The Hypothesis of Formative Causation:

(according to Rupert Sheldrake, Sheldrake Online)

The concept of morphogenesis involves such topics as ‘what causes plant embryos to develop into the characteristic shapes of their species?’ The word morphogenesis comes from the Greek word *morph* (form) and *genesis* (coming into being). Yielding a definition of morphogenesis as ‘the coming into being of form.’ This, as unusual and surprising as it may seem, is something science cannot explain –as yet. The unproven belief that modern mechanist scientists would have you believe is that all morphogenesis is genetically programmed. Some say that the inadequacy of this explication is two-fold: (1) All the cells of the body have the same genetic makeup –nevertheless something is causing differentiation of their structure and function– if they are all programmed the same way, why do they develop so differently? And (2) the genetic makeup of any cell was explored to the utmost in the human genome project where the simplicity of the 4 base cipher that codes only for the primary structure of the protein molecules of an organism was made evident. These are two points that shall be elaborated on further during the course of this section. Some genes code for the sequence of amino acids in the primary structure of proteins, others code for the control of protein synthesis. But this alone cannot account for form as we see it around us today. Something over and above genes and the proteins they code for is needed to explain form. An example given is that of a the buildings of a city whose structural makeup is identical (i.e.: concrete, steel, etc) but whose design is quite different and whose shape was determined by the blueprints of an architect. Demolishing the building and analyzing it’s parts would yield no evidence of the architectural blueprints. The same is with the human form ( representing the buildings design) and the structural constituents (representing the DNA), the blueprints are elsewhere; and this search for these ‘blueprints’ has characterized the science of morphogenetics since the mid 1920’s. The mechanists seem to believe that be tearing apart the building, piece by piece and by labeling and identifying each element thereof, we can find the blueprints somewhere inside the building. Other scientists came up with the theory of *morphogenetic fields.* These fields underlying the development of form in organisms are not designed by a conscious architect-like entity, but rather are self-organizing fields of influence analogous to magnetic fields and other such recognized fields in nature. (Self-organizing in the same sense that natural selection is self-organizing). We seemed to have exhausted the depths of the DNA molecule and uncovered anything that mechanists could have used to label as a cause for morphogenesis. With the completion of The Human Genome Project there are astronomical implications, not because of what they found, but because of what they didn’t find and because of what they now proved does not exist. There is no physical mechanism that might be the cause of morphogenesis. Sheldrake’s theory of morphogenetic fields arises from this, and has three key concepts, (1) Morphogenetic fields are a new ‘kind’ of field, and possibly, as yet unrecognized by physics, (2) These fields evolve, have history and an inherent memory and are given by a process he has named *Morphic Resonance,* and (3) they are part of a larger family called *Morphic Fields*. There is a wholeness defined by the characteristics of the Morphic field established in and around a system. This wholeness is greater than the sum of it’s parts, which are themselves aggregates greater than the sum of their smaller parts, and so. These morphic fields can be defined as regions of influence in space-time, in and around systems they organize. Some important things to note are that these fields work probabilistically, restricting and imposing order upon the inherent indeterminism of the fields they organize. Acting by canalizing morphogenesis towards a characteristic endpoint, a common goal, these fields exercise embryonic regulation. An analogy, which best describes this process, is given by the British biologist C. H. Waddington: He visualized canals down which balls could roll, toward a characteristic endpoints. The rolling ball represents the development of a particular part of the embryo toward its characteristic mature form. Disturbances in the canal and the rolling (development) of the ball (embryo) may push the ball up the side walls of the canal, but unless the ball is pushed over the top of the side wall it will return to the original course heading toward the same endpoint. It will not return to the same location from which it left, but rather it will pick up development further down the canal. This describes the process of embryonic regulation, by which a developing organism can reach a normal mature form despite disturbances in its development. However, the most controversial aspect of this hypothesis is that these fields (canals) themselves evolve. Through repetition the patterns they organize become increasingly probable, increasingly habitual. And so we say these fields have a type of memory. The first field of any given type comes into being through a creative jump. (Ex: when Darwin came up with his theory of descent with modification.) The source this creativity is unknown to me, and is not dealt with in this experiment. Once this new field or pattern comes into being, then, if it survives natural selection, through repetition this morphic field becomes stronger. The more it occurs, the greater the probability of its reoccurrence. The fields contain a kind of cumulative memory and become increasingly habitual. According to Dr. Sheldrake, and this point of view, nature is essentially habitual, “even the so-called laws of nature may be more like habits.” (From an interview with Dr. Sheldrake, online.) The means by which the pattern in transferred is called morphic resonance. Morphic resonance involves the influence of like upon like. Thee greater the similarity between organisms, the greater the influence of morphic resonance. It is assumed that this influence passes through or across space and time –that they are not subject to decay when tested across large expanses of time and space as opposed to what we would expect most other fields in physics to do so. Morphic resonance is the basis of the inherent