

resonance with memory property. Indeed, with these properties of morphic fields, all of the difficulties of biological morphogenesis of materialist theories are resolved.

But Sheldrake's morphic fields have an implicit dualism. They are postulated to transcend matter. They are capable of influencing matter. But Sheldrake is silent about the source of the morphogenetic fields. Resonance phenomenon in radio needs electromagnetic wave propagation between a source and a receptor. In Sheldrake's theory, there is the receptor (the living object) and there is the information being received (the morphogenetic fields). But the source is left ambiguous and implicit. Perhaps this was because Sheldrake was aware that any explicit talk of a source will be attacked as dualism. But leaving out the source of morphogenetic information is the reason that Sheldrake cannot explain how the first such field comes into being. He leaves it to "some inherent creative intelligence in mind and nature".

I will show that Sheldrake's intuition is correct, and that this intelligence is consciousness itself looked upon as the ground of all being. Consciousness acts on matter in conjunction with a vital body that contains the blueprints of biological forms. That is the source of morphic information. (Here I am generalizing the use -- in Chinese and Indian medicine -- of the vital body as the container of the blueprints of health.) And the function of morphic fields and resonance is carried out by consciousness simultaneously choosing actuality from possibility forms of both the vital and the physical body of an organism. And yet, this process does not involve dualism. Instead, the process involves self-referential quantum measurement (see later).

In passing, let me mention one more thing. Sheldrake extends his theory of morphic fields also to nonliving things such as crystals. In the new theory expounded here, the non-living is excluded from the context of morphogenesis. This enables us to clearly distinguish between Life and non-Life. Life is where self-referential quantum measurement can take place (see later) via which consciousness imbues vital meaning to living things. Crystal has form, but its forms have no intrinsic meaning other than what we ascribe.

Who Programs?

Materialist biologists talk about programs of morphogenesis stored in DNA, but is stymied by the question of who programs the DNA, the biocomputer? The only answer for the materialist is environmental conditioning driven by competition for survival and natural selection. Furthermore, as Gregory Bateson pointed out a long time ago, computer learning is low-level learning. It is learning by rote, memory. Computers cannot learn the context of learning. In other words, they can learn within fixed contexts, but they cannot change contexts. In other words, genetic programming may be adequate for understanding morphogenesis under ordinary circumstances, but not for situations where regulation or regeneration of forms (see later) takes place. Nor is genetic programming able to explain how a new context for morphogenesis is learned.

Another difficulty with the concept of genetic programming (within the strict materialist philosophy I have already mentioned) is that classical programs can never simulate non-local behavior. So even with genes forming a cooperative program, can we understand the non-locality of morphogenesis with this concept?

In science within consciousness, we propose that there is a creative programmer -- consciousness itself. Consciousness is creative and changes the contexts of learning in the programs of the living cell. Not only is morphogenesis explainable with this hypothesis but also is the evolution of new forms. And not only morphogenesis and evolution, but the door is also opened to understand Life itself as a manifestation of consciousness as different from insentient matter.

For Life, there has to be a new organizing principle. But it is unlikely that such organizing principles reside in matter emerging at the appropriate level of complexity. But if downward causation and purpose are phenomena of consciousness, and if consciousness is the organizing principle for Life, how does consciousness intervene into the behavior of matter that make up the world of manifestation? If the world really ran by Newtonian laws, there would be no way for such intervention.

Fortunately, the world is not Newtonian. Ever since the beginning of this century we have been discovering the novelties of a new mechanics that originated with the study of motion of submicroscopic objects. The matter of the world obeys this new mechanics called Quantum Mechanics. But this mechanics lacks closure, thus making room for consciousness to intervene in the affairs of matter. Quantum Mechanics -- broadly interpreted within the philosophy that consciousness is the ground of all being (perennial philosophy or monistic idealism) -- gives us an adequate science of becoming in the biological world.

There is one more important question -- the question of meaning. Computers process symbols but not the meaning of symbols. The meaning exists in the mind of the programmer. Computer scientists routinely assume such a psychophysical parallelism in their theories as discussed by Varela, Thomson, and Rosch, and even by Dennett. Similarly, the meaning of living functions and attributes such as maintenance, reproduction, evolution, and form must be carried in a separate body within consciousness. This body is traditionally called the "vital body". In Eastern medicine of both China and India, the concept of the "vital body" is crucial. There is ample empirical knowledge of it in those traditions.

