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The Journal of Mind and Behavior
Summer, 1983, Volume 4, Number 3
Pages 353-368
ISSN 0271-0137

The Theory of "Formative Causation" and its Implications for Archetypes, Parallel Inventions, and the "Hundredth Monkey Phenomenon"

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The theory of "formative causation," proposed by plant physiologist Rupert Sheldrake (1981b) has implications and explanatory power for a number of hitherto unexplained phenomena: Jung's concepts of archetypes, synchronicity and the collective unconscious; the phenomenon of parallel inventions; the resonant effect of group meditations; Watson's (1979) "Hundredth Monkey Phenomenon"; the learning of new behavior in untrained animals; and a host of other physical and biological anomalies. The "formative causation" hypothesis proposes that all systems are regulated not only by known energy and material factors but also by invisible organizing matrices (termed "morphogenetic fields"). The structures of these fields are derived from the morphogenetic fields associated with previous similar systems; that is, the morphogenetic fields of past systems influence subsequent similar systems by a process called "morphic resonance." Thus this hypothesis proposes that the characteristic organization of systems depends on influences that lead to a repetition of the form and patterns of previous systems. It enables some regularities of nature to be regarded more as habits than as products of chance, neo-Darwinian evolution, or Lamarckism. An exposition of the theory is herein presented and the author attempts to demonstrate the intrinsic compatibility of the hypothesis with three important, comprehensive, and ascendent models of reality.

Rupert Sheldrake (1981b), a plant physiologist, has recently challenged our mechanistic world view with a radical, but testable, alternative theory. His "hypothesis of formative causation" proposes that the characteristic organization of systems depends on influences that lead to a repetition of the forms and patterns of previous systems. If we accept this line of reasoning and if we can think of the regularities of nature more as "habits" than as the reflections of immutable laws, we might be forced to change our thinking about the worlds of animate and inanimate objects, as well as consciousness itself. Sheldrake postulates that the characteristic forms taken up by molecules, crystals, cells, tissues, organs and organisms are shaped by specific fields called "morphogenetic fields" (denoting a coming-into-being of forms). The morphogenetic fields of past systems influence subsequent similar systems by a process called "morphic resonance." While this general concept is not new, Sheldrake seems to be the first to propose the exact nature and mode of operation of these fields. He describes a morphogenetic

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field as a novel type of physical field with effects that can be detected.

Specifically, the hypothesis of formative causation proposes that "organizing starting points," such as fertilized eggs, enter the morphic resonance with previous systems of which structures similar to these "morphogenetic germs" were a part. A morphogenetic germ thus becomes embedded within the morphogenetic fields of the higher-level system which then shapes or molds the process of development toward a characteristic form. Morphogenetic fields, although not energetic themselves, act on a developing system by patterning probabilistic events. They do this by restricting the possible outcomes of energetically indeterminate processes; the principle of morphic resonance holds true even when systems are widely separated in time and space:

> . . . all past systems of a given type influence subsequent similar systems; their influence is in fact cumulative. As these past systems are similar rather than identical, when a subsequent system comes under their collective influence by morphic resonance, its morphogenetic field will not be sharply defined, but will consist of a kind of composite of previous similar forms .... Thus morphogenetic fields not only act upon probabilistic events, but are themselves probabilistic in nature. (Sheldrake, 1981a, p. 767)

Sheldrake discusses how this theory offers an alternative explanation of the inheritance of form in animals and plants. The conventional theory provides for a "program" in the DNA which governs the development of organisms. According to the hypothesis of formative causation, however, the form and organization of the cells, tissues, organs and organisms as a whole are governed by a hierarchy of morphogenetic fields that are not inherited chemically (except for, of course, the DNA code for the sequence of amino acids in proteins) but rather are given directly by morphic resonance from past organisms of the same species. By extending the concept of morphogenetic fields to the organization and patterning of probabilistic events within the nervous system, Sheldrake interprets the inheritance of instinctive and learned patterns of behavior in a comparable manner.