collective memory in fields at all levels of complexity. Any given morphic system tunes into previous similar morphic systems. E.g.: a kangaroo embryo tunes into previous similar systems, in this case, previous developing kangaroos and in doing so is attracted towards the characteristic endpoint of a more mature kangaroo, as it draws upon (and contributes to) the collective or pooled memory of it’s species. There is another similar hypothesis developed along these same lines, by a scientist named C. G. Jung, in which he proposes the existence of a “collective unconsciousness” within the human realm. The hypothesis of formative causation dwells upon essentially the same principal, however, applied to the entire world of nature. The hypothesis of formative causation predicts that morphic resonance should be detectable in the physical realm; however, old established systems (like common crystal patterns) are governed by such strong morphic fields (such deep habits) that little change can be observed through experimentation. Some more such examples are: hydrogen atoms, salt crystals, and hemoglobin molecules. These types of systems have existed for so long and have been developing countless billions of times to the extent that any morphic fields influencing them have now become as fixed laws governing them –or at least that is how these systems behave. In contrast, new systems should show an increasing tendency to come into being the more they are repeated. (New ideas, new patterns of behavior, new organisms, new crystals, etc). It is assumed that morphic resonance involves non-local effects in both space and time. (It is this assumption that will comprise the focal aspects of my research and experimentation). A summary of the hypothetical properties of morphic fields, as outlined by Rupert Sheldrake, follows:

1. They are self organizing wholes
2. They organize spatio-temporal patterns of rhythmic activity.
3. Systems under their influence are attracted to characteristic goals. They organize the development of these systems and maintain their integrity.
4. Morphic fields contain within them other morphic fields, which contain within them other morphic fields and so on. The fields are in an organized hierarchy.
5. They are structures of probability and their organizing ability is probabilistic.
6. They contain a built-in cumulative memory comprised of the morphic resonance of previous similar systems and their own self-resonance. The more particular patterns of activity are repeated, the more habitual they become.

Morphic fields act along with known kinds of fields and gradients. And in general it is difficult to differentiate between the two. (Some examples of these other forms of causation are: chemical gradients, genes, and electromagnetic fields.) However, the observance of the occurrence of morphic resonance effects would provide indirect evidence for the existence of morphic fields. The simplest way of doing this is working with societies of organisms, organized in such a way that they cannot communicate with each other in normal sensory means. And if information can still travel between them, then there is evidence that would imply some bonds or connections of an extrasensory nature, one provided by the existence of morphic fields. Science has explored relatively little of this area of study and actual observance of these fields seems, for the time being, to be rather limited. (Ex: There is little that the scientific community knows about the ability of blind, uncomplicated, organisms such as termites to organize themselves into elaborate societies and build complex nests with a highly complicated internal architecture. And still less is known of the methods by which a flock of birds or school of fish changes direction so rapidly, beyond any organic sensory abilities. Likewise, no one knows the nature of human social bonds.) Morphic fields extend beyond the brain, into the environment, linking us to the objects of our perception. Possibly capable of affecting these objects we perceive through “…our intention and attention.” (Ex: we may be able to affect people by looking at them, from behind. The sense of being starred at is a well known phenomenon. Experiments have been conducted regarding people’s ability to sense some one else starring at them from behind and these experiments have yielded significant results that could not be explicated in terms of chance, or the known senses or any fields known to physics. In the morphogenesis of fruit flies, effects of morphic resonance have been observed. There is also evidence that animal behavior has evolved rapidly, in particular: the large-scale adaptations of domesticated animals all over the world, as if by the build up of a collective memory through morphic resonance. (Ex1: Roy Bedichek a Texas Naturalist in 1947 wrote of the change in the behavior of horses he had seen in his lifetime, saying that some fifty years ago, keeping horses confined with barbed wire was considered a bad way to keep horses. It would result in horses badly injuring themselves because of running into the wire whilst in a frolic. However, fifty years down the road, according to Bedichek, the entire species seems to have developed a fear and knowledge to avoid barbed wire. Sheldrake explains that this is not merely the young learning from their elders due to the fact that horses separated from their mothers at birth and then confined by barbed wire generally do not react in the manner that their predecessors did, one hundred years ago. Ex2: Ranchers now a-days use fake cattle guards in an effort to save money, by simply painting a portion of the road the same color as real cattle guards. And, mysteriously, the fake cattle guards have the same effect on the cattle that the real cattle guards did. New herds of cattle, never previously exposed to cattle guards refuse to cross them. This is evidence of the effects of morphic resonance.) The evolution of biological forms involves not merely the evolution of gene pools within the species but also the evolution of the morphic fields characterizing that species. And because of this, evolutionary changes may occur more rapidly: due not only to the transfer of mutant genes from parents to offspring but also by way of morphic resonance. And so because of this it would seem that acquired habits can be inherited. Going off on a tangent, I would like to address some historical implications of the discovery of the