In summary, we need a theory of bio-physical parallelism -- a simultaneous and parallel functioning of a vital body and a physical body. But the introduction of the vital body (and consciousness) in biology surely raises the specter of dualism. It is the solution of the problem of dualism with the help of quantum measurement theory that makes science within consciousness a viable concept for biology.

How Consciousness Creates Biological Order Without Dualism

It is well-known that Quantum Mechanics is not deterministic but probabilistic. Quantum mathematics (the Schrodinger equation) calculate possibility waves (the wave functions, the square of which determines probability). Normally for doing physics and chemistry, since one is always dealing with myriad objects, the probability calculus works in a statistically deterministic fashion and dealing with grave questions of philosophy can be postponed. But this is not possible in certain situations of biology because a single system -- such as a single living cell (assuming that there is a quantum mechanism within the cell) -- is involved.

For a single system, the question of quantum measurement become paramount. Who-or-what collapses the possibility wave into actuality? The possibility wave is a superposition of eigenstates. The process of measurement is always found to have reduced the superposition into a single eigenstate. But what causes this reduction? The mathematician John von Neumann said that consciousness does.

When we look, when we measure, we choose the space-time actuality from superpositions of possibilities that exist in transcendent potentia. But von Neumann's idea that it is consciousness that brings into being the world of manifestation from the transcendent possibility waves of Quantum Mechanics met with considerable resistance. It was labeled dualistic. How can consciousness act on matter without violating the law of Conservation of Energy? If there are 2 simultaneous observers, whose choice counts for the outcome? Many alternative resolutions of the quantum measurement

problem were proposed (e.g. hidden variables) to close down this window of idealism. But none succeeded.

Progress toward opening the window of monistic idealism came in 3 steps. The first step was an epoch-making discovery in 1964 by the theorist **John Bell** [7]. Bell showed that the introduction of hidden variables into Quantum Mmechanics (i.e., a resolution of the quantum measurement problem suggested by many physicists) conflicts with the locality principle of material realism -- that influence can propagate only within the Einsteinian speed-of-light limit. But the basic non-locality of Quantum Mechanics has been verified experimentally by Alain Aspect and his collaborators in France.

In the crucial second step, ignoring conventional wisdom, E. Harris Walker, Fred Alan Wolf, Ludwig Bass, Stuart et al, Henry Stapp, and John Eccles all proposed -- implicitly or explicitly -- that our consciousness is related to the processes of quantum measurement in the brain.

This opened the door for my own work -- the third step. The measurement problem is squarely resolved when we turn the metaphysics of science upside down and posit consciousness as the ground of all being and thus -- having causal efficacy -- downward causation. What else can we say about a consciousness that collapses the quantum possibility wave into actuality? All objects are quantum objects. Therefore, any machine -- such as the ones called "measurement apparatuses" that we use to amplify a quantum phenomenon -- itself becomes a possibility wave (a superposition of Macroscopically distinguishable possibilities) when in contact with micro-quantum possibility waves that they purport to measure. This includes such measurement apparatuses in our brain. Consciousness can collapse the whole conglomerate because it transcends the material Universe. Does such collapse constitute mind over matter? No, consciousness transcends the brain, whose states exist as possibilities within consciousness before collapse. Collapse consists of recognition and choice of one of these possibilities.

If 2 people simultaneously make an observation, whose choice counts (a slight variant of this paradox is sometimes called the paradox of Wigner's friend)? Neither's. Consciousness is one, unintuitive. Our individual separateness is only an apparent one arising from the reflection of experience for a repeated stimulus in the mirror of memory (conditioning). If a tree falls in the forest, is there a sound if nobody is there to hear it? Centuries ago, Bishop Berkeley said that there is always God to hear the sound, so the sound is there. But not so with quantum measurement.