Three aspects of this theory make it particularly appealing: (1) its inherent testability; (2) its explanatory power; and (3) its consonance with several ascending and comprehensive theories and models of reality: Popper's (1977) Three Worlds Theory; the Pribram-Bohm "holistic theory of the universe" (Bohm, 1980; and Ferguson, 1977); and Prigogine's (1979) proof of an ordering principle in entropy itself.

Testability. Sheldrake himself suggests several methods of testing the hypothesis. Perhaps the two most obvious approaches would be the study of crystallization in the laboratory and the observation of new learning in animals. According to the hypothesis, prior to the first crystallization of

chemicals, no specific (morphogenetic) field for the crystals should exist. After the first crystals have formed, subsequent crystallization should be influenced by the morphogenetic fields of earlier crystals. Hence, the more often a substance is crystallized, the greater should be the facility with which this occurs. Obviously, controls would be necessary to rule out the "seed crystal" explanation—the conventional explanation for the phenomenon in which there are simultaneous reports at different laboratories of a new compound, never before observed in a crystalline state, which suddenly begins to form cystals. The "seed crystal" hypothesis asserts that fragments of previous crystals serve as seeds and get carried from laboratory to laboratory on unsterilized specimens, on the bodies of scientists, or perhaps on their own force as migrating microscopic particles of air.

Sheldrake's alternative explanation asserts that after the first crystal formed, whenever or wherever the compound crystallized under similar conditions, it would take up the same structure. Although Sheldrake does not make the connection, his theory is given considerable support by Bell's Theorem, which allows for the requisite "action at a distance" in space-time. A brief exposition of Bell's theorem and its relation to quantum mechanics is needed here, for the theorem seems to be the needed bridge linking subatomic and psychological events.

Quantum mechanics, when interpreted in the traditional fashion of Niels Bohr and the Copenhagen school, maintains that a complete picture of reality is impossible to attain. For example, when an atomic electron jumps from one energy level to another (these energy levels being the only allowed energy states of the electron in the atom, according to quantum mechanics), the quantum physicist is restricted to a probability estimate of the electron making a jump. However, this same scientist is forced into silence about *where* the electron is in-between jumps, or *when* precisely a particular electron is going to jump. This dilemma is usually referred to as the "measurement problem," which is short-hand for some very sophisticated mathematical equations and certain paradoxes they generate.

Physicist Werner Heisenberg's Uncertainty (or Indeterminancy) Principle expresses the measurement limitation succinctly: we can never know both the position and the momentum of a particle with absolute precision; we can know both, approximately, but the more we know about one, the less we know about the other; we can know either of them precisely, but in that case, we can know nothing about the other. In summary, there is a transcending of ordinary, traditional logic language concomitant with an increased emphasis on the limitations inherent in experimental maneuvers. Bell's theorem continues this assault against "conventional reality."

J.S. Bell, a physicist working in Switzerland in 1964, gave us a careful mathematical statement of the Einstein-Podolsky-Rosen paradox named after the men who first proposed it. It was said, incidently, that the Einstein-

Podolsky-Rosen paradox was Einstein's revenge against quantum mechanics —a way to show that quantum mechanics must be incorrect or at least imcomplete. However, the revenge backfired; and the paradox proved true and gave even further support for quantum mechanics.

The paradox goes like this: when two particles of opposite "spin" fly apart, changing the spin of one also changes the spin of the other—even if they are at opposite ends of the world. Either they can communicate at speeds faster than the speed of light (clearly impossible) or they are not "things" and not separate (another impossibility). But the impossible seems to have been proven. At least five separate experiments in the last decade have confirmed it. The experiments entail creating pairs of particles, each partner of which then flies off in opposite directions. Each particle seems to know instantaneously what is happening to the other. Quantum mechanics had predicted the results of these experiments; Einstein had pointed out the paradox; Bell had given us the necessary mathematical deductions; and now it was really happening in the laboratory. Even as this is written, a team at the University of Paris (Aspect-Grangier-Roger) is carrying on still more of these experiments. Summing up the experiments and their implications, Bernard D'Espagnat (1979) of the University of Paris concluded that "the violation of separability seems to imply that in some sense all these objects constitute an indivisible whole" (p. 181). Accepting non-locality means embracing the temporal paradoxes of an instantaneously connected world in which nothing can really be separated from anything else. Bell's proof of a non-local ultimate reality provides for the possibility of a "pioneer" crystal to be the conductor of a vast symphony of inseparable, interacting and interpenetrating components.