phenomenon of morphic resonance. If we consider the astronomical ramifications that this theory may have on modern day scientific understanding we will soon realize that this not only implies that we must uproot our current scientific mentality, but also the scientific laws, theories, proofs and suggestions of the past will have to be reevaluated, in a new light. (The following is a comparison between the hypothesis of formative causation and some past theories presented in the A.P. Biology textbook, Chapter 22). The statement above, ‘acquired habits can be inherited’ is similar, to a degree, with one the theories of the past, called ‘Inheritance of acquired Characteristics’ developed by Naturalist Jean Baptiste Lamarck (1744-1829). Lamarck’s Theory of Evolution (1809) was thrown out and supposedly proven inadequate by the arrival of the purely mechanistic theories of the famed Charles Darwin. Toward the end of the eighteenth century, several naturalists suggested that life had evolved along with the evolution of the Earth, the leading and most comprehensive model was provided by Lamarck’s publication. In charge of the invertebrate collection at the natural history museum in Paris, Lamarck began to compare current species to fossil forms and he began to see what appeared to be several lines of descent, each a chronological series of older to younger fossils leading to a modern species. He thought that species could move up the many ladders of life towards greater complexity. With the least complex, microscopic organisms (he believed were generated spontaneously from inanimate material) occupying the lowest rungs of the evolutionary ladder. And at the upper rungs of the ladder there are the most complex organisms, namely highly developed plants and animals. He believed evolution was driven by an innate tendency towards greater and greater complexity, which he seemed to “…equate with perfection.” (A.P. Biology textbook, Ch22) As organisms progressed towards and attained a state of perfection they became better and better adapted to their environments. Thus Lamarck believed that evolution responded to organisms’ *sentiments interieurs*, or their “felt needs”. This phenomenon was described quite adequately by Darwin as descent with modification, as chance mutations of genetic material, in his book *Origin of Species*. And Lamarck’s theory of Inheritance of Acquired Characteristics never developed any foundation. I believe that it still lacks foundation in the sense that acquired bodily developments will not be passed on to offspring, however through morphic resonance acquired habits can be passed on to all members of the same species. This is in a sense a type of acquired characteristic that when manifest within some individuals, becomes increasingly probable to be manifested in other individuals. Therefore, Lamarck’s theory of acquired characteristics is still invalid in the physical sense, which is, I believe, the sense in which he proposed it. But, with regard to characteristics on the mental plane and dealing with habits of memory and characteristics defined by foresight, the Theory of Acquired Characteristics (characteristics in the mental realm) is supported by Dr. Sheldrake. With regard to the second part of Lamarck’s evolutionary theory, adaptation to the environment, these “felt needs” detected by Lamarck can be representative of augmented sexually reproductive success coupled with the morphic fields, established as a result of natural selection selecting only the fittest adaptations to survive and then making them repeated occurrences and then common within the species to such an extent that a morphic field is created and it begins to have a large influence on the new members of the species and it begins shaping the following generations by increasing the probability for morphogenesis into the mutant form. This may be the cause of rapid, shorter stages of animal evolution and then longer stages of more mild adaptations. The cumulative effects of morphic resonance and descent with modification are capable of explicating the phenomenon of an unequal evolutionary rate in the fossil record. (Returning to the hypothesis of formative causation.) Instincts depend on the species’ habitual behavioral fields patterning the activity of the nervous system. They are influenced by genes and also inherited by morphic resonance. Newly learned patterns of behavior can be spread rapidly throughout a species. The learning of these new skills can become progressively easier as time goes on and they become increasingly habitual. In psychology, the activities of the human mind can be interpreted, or thought of as interactions between these morphic fields and the physicochemical patterns of activity in our brain. Thus, human thought and memory can be thought of as correlations between morphic fields and our personal chemical composition in our brains. These extended mental fields (morphic fields) are not confined to the body, they interact with the environment to the extent that they allow paranormal activity to be excepted as regular sensory perception. These fields underlie perception and behavior so regularly and to the level that their effects are interpreted as normal. (Ex: the sense of being stared at.) One important aspect of this hypothesis arises when the question is asked: we know that cumulative memory comes from morphic resonance, but where does ones personal memory fit into the equation, or, how would you reconcile the concept of one’s individual memory with the concepts presented in this hypothesis. The answer is this, that one’s personal memory is in fact entirely a part of his system’s morphic fields and his ability to draw on his memory bank with exact precision is due to self-resonance. It is no longer necessary to suppose that all memories need to be stored as material traces in the brain. Rather, it can be thought of as an individual being almost exactly the same as he was five minutes ago when he memorized a fact and thereby being very similar to the organism that committed this certain fact to the collective unconsciousness (himself minus five minutes) he is able to recall this fact with greater ease than any other organism because of the properties of like upon like. The more similar an individual is to the individual who established a morphic field, the easier it will be for this individual to draw on that section of the collective unconsciousness. Therefore, you, being