If transcendent consciousness is always looking and collapsing, quantum possibilities would never develop and all the wonderful phenomena of quantum physics that give us the technologies of computers, lasers, and superconductors would be impossible. The solution is to realize that consciousness collapses the possibility wave only in the presence of brain awareness of an immanent observer. The measurement is **tangled-hierarchical** and produces self-reference -- our ability to distinguish between us, subjects, and the objects we experience.

To see the meaning and importance of the last statement, consider the liar's paradox -- the sentence "I am a liar". Notice that as the predicate of the sentence defines the subject, the subject of the sentence redefines the predicate. If I am a liar, then I am telling the truth, but then I am lying ... and so on ad infinitum. This is called a "tangled hierarchy" because the causal efficacy does not lie entirely with either the subject or the predicate but instead fluctuates unendingly between them.

But the real tangle of causal efficacy in the liar's paradox is not in the sentence "I am a liar". It is in our consciousness, in our knowledge of the meta-language rules of the English language. Try the paradox with a foreigner. She will ask "Why are you a liar?", failing to appreciate the tangle because the rules of meta-language are obscure to her. But once we know and abide by these meta-language rules,

looking at the sentence from "inside" we cannot escape the tangle. When we identify with the sentence, we get caught. The sentence is self-referential -- talking about itself. It has managed to separate itself from the rest of the world of discourse.

Thus, realizing that the quantum measurement in an observer's brain is a tangled-hierarchical process helps us to understand our self-reference -- our capacity to look at the (collapsed) object of our observation separate from us, the subjects. Note also that this subject-object split is only appearance, just as the self-referential separation in the liar's paradox of the sentence from the rest of the world of discourse is only appearance. The subject that collapses, that chooses, that observes (or measures), that experiences dependently co-arises with awareness of the object(s) that are observed and experienced. They dependently co-arise (as appearance) from one undivided, transcendent consciousness and its possibilities. When consciousness identifies with the subject, there is (apparent) separation -- the subject-object split. Notice how, in this description, dualism is avoided because ultimately there is only undivided consciousness.

Notice also that the self of self-reference in the quantum measurement of an unlearned stimulus operates with complete freedom to choose from the Macroscopically distinguishable quantum possibilities offered by the brain (in other words, with creativity). However, due to conditioning, the freedom of choice is compromised for a learned stimulus. As a result of experience, the self thus acquires a conditioned mode, conventionally called the "ego". Therefore, in a self-referential system, consciousness can act in and identify with 2 different modalities: one is creative or quantum modality, and the other is conditioned or classical determined modality.

To make quantum measurement theory relevant in biology, we must postulate that self-referential quantum measurement already takes place in the living cell and is responsible for the split of one consciousness and its possibilities into life and environment. This gives us a profound distinction of the living as opposed to non-living.

This also opens the door for the explanation of both creative and conditioned modalities of biological evolution in the theory of punctuated equilibrium. According to this theory, the famous fossil gaps represent rapid evolution that gives rise to speciation. In between rapid epochs of speciation, there is gradual neo-Darwinian evolution which maintains species homeostasis. In my theory, the rapid evolution is due to discontinuous, creative quantum leaps in the quantum mechanism of gene mutation in the cell. In between, the cell operates in the conditioned modality which is continuous and gradual -- in other words, neo-Darwinian.

Now to the problem of bio-physical parallelism introduced in the previous section, how can we avoid dualism there?

Avoiding Dualism in Bio-physical Parallelism

Vitalism was rejected in biology because of its problem with interaction dualism (faced by all Cartesian type of dualism in general). If there are 2 separate dual bodies, what mediates their interaction and without violating conservation laws such as the Conservation of Energy? If the vital body exists in a parallel existence with the physical in exact correspondence (biophysical parallelism as enunciated by Leibnitz), the problem of dualism still larks. What maintains the exact correspondence?

The solution that idealist quantum measurement theory gives us is this: Consciousness mediates the parallelism between the physical and the vital body. This is not dualism, because consciousness simultaneously collapses (non-locally) the quantum possibilities of the physical and vital bodies for its self-referential experience. These quantum superposition of possibilities already exists within

consciousness which is only choosing by recognizing a particular possibility. Thus, it is not "mind over matter".

This resolution of the problem of dualism requires that the vital body be a quantum body (i.e., its states describable by Quantum Mechanics as waves of possibility).