Sheldrake's theory could also be tested at the biological level. If a number of animals learn to carry out a certain task that members of their species have never done before, then other members of the species everywhere else in the world should be able to learn the same task more easily. Preliminary evidence for this prediction also is cited by Sheldrake (1981b). He describes a long series of experiments started at Harvard University in 1920 by William McDougall. It was observed that rats which learned a particular task—to escape from a specially-designed water maze—produced offspring which were able to learn that task more quickly.

The experimental animals, carefully inbred under laboratory conditions, were white rats of the Wistar strain. Their task was to escape from a tank of water by swimming to one of two gangways which led out of the water. The "wrong" gangway was brightly illuminated; if the rat selected that route, it was given an electric shock. The two routes were alternated in terms of which served as the illuminated—and hence the "wrong"—path of escape. The measure of learning was simply the number of errors the rat made before it finally learned to leave the tank by the nonilluminated gangway. Some of the

rats required as many as 330 trials (immersions in the water tank) before the point of complete learning—consistent choosing of the nonilluminated gangway—occured.

In each generation the rats were bred from parents which had already learned to perform the task; there was a very noticeable increase in the rate at which successive generations learned the task. The experiment, incidently, took fifteen years to complete and utilized 32 generations of rats. The results looked to McDougall as striking confirmation of Lamarckian theory. In the first eight generations, the average number of errors was greater than 56; in the second, third, and fourth groups of eight generations, the average number of errors was 41, 29, and 20, respectively. Indeed it looked as if the rats were demonstrating the inheritance of acquired characteristics.

Other researchers attempted to replicate McDougall's work in an effort to quash the acceptance of the heretical Lamarckian theory. One group, W.E. Agar and his colleagues (Agar, Drummond, Tiegs, and Gunson, 1954), worked for 20 years measuring the rate of learning of trained and untrained lines of these rats for 50 successive generations. They found, as did McDougall, a marked tendency for rats of the trained line to learn more quickly in succeeding generations. But they also found that rats born of *untrained* parents also learned more quickly after other rats had been trained—even though they were separated by time and distance. This result suggested that the rats' improvement could not be explained in terms of the passing on of modified genes from parent to offspring, as Lamarckian theory would require. McDougall's conclusions supporting Lamarckianism were thus refuted but his *findings* were confirmed—and have not yet been accounted for in conventional terms. Sheldrake, of course, can explain them by the hypothesis of formative causation.

Sheldrake even suggests a specific test for his theory:

> In experiments specially designed to test for the effects of morphic resonance, it would probably be best to compare the rate at which rats learned a particular task in one location, say New York, before and after a large number of rats had been trained to carry out the same task at another, say London. Obviously, appropriate precautions would have to be taken to avoid any conscious or unconscious bias on the part of the experimenters. One way would be for those in New York to go on testing the rate of learning on fresh batches of rats at, say, monthly intervals over a period of a year. Then in London the time at which the training began would be selected at random within this period; for example, it might be five months after the regular tests started in New York. If the experimenters in New York, who would not have been told what was going on in London, detected a marked increase in the rate of learning only after the rats in London had been trained, then the result would provide evidence in favour of the hypothesis of formative causation. (Sheldrake, 1981a, p. 768)

Explanatory Power of the Theory of Formative Causation. Novel theories are always fascinating. The importance of a particular theory must be judged not only on its inherent plausibility but also on its ability to make inroads on the

continent of unexplained phenomena—its power to give a scientific base to oft-reported and widely accepted occurrences and experiences. By this latter criterion, Sheldrake's theory should be judged as extremely important. A host of physical and biological anomalies could be explained by its invocation. In no particular logical order, some of the more intriguing phenomen will be discussed in the subsequent pages: archetypes, synchronicity, parallel inventions, the "Hundredth Monkey Phenomenon," and the resonant effect of group meditations. Finally, there will be an exposition on the compatibility of Sheldrake's thesis with three important, comprehensive and ascendent models of reality.