a very similar organism to you in the recent past will exercise a great amount of ease when it comes to recalling portions of the collective unconsciousness that you created in the past. This is also why as time goes on and an individual changes and grows he has difficulty recalling information from sections of the collective unconsciousness that he had committed to it in the past. That is to say that personal habits differ from collective habits, not in kind, but in degree. This concept is known as self-resonance and it forms the basis of the concept of individual memory. Morphic fields of social groups would help explain many mysterious aspects of social organization. (Ex: the behavior of social insects, flocks of birds, and human societies.) Not to sound redundant, but understanding the hypothesis of formative causation is a key aspect to understanding this project, and I would therefore like to approach this concept from another viewpoint and lead up to the same theories and conclusions of the hypothesis of formative causation as we saw above. A starting point for this viewpoint is the concept of death. When someone dies, what has happened? There is still the same amount of biomass present, still the same weight, and still the same chemical composition, so what has happened? All over the world, people have come to the same conclusion –something leaves the body, something in the form of a flux. In scientific terms, this something is energy. Living organisms draw it from their environment; they accumulate it in their own bodies and use it to power their movements and behavior. Upon death of a living organism this energy is released and it flows onward taking on countless different forms as it had done before it reached the organism. (First in photosynthesis in plants and being stored as chemical energy, then released be respiration in the animals etc.) Therefore, this vital force can only account for one of the aspects of life. The very fact that the same energy can take so many different forms implies that something else must account for the forms themselves. All the entities that make use of the different forms of the same quantity of energy owe their forms to some formative principal over and above the flow of energy. Aristotle called this principal *psyche* (soul). Thus, the aspects of life are two fold and can be understood in terms of an energy flux and a formative principal. The question addressed here is with regard to the nature of this formative principle. In the past there have been two distinct theories on life, the *Vitalists* and the *Mechanists.* The vitalists believed that living organisms are truly alive and animate and are organized by immaterial souls. Mechanists see no difference between living and dead material (outside of complexity) –that organisms are simply inanimate machines governed by the laws of physics and chemistry with no non-material factors, unknown to physics, involved. Ever since Descartes there has been two problems for mechanists: firstly, that there evidently is an inner urge within developing embryos to acquire characteristic endpoints and secondly, the existence of animal instincts. Mechanists have attributed both of these anomalies to the existence of DNA. Holding this inanimate material responsible for all human characteristics. But far from considering DNA inanimate material, mechanists have now endowed this four base code with all the properties of life and mind. It appears that DNA is the mechanist’s substitute for the vital factors of the soul, in vitalist beliefs. A genetic material that codes for primary protein structures appears to have been allotted responsibility for individualistic, selfish and competitive characteristics of man. And in the words of Richard Dawkins these genes are no longer mere chemicals, they are survival machines with not only the power to “create form,” “mold matter,” and “choose,” but they engage in “evolutionary arms races” and even “aspire to immortality”. This is known as the selfish gene theory and it represents a segment of the mechanistic view of life. It takes anthropomorphism giving inanimate objects, animate characteristics) to the highest levels. DNA provides the amino acid sequence for the synthesis of protein not the shape of a bird’s wing. The way the proteins are arranged in cells, the way cells are arranged in tissues, the way tissues are arranged in organs and organs in organ systems and organ systems in organisms are not programmed in the genetic code. Given the right genes (and therefore the right proteins) and appropriate methods of protein synthesis control, the organism is some how expected to assemble itself in a very specific shape? An analogy presented by Rupert Sheldrake is that this would be tantamount to delivering the materials to a buildings sight at he right times and expecting a house to assemble spontaneously. All cells are genetically programmed identically, yet somehow they function differently and differentiate into tissues and organs of different structures. There clearly must be something else shaping these organisms. This is a fact, acknowledged by the scientific community and so far their mechanistic attempts at explanations have proven futile. That is where the hypothesis of formative causation steps in. However, the machinists have always had a defense for the seemingly ridiculous selfish-gene theory in that vitalists propose an equally ridiculous substitute in that it is an undetectable, un-testable and therefore unscientific alternative view on life. These two theories (mechanistic and vitalist) were developed some time in the 1700’s, but now there is a more modern theory developed in the 1920’s, known as the *Holistic* theory of life. It appears to be the middle ground between these to theories, taking neither extreme viewpoint. This theory is one that provides an adequate background for the hypothesis of formative causation. The mechanistic viewpoint has done a flawless job in describing how adult organisms function and respond to their environment. Like computers and other machines, they function with complex feedback mechanisms –or so the mechanists believe. (Airplanes like birds, cameras like eyes, pumps like hearts, computers like brains, etc.) But the fact that machines are like artificial organisms does not mean that organisms are nothing but machines. The machine analogy of the mechanists breaks down when it comes to describing the growth and