Evidence of the quantum nature of the vital body can be found in our own experience. Although "vital body" talk is unfashionable in the West, it remains the basis for Eastern medicine. The modes of the vital body are variously known as *prana* in India, *chi* in China, and *ki* in Japan. But in all these cultures, one always finds a complementary mode of description of the vital modes common to quantum modes of movement. For example, *chi* is supposed to have *Yin* and *Yang* aspects. This corresponds to particle and wave complementarity of material quantum objects. Operationally, in Chinese medicine, *chi* is supposed to move in approximately localized paths called "meridians". But it is well known that there is a complementarity between finding the location of the meridian vis-a-vis its direction. This is similar to the Uncertainty Principle of Quantum Mechanics.

More telling evidence for the quantum nature of the vital body is found in the demonstration of non-locality. *Qigong* masters can non-locally affect the vital field of plants enough to enhance or reduce the rate of biochemical reactions involved in plant growth.

It is a puzzling paradox for material realist science that the perception of *chi* are internal and private (and thus one can doubt their existence) in contrast to the physical external, public objects that we share with other people. There is an explanation in our new science of the quantum vital body.

Quantum objects obey the Uncertainty Principle. That is, we cannot simultaneously measure both their position and velocity with utmost accuracy. In order to determine the trajectory of an object, we need to know not only where an object is now but also where it will be a little later. In other words, both position and velocity simultaneously. So we can never determine accurate trajectories of quantum objects.

Although the Macro bodies of our environment are made of the micro quantum objects that obey the Uncertainty Principle because of their grossness, the cloud of ignorance that the Uncertainty Principle imposes on their motion is very small. So small that it can be discounted in most situations. This is the Correspondence Principle. Thus, Macro bodies can be attributed both approximate position and approximate momentum and, therefore, trajectories (their possibility waves spread, but extremely sluggishly). For the physical world, we use the intermediary of the Macro bodies (a Macro "measurement" apparatus) to amplify the states of the micro quantum objects before we can observe them. This is the price we pay -- losing direct contact with the microcosm so that we have a shared reality of physical objects in the Macrocosm. Everybody can simultaneously see the physical Macro bodies.

But vital substance is indivisible. For this substance, there is no reduction to smaller-and-smaller bits. There is no micro out of which the macro is made. The vital world is a whole or what physicists sometimes call an "infinite medium". There are waves in this infinite medium -- modes of movement that must be described as quantum possibility waves obeying a probability calculus. And we directly observe these quantum modes (*prana*, *chi*, or *ki*) without the intermediary of the Macro measurement apparatus (there isn't any).

But there is a price that we pay for the direct experience. The observation and experience of the vital modes of movement (*chi*) are subject to the Uncertainty Principle. What this means is that any observation disturbs the vital object so much so that another observation would not lead to the same

experience of *chi*. Therefore, *chi* cannot ordinarily be shared by 2 different observers. *Chi* is private. *Chi* is experienced internally.

Further note that the quantum picture enables us to think about the physical and the vital worlds differently from what we are used to. Normally, we tend to think of both of these worlds as made of substances (something "concrete"). Sure, the vital substance is more subtle. We cannot quantify it in the same way as we can the physical. But it is still a substance, or so we think. We must change our view. Even the physical is not substance in the ordinary sense, let alone the "vital". Both physical and vital worlds remain as quantum superposition of possibilities until consciousness gives them substantiality by collapsing an actual experience.

The quantum system in the cell along with Macro-measurement apparatuses that amplify its states (and also make a record of the actualized states upon measurement) -- whose states are collapsed in a correlated parallel fashion with the states of the vital body -- can be said to have mapped the blueprint, the meaning, contained in the latter. This is similar to how we write software on computer hardware. The maps are inherited by all the cells of the body of a multicellular organism through cell division. The shared maps can solve some of the profound puzzles of biological morphogenesis.

Non-locality in Morphogenesis

In the 17th and the 18th centuries, morphogenesis was explained by biologists with the hypothesis of "preformation" -- the fertilized egg already contains a tiny form of what is to come later. Of course, modern embryology has proven this theory to be entirely wrong. The embryo of a highly-developed organism starts as a homogeneous structure-less entity that develops in successive stages that shows the evolutionary history of the organism.