Archetypes

Jung (1959) has given detailed expositions of a deep layer of the psyche which he has termed the "collective unconscious." In contrast to the personal unconscious, the collective unconscious has contents and modes of behavior that are more or less the same everywhere and in all individuals; it thus constitutes a common psychic substrate of a suprapersonal nature which is present, according to his theory, in each of us. "Archetypes" constitute the primary contents of the collective unconscious.

While Jung describes the collective unconscious as the psychic residue of our evolutionary development that accumulates as a consequence of repeated experiences over many generations, he apparently conceived of it as residing *within the individual* as a storehouse of latent memory traces inherited from one's ancestral past. However, this apparent difference from Sheldrake's conception of a morphogenetic field may be negligible or irrelevant, as Jung seems to be describing the same process that Sheldrake does in discussing the probability of the occurrence of a given behavior.

According to Jung, an archetype originates when an experience has been constantly repeated for many generations. The archetype then functions to predispose thoughts, feelings, and behaviors toward that important experience. For example, humans have been exposed throughout our existence to innumerable instances of great natural forces—earthquakes, floods, lightening, hurricanes and fires. Out of these experiences there has developed an archetype of energy, a predisposition to perceive and be concerned with power.

If memory is not localized at particular sites within the brain but is available through morphic resonance, the cumulative experience of humankind might very well give rise to Jung's archetypes as well as the "memes" described by Dawkins (1976) to denote ideas, concepts, or theories which seem to have a reality and an evolutionary momentum of their own. (A more detailed exposition of the relationship between Sheldrake's hypothesis and both

archetypes and synchronicity may be found in a recent article by Keutzer (1982).)

Synchronicity

Since antiquity, there have been many individuals who spoke in terms of "influences," "sympathies," and "correspondences" to explain events that seemed to be unaffected by the law of causality. It was only in the eighteenth century, in the wake of the Newtonian revolution, that causality was enthroned as the absolute ruler of matter and mind—to be subsequently dethroned, of course, in the first decades of the twentieth century as a consequence of the revolution in physics, most particularly quantum mechanics.

In 1952, in collaboration with the noted physicist Wolfgang Pauli, Jung wrote his well-known treatise on "Synchronicity: An Acausal Connecting Principle," which was published together with Pauli's essay on Kepler in one volume. Jung (1960) defines synchronicity as "the simultaneous occurrence of two meaningfully but not causally connected events" (p. 441) or alternatively as "a coincidence in time of two or more causally related events which have the same or similar meaning" (p. 511). The central idea is that coexistent with causality there is an acausal principle active in the universe. In some respects synchronicity is comparable to universal gravity. But unlike gravity which acts on all mass indiscriminately, this force acts selectively on form and function to bring similar configurations together in space and time; that is, synchronicity correlated by affinity. In space synchronicity produces concurrent events related by affinity; in time it produces similarly related series. Bolen (1979), a psychiatrist and Jungian analyst, writes further on the subjective experience of synchronicity:

> In the experience of a synchronistic event, instead of feeling ourselves to be separated and isolated entities in a vast world we feel the connection to others and the universal at a deep and meaningful level. That underlying connection is the eternal tao, and the synchronistic event is a specific manifestation of it. (p. 24)

Now perhaps it is easier to conceptualize the synchronistic event as occurring within a morphogenetic field. The meaning inheres in such events by virtue of the significant and repetitive history of the events. More specifically we could translate from Jung's terms of an archetype as being activated to facilitate a synchronistic event to Sheldrake's terms of tapping into a morphic resonance to organize and coordinate indeterminate processes which are widely separated in time and space. Thus one could have a dream or vision of the novel crystallization of a substance while across a continent the

crystallization is actually taking place.[1]