development of organisms. Living organisms develop from single cells and embryos into elaborate functional organisms. Living organisms reproduce from smaller sections of themselves. Living organisms regenerate lost sections. Elaborate segmented, and specialized organisms can develop from a single cell of a highly specialized section of the organism. No machines are capable of any such similar activity. This is the most astounding, convincing and most powerful argument for theories alternative to the mechanistic view. Vitalists argue that morphogenesis cannot be explicated mechanistically. As machines are nothing more than the sum their parts (and the interactions thereof) if parts are taken away, the integrity of the machine is lost. In contrast, living organisms have a wholeness that is more than the sum of their parts. There is something within them that is holistic. German Embryologist Hans Driesch developed a theory very similar to that of formative causation but it was rejected because of it’s undeterministic concepts of vital factors until the 1920’s quantum theory proved everything in life to be probabilistic and not deterministic. The explanation to this anomaly came in the form of morphogenetic fields –as yet unknown to physics. Invisible regions of influence with inherently holistic properties, they existed within and around organisms and contained within themselves a hierarchy of fields within fields. There are three ways of conceiving of these fields. Firstly, merely useful turns of phrase that are not fully understood; secondly, as fixed mathematical equations beyond the realm of time, independent of evolution in the physical world, that are eternal attractors of living organism to unchanging characteristic ends. And thirdly as Rupert Sheldrake describes them in the hypothesis of formative causation, as intrinsically evolutionary fields of a given species, inherited by present day members of that species, from past members, containing a collective memory from which each member draws and contributes –without decay over time and space. The more often a pattern of development is repeated, the more probable it is that it will be followed again. These fields are the means by which the habits of the species are built up, maintained and inherited. Morphogenetic fields are one type of morphic field pertaining to morphogenesis of organisms. (Ex: shaping the complex three-dimensional structures of proteins.) Things grow not because of timeless mathematical laws, but because that is the way they grew before. They are following habits established through repetition. Morphic resonance is the influence of like upon like through space and time. Morphic resonance does not fall off with time or distance and it does not involve a transfer of energy, but rather of information. Development in a certain fashion is more likely to occur after others have done so in the same fashion. (After a new crystal formation is developed there is a higher probability that it will occur more rapidly in other developing crystals around the world.) Therefore, living organisms inherit not only genes, but also morphic fields. (Experiments with fruit flies show that individuals are indeed more likely to develop abnormally after other of that species were caused to do so by steam treatment of larvae.) The developing organism tunes into the morphic fields of its species and draws upon a pooled or collective memory. Genetic mutations can affect this tuning process and the ability of the organism to tune into the morphic fields of its species. This means that genetic defects can cause an error in the formation of an organism, resulting in physical defect. Just as changes in the components of a TV set can affect it’s tuning or it’s reception of programs, and then distorting sounds and pictures. But just because a mutant component can affect the pictures and sounds produced by the TV receiver, this does not prove that TV programs are programmed and generated within the TV set or it’s components. In the same sense, the fact that genetic changes can affect the form and behavior of organisms does not prove that their form and behavior are programmed in their genes. Instinctive behavior consists of a series of fixed action patterns –the end point of one serves as the starting point of the next. And as in morphogenesis the same endpoints can be reached by different routes, if the normal pathway is disturbed. Instincts are the behavioral habits of a species and depend on a collective unconscious memory. Patterns of behavior are drawn towards ends or goals provided by their attracting morphic fields. When some members of a species acquire a new pattern of behavior then others of that same species in other parts of the world should tend to learn the same thing more quickly, even in the absence of any known means of communication. This is the operative principal behind my experiment, and it forms the basis of the hypothesis of formative causation. The search for the material traces of memory has been one that has plagued neuroscientists for the past century. Attempts to locate memory traces in the animal brain have proven futile. The common method is to teach an animal, (sometimes, even humans in the early parts of this century) a specific fact, or make it memorize a certain point. Successive parts of the subject’s brain would then be removed. After each subsequent removal the subject was tested for his ability to recall the memorized point. Sometimes up to sixty percent of a subject’s brain would be removed before it would suffer total collapse and yet still it would display ability to make use of its memory until the very end. Some scientists have proposed that memory may be stored in a distributed manner, spread out over several modifications of junctions between nerve cells, called synapses. But there is no evidence to support such a claim, and the reason for these recurrent failures to find memory traces in the brain may be simpler than we think. As Sheldrake proposes, these memory traces may not exist. A search inside your TV set for traces of the programs you watched last week would be doomed to failure for the same reason. The set tunes into TV transmission but does not store them. The hypothesis of formative causation suggests that memory depends on morphic resonance rather than material memory stores. Morphic resonance depends on similarity –again, it involves an effect of like upon like. Which means that the