But the preformation theory illustrates part of the materialist predicament. In materialism, we look for a materialistic beginning for everything. All development must be contained within the reductive components and their interactions. Materialist biologists have long abandoned the simplistic theory of preformation. They now believe that the genes -- the DNA of the embryo cell -- contains a blueprint of the form that develops. The DNA is analogized to a computer. Its components behave according to programs that contains all the necessary instructions for cell differentiation. But as already mentioned, there is a grave problem in this kind of thinking.

The problem is this. How can local interactions among the components of the DNA give rise to such spectacular non-local correlations as exhibited by morphogenesis? If we think of the DNA as a computer, a classical computer, then the problem is that a classical computer can never simulate non-locality as shown by the physicist Richard Feynman. But if we assume a quantum component to the computing machinery of the cell, then non-locality is no longer a problem.

It is readily recognized that biological correlations exhibited in morphogenesis are not only correlations that persist over distances but also over time. The distance correlations can be understood easily as the play of quantum non-locality. But how about the correlation over time? It turns out that the latter is also the play of quantum -non-locality. The name of this particular play is "**delayed choice**".

The crucial point is that in the quantum picture, the morphogenetic forms take shape first as possibility forms. They are not manifest until a bifurcation of form occurs that necessitates choice. Such a bifurcation may involve a particular form that occurred in the Past or a brand new form. Once collapse occurs, the entire causal pathway leading to the chosen form manifests at once as if by "delayed choice". Obviously this seems teleological -- Future-oriented choice of form. But delayed choice is a

well-known characteristic of non-locality in quantum measurement. It has been verified by laboratory experiments.

Evolution and Morphogenesis: a Quantum explanation of Morphic Resonance

The lesson of the "delayed choice" -- that **possibilities can wait in limbo until consciousness chooses actuality from among them** - is crucial to understand not only morphogenesis but also the creative quantum leap in evolution and how evolution and morphogenesis work together to map the meaning-forms of the vital body onto the physical as physical forms.

I have mentioned creative leaps of biological evolution before. According to neo-Darwinian dogma, Evolution is gradual. But a creative change requires many individual micro mutations at the gene level working together making a Macro-mutation that gives rise to a new phenotype trait leading to a new species. If neo-Darwinist ideas of selection on every individual mutation were at work, most mutations - - since individually they are not beneficial -- would be eliminated. But why assume that individual mutations are selected for or against?

It is a fact that mutations (either point mutations or mutations acquired in gene recombination) are quantum in nature. They are mere superpositions of possibilities before consciousness has collapsed them. Suppose the quantum superpositions of mutated genes wait in limbo until enough of them accumulate to give rise to a phenotype trait leading to new form. Not only the gene mutations are quantum processes, but also the making of form from genes (morphogenesis). Both evolution (of the mutated genes) and morphogenesis of the new trait wait in limbo as superpositions of many possibilities, from among which consciousness can see a pattern that is just right for mapping a meaning-blueprint contained in its vital body.

Why should a form that occurred in the past be chosen? The answer is that forms are conditioned as part of the developmental history of Life. Initially, forms exist as degenerate multitudes of coherent superposition, and the choice among them requires creativity and purposiveness. However, a collapse of a self-referential quantum system conditions the system. Thus once a form has manifested through a creative breakthrough, the probability of its repetition increases.

In biology, since all life is connected to some first living cell, conditioning propagates down-the-line throughout the tree of Life. This is the explanation of why certain forms repeat over-and-over in morphogenesis. In a sense, this is a kind of memory as proposed by Sheldrake. And its manifestation does involve non-locality. But the mechanism is quantum. In other words, we have arrived at all the virtues of Sheldrake's theory of morphic resonance without the implicit dualism.

Regulation and Regeneration

In the 1890s, the embryologist Hans Driesch discovered that if we destroy half of the young embryo of a sea-urchin, it is able to recover from the loss and develop into a complete sea-urchin (not just half) albeit a small one. This phenomenon is now called "**regulation**".