Although many eminent scientists have been intrigued by Jung's concept of synchronicity, it was not until quite recent times that science could consider such an unconventional phenomenon—an event outside of a space-time, cause-and-effect sequence. Now, as we have seen, quantum mechanics has demonstrated some synchronicities of its own, most notably the apparent underlying connectedness shown by the "distant correlation" experiments based on Bell's theorem. These events are no more plausible to our commonsense view of reality than are the synchronicities of the psyche described by Jung. Each of these events is a clue intimating the possibility that we, and everything in the universe, might be invisibly linked rather than unrelated and separate.

Parallel Inventions

History is replete with instances of two or more researchers, apparently without collusion, simultaneously producing answers to questions that seemed insoluble for years. Once the barrier is broken, the solutions often seem so obvious that it is difficult to understand why they were not apparent to everyone all along. Whenever a new particle, a neutrino, for example, turns up in a laboratory experiment, other researchers start looking for it too. More often than not, they find manifestations of it— sometimes right where they looked before without success.

The question becomes one of *source*. What is the inspirational source that allows for simultaneous creative productions or cracks in heretofore barriers of physical, physiological, or psychological possibilities? As Ferguson (1982) suggests, parallel inventions may be akin to the accelerated record-breaking in competitive athletic events—e.g., breaking the "Bannister Barrier" in running the mile under four minutes— and also akin to the intuitive "knowing" of psychomotor skills. In all three instances, an individual may be able to tap into the morphogenetic field for a particular skill or inspiration and capitalize on the cumulative experience of everyone who ever attempted that task. What evidence we have of the creative process would be in harmony with this speculation. The biographies of great scientists provide countless examples of spontaneous intuitions and hunches of unknown origin. Watson (1979) believes that all invention probably depends on a "delicate interplay of liberal dissociation and more conservative traits" and that "all truly creative insight seems to flow from the breaches in the (unconscious) barrier" (p. 259). He

[1]It is recognized here that there is an equally plausible alternative explanation provided by one interpretation of the Einstein-Rosen-Podolsky demonstration and suggested by Bell's theorem; *viz.*, superluminal information transfer on the quantum level which could account for patterns which are acausal but meaningful. Every sub-atomic system in the universe, or in the multiverses, could adjust instantaneously into conformity with the whole, by synergetic feedback faster-than-light. Here we approach what Capra (1975) describes as the "bootstrap theory" which makes everything the cause of everything else.

cites such instances as Coleridge composing the *Kubla Khan* is his sleep; Mozart finding his best musical inspiration rising like dreams; and Friedrick Kekulé making his revolutionary perception of the cyclic structure of carbon rings while dozing in front of a fireplace on a cold night. In his dream, Kekulé envisioned chains of atoms that writhed like snakes. When one of the "snakes" took its tail into its mouth, Kekulé awoke with a start; his problem was solved. Carbon compounds such as benzene are not open structures but closed rings resembling the snake in his dream. "Let us learn how to dream, Gentlemen," Kekulé later told a group of colleagues, "and then perhaps we will discover the truth" (Glassman, 1981, p. 65).

One further example brings us back to physics. In 1913 Niels Bohr, then a student at Cambridge University, had a dream in which a physicist stood on a sun, his body enveloped by burning gas. Planets, attached to the sun by thin filaments, whizzed by him on a revolving course. Suddenly the gas cooled, the sun solidified, and the planets drifted away. At that moment, Bohr awoke, realizing that he had just visualized a model of the atom and that the sun in his dream was a fixed center and the planets were electrons, held in place by an energy field. That vision inspired the system of quantum mechanics (Glassman, 1981).

The Hundredth Monkey Phenomenon

The name for this phenomenon is provided by biologist Lyall Watson (1979) who recounts a most fascinating story about a monkey tribe on an island near Japan. In 1952 researchers established provision stations at selected sites within range of the troop. Normally young macaque monkeys learn feeding habits from their mothers, who teach them by example what to eat and how to handle food; however, nothing in their established repertoire enabled them to deal with the new artificial food supplied by the researcher—raw sweet potatoes covered with sand and grit.