more similar an organism is to an organism in the past, the more specific and effective the morphic resonance between them. In general, any given organism is most like itself in the past and hence, subject to highly specific morphic resonance from it’s own past. This self-resonance helps maintain an organism’s form, tunes it into it’s own past patterns of activity, habits of behavior, of speech, of thought or memories of particular facts. None of these need to be stored physically. The next question is then, what about people who suffer brain damage and thereby loose some specific aspects of their memory? Wouldn’t this prove that the relevant memories were stored within the damaged tissues? No. Think again of the TV analogy, if some components of the TV are damaged then this may lead to specific aspects being distorted such as sound quality, or color ratios etc. But this by no means implies that the pictures, sounds and entire programs are stored within the damaged components. Therefore, individual memory as well as behavioral capacities and instincts can be seen as two different aspects of the same phenomenon of morphic resonance/formative causation. Societies of termites, ants, wasps, and bees can contain thousands of individuals, which build large elaborate nests and exhibit complex division of labor. Such societies can be considered organisms at a higher level of organization –superorganisms. Debates rage on as to whether these should actually be regarded as a higher level of living organization with irreducible holistic properties of their own, or whether they should be regarded as aggregates explicable in terms of their parts and the mechanistic interactions between the individual insects. From the point of view of the hypothesis of formative causation they can be viewed as organisms at a higher level of organization. Sheldrake proposes that they should be considered as morphic fields, which embrace and include the individuals within them, just as magnetic fields embrace and include the particles of iron they organize into characteristic patterns. Therefore trying to understand the social morphic field on the basis of isolated insects would be just as impossible as trying to understand the magnetic field by taking iron filings out of it and studying their mechanical properties in isolation. All in all, if morphic fields are regarded as habitual, they do become experimentally testable. Such fields contain an inherent memory given by morphic resonance and because of this, they differ from the known fields of physics because these known fields are thought to be governed by eternal and absolute, non-evolving laws. According to the hypothesis of formative causation, morphic resonance is at work in all of nature (crystals, molecules, galaxies, etc.), which are also organized by fields with an inherent memory. Because all nature is now assumed to be evolutionary, one can no longer take for granted the conventional idea that all chemical and physical systems are governed by eternal laws of nature. The so-called laws of nature may therefore be thought of to be more like habits, maintained by morphic resonance. Only one specifically designed test for morphic resonance has so far been carried out. This experiment (as described by Rupert Sheldrake in his book *Dogs That Know When Their Owner’s Are Coming Home*) involved day-old chicks and was carried out in the laboratory of a skeptic named Steven Rose, at the Open University in England. The focus of this experiment was to observe the effects of morphic fields and therefore attempt to determine whether they exist or not. This would be conducted with the intention of putting the primary concept, advocated by the hypothesis of formative causation, to test. To determine the existence of a collective unconsciousness and cumulative memory of a given species; to determine whether there is any truth in the statement that, “the more often particular patterns of activity are repeated, the more habitual they become.” This experiment set out to determine if any such habits of behavior in nature would evolve into a component of a cumulative memory belonging to a species. Day after day, newly hatched batches of chicks were shown a small yellow light, A light emitting diode (LED). And naturally, the chicks pecked at it, as they peck at any small object in their environment. Half and hour after the chicks had pecked at it, they were injected with lithium chloride, a chemical that makes them slightly ill. They associated feeling ill with pecking at the yellow light, and avoided pecking at it when they were shown it again. This rapid form of learning is called *conditioned aversion*. As a control an equal number of chicks were shown a small chrome bead. And similarly, after half an hour, they were injected with a chemical. However, this chemical was merely saline solution, resulting in very little if any effect on the chicks and therefore they produced no aversion to pecking at the chrome bead when they were shown it again. They were then tested three hours later, each chick being exposed sequentially to the control and the test stimulus. And it turns out that most test birds were averse to pecking the yellow LED, but not averse to pecking the control bead. The response of the chicks was measured by recording the time delay in seconds before they first pecked the stimulus, the yellow LED, this is known as the latency (time delay). The same experimental procedure was repeated for 37 days. The idea was that by morphic resonance subsequent batches of newly hatched chicks should show an increasing aversion to pecking at the yellow LED when they were first shown it, because of morphic resonance from their predecessors. They would draw on a collective memory of aversion, developing a fear or a caution through this collective unconsciousness. Which means that the more chicks that were made averse to this yellow LED, the stronger the morphic field and hence the stronger this effect should become. But in the chicks pecking at the chrome bead, there should be no such aversion developing towards pecking the chrome bead. In fact, subsequent batches of chicks exposed to the yellow LED did indeed become increasingly averse to it as predicted on the basis of morphic resonance. This affect was statistically significant when the aversion to the yellow LED is compared to the aversion to the control (chrome bead) yielding p < 0.01 on the ANOVA test of significance.