The prevalent theory in Driesch's time was that the early embryo is like a mosaic of independently developing parts according to which the severed sea-urchin would have grown into a half sea-urchin. His experiment persuaded Driesch to give up materialistic models altogether and opt for the idea of **entelechy** -- a non-material causal factor of Aristotelian vintage that guided a living system holistically. Unfortunately, Driesch's thinking was dualistic and was easily rejected by the scientific establishment for that reason.

In the present theory, we have quantum probability forms that have non-locally correlated wholeness. But they are possibilities within consciousness -- not separate and dualistic. The present theory, therefore, is able to explain why the body is able to mend certain harmful stimuli if early enough in development. If the stimuli catch the system still in the possibility domain, the system is able to work around the intruder with an alternative pathway. But at later stages when part of the causal pathway has been manifestly laid out by the collapse of the wave function, this accommodation will be difficult. This is what is found experimentally.

A similar phenomenon is regeneration. A flat worm can be severed into many pieces. But each piece can regenerate to grow into a new flatworm. Similarly, a hydra can grow back its tentacles. Even we humans have some leftover regenerative power -- i.e., broken bones and severed nerves can heal. And of course, a plant has the most spectacular regenerative power. We can take a cutting from it and grow it into a new plant. What is the quantum explanation of this? Or is there any?

Regeneration is quite different from regulation. Notice that in regeneration, the parts are quite independent of one another. They are just conglomerates of cells without any holistic function. In this case, the quantum (and the classical machinery required for amplification) of each severed part are complete by themselves and can grow by themselves. Of course, the vital body is always available with its meaning/blueprints to guide the way.

Quantum Healing

Sheldrake's idea of meta-plans (the morphic fields) of meaning/blueprints for the physical body forms has revived interest in Eastern medicine. It is a tradition according to which the "vital body" -- not the physical -- holds the blueprints of health. Recently, many cases of rapid and discontinuous healing have been found for which a quantum explanation is being sought. The present theory of bio-physical parallelism clarifies how a quantum healing mechanism may work.

What is "disease"? So far as the conditioned maps of the body form work properly, we are healthy. But due to the ongoing interactions with the environment, a defect may develop. The existing pathways of body functioning may misinterpret the defect and further exacerbate the problem. An example of this can be found in coronary artery clogging.

How does quantum healing work? Since the blueprints are available in the vital body via intention and imaginative, creative efforts, a patient may be able to use these blueprints to make new pathways of body functioning leading to healing.

Comments on Sheldrake's Proposed Experiments

Sheldrake has lamented that he has not been able to think of decisive experiments to test his hypothesis of formative causation through morphic resonance in living systems such as microorganisms, plants, and animals. It is equally difficult to think of new experiments to verify the quantum mechanism above. And I will not attempt to do it here.

In his early work, Sheldrake concentrated on experimental tests on detecting changes in the probability pattern due to learning en masse in societies of organisms. The results were inconclusive and controversial.

Should somebody else's learning a new thing affect my learning it? In the quantum picture, it can if I and the other person are non-locally correlated through intention. Thus some of the successes of the Sheldrake-tests can be attributed to the presence of proper intention ... and the failures attributed to lack of intention.

More recently, Sheldrake looks for tests of his theory in experiments of non-locality in societies of organisms (see his article in this book). It is easy to see that all experiments of this category to verify Sheldrake's theory can also be explained as quantum non-locality.

Conclusions

I think that Sheldrake's theory of formative causation via morphic fields and morphic resonance will go down in History as a bold departure in the right direction in that he introduced many of the right elements -- downward causation, purpose, and non-locality -- in his theory. Because of its bold initiative, Sheldrake's theory inspired many scientists (including this author) to investigate similar ideas in other fields. I have already cited the renewed interest in Eastern medicine as an example.

However, Sheldrake's theory contained an implicit dualism. Furthermore, he did not go far enough in recognizing that consciousness is the creative organizing principle behind biological evolution and morphogenesis.

In this article, I have outlined how a more complete theory can be formulated using quantum measurement theory in the context of a science within consciousness. It retains all the novelties of Sheldrake's theory but without dualism. The current theory has the further virtue that it applies to all Science -- not just to morphogenesis. By basing science on the primacy of consciousness, the current theory also integrates Science with *Spirituality*.

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