> Then an 18-month-old female, a sort of monkey genius called Imo solved the problem by carrying the potatoes down to a stream and washing them before feeding. In monkey terms this is a cultural revolution comparable almost to the invention of the wheel. It involves abstraction, the identification of concept, and deliberate manipulation of several parameters in the environment. (Watson, 1979. p. 147)

Many other monkeys learned this trick by watching Imo and one another and by 1958 all juveniles were washing dirty food. However, the only adults over five years old to do so were the ones who learned by direct imitation of their children. Then, in the autumn of that year, the behavior became universal. Watson speculates about this process:

> Let us say, for argument's sake, that the number (of potato washers) was 99 and at 11 o'clock on a Tuesday morning, one further convert was added to the fold in the usual

> way. But the addition of the hundredth monkey apparently carried the number across some sort of threshold, pushing it through a kind of critical mass, because by that evening almost everyone in the colony was doing it. Not only that, but the habit seems to have jumped natural barriers and to have appeared spontaneously, like glycerine crystals in sealed laboratory jars, in colonies on other islands and on the mainland in a troop at Takasakiyama. (Watson, 1979, p. 148)

Watson believes that humans have gone through a Hundredth Monkey experience and that there is evidence for it in the fossil record. He points to an explosive growth in the style and complexity of human culture about 100,000 years ago. In the "first great quantum leap in the field of artifact design," (p. 149) he sees evidence of the entry of a new factor into evolution. He feels that, in addition to ordinary natural selection in evolution, there is such a thing as the Hundredth Monkey Phenomenon which could easily account for the way in which "many memes, ideas, and fashions spread through our culture. It may be," he concludes, "that when enough of us hold something to be true, it becomes true for everyone" (Watson, 1979, p. 148). If Sheldrake is correct, we could account for the Hundredth Monkey Phenomenon by assuming that animals can transfer knowledge, after it reaches some critical threshold, to other animals via morphogenetic fields.

The Resonant Effect of Group Meditations

The same kind of "critical mass" theory could account for the resonant effect of group meditations cited so often, especially by researchers studying the salubrious effects on a community when enough of its members begin to practice Transcendental Meditation (TM) (Orme-Johnson and Farrow, 1976). A number of investigators see the TM technique as a relaxation of the nervous system to a regime of extremely low excitation, with results parallel to states of least excitation in quantum mechanics—including the occurrence of long-range temporal and spatial orderliness. The pure consciousness state experienced during the TM technique is thus interpreted in terms of quantum physics as a zero-entropy vacuum state, and a hypothesis put forward suggests a form of superconductivity in the brain. But whatever the physiological mechanism involved (and there are numerous hypotheses) there is general interest in the social impact.

R.K. Wallace, in his address to the plenary session of the 26th International Congress of Physiological Sciences in New Delhi in October 1974, said that the TM program is an "unforeseen" technological breakthrough "of immense benefit to human life." Since neurophysiological functioning is the basis of human life and cultural values, and since the TM program improves neurophysiological function, Wallace inferred that the TM technique is the scientific basis of cultural integrity and world peace. He proposed that we accelerate the development of world consciousness by increasing the number

of participants in the TM program to one percent in each population area of the world—a "sociological experiment of global significance."

Of course, TM is just one form of meditation and the optimism voiced by Wallace for TM is likely that of a devotee. Yet since 1969 this technique, available in a form easily subjected to laboratory scrutiny, has attracted a great deal of scientific attention among physiologists, psychologists, and physicists who have published hundreds of papers on the long- and short-term physiological and sociological effects of the TM technique. If indeed, one does approach "pure consciousness" in the meditative state and if enough people are practicing this technique, then there well could be a cumulative pool of morphic resonance which has a critical threshold at which higher forms of consciousness are more easily accessed by all persons.