Connections with quantum Physics: The foundation of the assumption that morphic fields are not subject to spatial decay –proof the existence of non-locality.

The hypothesis of formative causation describes certain aspects of morphic fields that have a kind of non-locality. This concept of non-locality is one, which is, as yet, unaccepted by the scientific community at large and thus, it serve as one of the major points of the hypothesis of formative causation that make it highly objectionable to many present-day scientists. Therefore I feel it necessary to dwell on it in order to give some arguments to satisfy these objections. Although non-locality is not an accepted theory, there is experimental evidence which proves its validity, which is in fact recognized by the scientific community as an ‘exception’ –for lack of a better word– to the rule. And it is suspected that the properties of morphic fields, of relevance, are in fact related to these recent developments in *Quantum Physics.* Albert Einstein played an integral role in the development of the Quantum theory and at the time of his death he felt there was still much more to be understood about this field than we yet know. He disliked the concept, implied by the quantum theory, of “spooky action at a distance.” The implications of these recent developments are such that they rescind much of the assumptions of classical physics. They are very paradoxical in nature and represent an aspect of science that is highly unintuitive. In general, parts of a past quantum system seem to retain instantaneous connections in the present even when no longer in each other’s proximity. At the Center for Quantum Computation (CQC) the concept of quantum entanglement was explicated using the unorthodox analogy of a bank robbery. In the day-to-day world that is well described by classical physics, we often observe correlations –simple correlations between regular every day objects. Now, imagine you are observing a bank robbery. The situation is the following: the bank robber is pointing a gun at the terrified teller. From this one can deduce quite logically that by looking at the teller you can tell whether the gun has gone off or not. The following relationship or correlation can be deduced: If the teller is alive and unharmed, one can be sure the gun has not fired. If the teller is lying dead of a gunshot wound on the floor, one knows that the gun has fired. This is elementary detective work. On the other hand, (again based on the deduced premise that if the gun has fired the teller is dead) by examining the gun to see whether it has fired, one can find out and conclude whether the teller is alive or dead. Therefore we could say that there is a direct correlation between the state of the gun and the state of the teller. 'Gun fired' means 'teller dead', and 'gun not-fired' means 'teller alive'. We assume that the robber only shoots to kill and he never misses. But in the world of microscopic objects described by quantum mechanics, things are not always so simple. Imagine an atom which might undergo a radioactive decay in a certain time, or it might not. We might expect that with respect to the decay, there are only two possible states here: 'decayed', and 'not decayed', just as we had two states, 'fired' and 'not fired' for the gun or 'alive' and 'dead' for the teller. These seemingly simple correlations in the Newtonian/Classical world give the illusion of determinism. However, in the quantum mechanical world, there is an alternative situation, it is also possible for the atom to be in a combined state 'decayed-not decayed' in which it is neither one nor the other, but somewhere in between. This is called a 'superposition' of the two states, and is not something we normally expect of classical objects like guns or tellers. Two atoms may be correlated so that if the first has decayed, the second will also have decayed, and if the first atom has not decayed, neither has the second. This is a 100% correlation. But the quantum mechanical atoms may also be correlated so that if the first is in the superposition ‘decayed-not decayed’, the second will be also be ‘decayed-not decayed’. Quantum mechanically there are more correlations between the atoms than we would expect classically. Classically, there is only a relation of 100% correlation, meaning the states of the atom are as follows: decayed and decayed, or not-decayed and not-decayed. However, in the quantum mechanical world there are several intermediate states (‘super-positions’) for the atoms. (E.g. ‘decayed-not decayed’ and ‘decayed-not decayed’) This kind of quantum 'super-correlation' is called 'entanglement'. Schrodinger a German physicist was one of the first people to realize how strange this concept of entanglement really was. Entanglement was originally named in German, by Schrodinger, as 'Verschrankung'. The paradoxical aspect arises here: Imagine it is not the robber but the atom which determines whether the gun fires. If the atom decays it sets off a hair trigger which fires the gun. If it doesn't decay, the gun doesn't fire. But what does it mean if the atom is in the superposition state 'decayed-not decayed'? Then can it be correlated to the gun in a superposition state 'fired-not fired'? And what about the poor teller, who is now dead and alive at the same time? This state of ‘inbetweeness,’ of super-position is more easily understood when merely thinking of inanimate atoms at a microscopic and perhaps even inapplicable level. But what when the cumulative influence is considered. Upscale the effects. Consider it in the classical world and you’ve got a mind bending seeming impossibility. For example, consider the predicament Schrodinger faced here: he was worried by a similar situation where the victim of the quantum entanglement was a cat in a box where the decaying atom could trigger the release of a lethal chemical. The problem is that in the everyday world we are not used to seeing anything like a 'dead-live' cat, or a 'dead-live' teller, but in principle, if we expect quantum mechanics to be a complete theory describing every level of our experience, such strange states should be possible. So the next logical question which demands to be answered is “Where does the strange quantum world stop and the ordinary classical world begin?” These are problems which have now been debated for decades, and a number of different interpretations of the quantum theory have been suggested.

The problem was brought into focus by a famous paper in 1935 by three of the most well known physicists, Einstein, Podolsky and Rosen (known as the EPR paradox.). They argued that the strange behavior of entanglement (what Einstein called “spooky action at a distance”) meant that quantum mechanics was an incomplete theory, and that there must be what came to be known as 'hidden variables' that have not yet been discovered. From this arose alternative theories to quantum mechanics known as hidden variable theories. This produced a famous debate between Einstein and Niels Bohr (another well known name in physics), who argued that quantum mechanics was complete, and that Einstein's problems arose because he tried to interpret the theory too literally. However in 1964, John Bell pointed out that for certain experiments classical hidden variable theories made different predictions from quantum mechanics. In fact he published a theorem which quantified just how much more strongly quantum particles were correlated than would be classically expected, even if hidden variables were taken into account. This made it possible to test whether quantum mechanics could be accounted for by hidden variables. A number of experiments were performed, and the result is almost universally accepted to be fully in favor of quantum mechanics. Therefore there can be no 'easy' explanation of the entangled correlations. The only kind of hidden variables not ruled out by the Bell tests would be 'non-local', meaning they would be able to act instantaneously across a distance.

More recently, from the beginning of the nineties, the field of quantum information theory opened up and expanded rapidly. Quantum entanglement began to be seen not only as a puzzle, but also as a resource for communication. Imagine two parties, Alice and Bob who would like to send messages to one another over a distance. In 1993, Bennett *et al.* showed that if Alice and Bob each hold one of two particles which are entangled together, a quantum state can be transmitted from Alice to Bob completely by sending fewer classical bits than would be required without the entanglement. This process has been called 'quantum teleportation'. It involves not only bits for sending information, but 'e-bits', or entanglement bits, which consist of a maximally entangled pair of particles. Other ways in which entanglement can be used as an information resource have also been discovered, for example, dense coding, cryptography and applications to communication complexity. Entanglement was found to be a manipulable resource. Under certain conditions, states of low entanglement could be purified into more entangled states by acting locally, and states of higher entanglement could be 'diluted' to give larger numbers of less entangled states. Meaning entanglement can be reduced or increased.

Investigation of quantum entanglement is currently a very active area. Research is being done on measures for quantifying entanglement precisely, on entanglement of many-particle systems, and on manipulations of entanglement and its relation to thermodynamics. In Paris in the 1980’s a repeatable and conclusive experiment was carried out proving the existence of non-local influence. Alain Aspect et al performed the *Paris Experiment* in 1981. Einstein’s fear’s had come true and this experiment heralded the advent of Quantum entanglement. The experiment had the following parameters. Two photons, (by definition travelling at the speed of light) moving in opposite directions from a central atom that has emitted them retain an immediate non-local connection. This correlation between the two photons is such that if the polarization of one was measured the other will instantaneously have the opposite polarization. This occurs even though the polarization of the photons was not determined until the instant the measurement was taken. (Proof of quantum entanglement, non-local influence, and “spooky action at a distance.”) The two parts of the same quantum system are separated in space but are linked by a quantum field. The complications arise once again (as in morphic fields) when attempting to determine the properties of these fields. The quantum fields are not ordinary fields in space like magnetic fields, but they are rather represented mathematically as a multidimensional space of possibilities. A location or region where there are several possibilities (super-positions) for it’s constituent elements determined by this quantum field is known as a quantum system. And this link of possibilities is mathematical in nature and can act instantaneously and non-locally. Like atoms and molecules in a quantum system, the members of social groups share a system. This is obvious in their physical correlations: they share food, breath the same air, interact continually and now we say they are interconnected through their minds and senses. When they are separated like the elements of a quantum system, these parts of one social system may retain a non-local and possibly non-separable correlation comparable to that observed in quantum entanglement. The theoretical proof of morphic field’s non-local influence lies in quantum entanglement and its effective evidence comes to light in my experiment. But, I merely investigate the outward manifestations of this phenomenon and a step that physics may well need to take would be to make an extension of the quantum theory to the degree that it covers biological systems and social organization. (For further reading on the topic of Entanglement and non-seperability read the work of David Bohm; for further reading on its connection with the hypothesis of formative causation, read the works of Amit Goswami and Hans-Peter Durr.)