Consonance with Contemporary Models of Reality

Though it would be impossible to give in these pages a complete elucidation of any model of reality, cursory reference to three important, comprehensive, and ascending models and their compatibility with the theory of formative causation will be attempted.

Popper's "Three Worlds" Theory

Popper (1977) has constructed a three-level model of reality to include mind and its effects. He proposes that the physical universe, which consists of obvious "things," exists in *World One*. *World Two* houses the mind in all its possible conscious and unconscious states. *World Three* is the repository of the contents of thought—all the products of the mind, including myths, legends, and theories. While many of the objects of *World Three* can obviously exist in material form as books or equations in *World One*, Popper is also suggesting that they have an independent reality. As mentioned before, Dawkins (1976) has coined the term "meme" to describe such a *World Three* object—a unit of cultural transmission. These "memes" are like nonphysical genes—abstract DNA—in that they go from brain to brain, replicating by imitation. Once an idea catches on, it even begins to propagate itself, independent of *Worlds One* and *Two*. Such propagation could easily be understood analogous to the morphic resonance described by Sheldrake.

Pribram-Bohm Holographic Model of the Universe

One current model of reality is that advanced by psychologist Karl Pribram and physicist Davis Bohm—generally referred to as the holographic model of the universe (Ferguson, 1977). The theory, in brief, states that our brains mathematically construct "concrete" reality by interpreting frequencies from

another dimension, a realm of meaningfully patterned, primary reality that transcends time and space. In other words, the brain is a hologram interpreting a holographic universe.

A brief review of the Pribram-Bohm model, with pertinent digressions into its historical evolution, might be helpful to those readers who have caught only glimpses and snatches of this over-arching "super-theory." Pribram's part of the product emerged from his research with the famous brain scientist Karl Lashley, who, for 30 years had been engaged in a search for the "engram"—the localized site and substance of memory. However, since the removal of all but lethal amounts of brain tissue of the experimental animals with which he was working failed to eradicate the memory of what they had learned, the experimenters were plagued with this question: How could memory be stored not in any one part of the brain but be distributed throughout it? Not until the mid-60's when he read a *Scientific American* article describing the first construction of a hologram did Pribram get an inkling of how the brain might store memory. As is fairly well known, holography is a method of lensless photography in which the wave field of light scattered by an object is recorded on a plate as an interference pattern. When the photographic record—the hologram—is placed in a coherent light beam like a laser, the original wave pattern is regenerated, and a three-dimensional image appears. But because there is no focusing lens, the plate appears as a meaningless pattern of swirls. The amazing attribute of this plate, however, is that *any* piece of the hologram will reconstruct the *entire* image. Perhaps, Pribram thought, the brain too deals with interactions, interpreting frequencies and storing the image, like the hologram. If this were true, then the memory would not be localized but would be dispersed throughout the brain like the hologram (in which any piece of the photographic record can reconstruct the entire image). In taking a hologram, light waves are encoded as an interference pattern and the resulting hologram that is projected, after being placed in a coherent light beam like a laser, is decoded or deblurred. If the brain worked in an analogous way, we could explain how billions of bits of information could be stored in a tiny space—just as the pattern on the holographic plate has no space-time dimension and the image is stored everywhere on the plate.

Simultaneously, an eminent physicist, David Bohm, had been thinking along similar lines on a much larger scale—on an issue which concerned not mere memory storage in the brain but reality itself. He proposed that what appeared to be a stable, tangible, visible, audible world was merely an illusion (the holographic image) or the unfolded, "explicate" order of things. However, Bohm went on, there may be an underlying order (the interference pattern) which he called the "implicate" or enfolded order of things which may constitute the more fundamental reality.

A tangible example might make comprehensible this more fundamental

reality (the "implicate" order) and our proclivity to overlook it. Since the days of Galileo, we have been looking at nature, one another, and our own selves through lenses; and our very act of objectifying, as with an electron microscope, alters, limits, and distorts that which we see. While desperately searching for "it"—an object with borders and definite position and clarity—we may be missing a "truer" nature which is in another order of reality where there are *no things*. It is as if we are bringing the "observed" into focus (in much the way that we bring a picture into resolution) while the *blur* is the more accurate representation—being the basic, the enfolded or implicate order of reality. If this were the case, then, the lens would actually be acting as a perceptual barrier. Analogously, this theory argues that the brain's mathematics or neural strategies for "knowing" may also be acting as a lens and if we didn't have that lens—the intricate mathematics hypothesized to occur as a nerve impulse travels along and between cells—we might know a world organized in the frequency domain, a domain in which there was no space or time. This suggests that if we could by-pass our normal constricting perceptual mode (what Aldous Huxley called the "reducing valve"), we could be attuned to the source or matrix of reality; and that this by-pass is exactly that which occurs during transcendental experiences and all paranormal events. Since with this model, individual brains are bits of the one unifying, greater hologram, they have access under certain circumstances to all the information in the total cybernetic system (in Sheldrake's terms, the morphogenic field).

The reader can see the similarity of Sheldrake's morphogenetic fields with Bohm's "implicate" order of reality, a concept which suggests that the universe exists in the form of waves or swirls which are somehow encoded into space and time. Bohm (1980) proposes that what appears to be a stable, tangible, visible, audible world is merely an illusion (the holographic image) or the unfolded, "explicate" order of things. Underlying this is the "implicate" or enfolded order of things which constitutes the more fundamental reality. The idea of morphic resonance is compatible with the idea of a holographic reality. Sheldrake doesn't require a holographic theory of brain function, however, because he doesn't think memory is confined to the brain itself.

Prigogine's Theory of Dissipative Structure

In 1977 Ilya Prigogine was awarded the Nobel Prize in chemistry; his theory of dissipative structures has profound implications for psychology, consciousness research, social transformation, and learning (Ferguson, 1979). Answering the questions of how life developed in a universe of ever-increasing disorder—how order and complexity emerge from entropy (the natural proneness to disorder leading to a decrease in energy)—Prigogine's

(1979) research closes the age-old gap between biology, chemistry, psychology, physics, and astronomy, between the study of living systems and the study of the apparently lifeless universe in which they arise. His explanation is that order emerges because of, and not despite, entropy. Order emerges from increasing disorder. The dissipative structures for which his theory applies are open systems, structures which exchange energy with the surrounding environment (and this could include anything from a chemical solution, to an amino acid, or a human being). The form or pattern of the dissipative structure is self-organizing, maintained by a continuous dynamic flow. The more complex the structure, the more energy it must dissipate or disperse in order to stabilize and maintain its complexity. When even minor fluctuations, or perturbations, reach a critical level, they drive the entire system into a new state—one which will be even more ordered, coherent and connected, thereby violating the so-called "laws of large numbers." The new state occurs as a sudden often qualitative shift, similar to a new pattern in a kaleidoscope—or even a paradigm shift. The process of such an event is non-linear; multiple internal fluctuations or factors influence and interact upon one another simultaneously. With each new state, there is an exponentially greater potential for transcendence to ever increasingly higher levels. Prigogine's nonlinearity fits in quite well with the Eastern views of co-origination—"all in each and each in all"—and with the "interpenetration" of which Capra (1975) speaks, as well as being consistent with ecological ideologies. Moreover, Sheldrake himself (1981b) refers in his synthesis to the compatibility between his ideas and Prigogine's proof of an ordering principle in entropy itself.

Sheldrake's proposal concerning universal consciousness of learning-memory has aroused considerable controversy within the scientific community. To accept his ideas entails what Kuhn (1962) calls a "paradigm shift." However, it seems presumptious of contemporary mechanistic philosophy to insist that all the major forces and fields at work in the world have been identified. Such a complacent position is untestable and therefore, by Popper's criterion, unscientific. In contrast, what Sheldrake proposed *is* scientific. This does not mean that it is true, but solely that it is testable.[2]

This hypothesis involves such a radical departure form the current orthodox way of viewing reality that it is unlikely to be accepted unless supported by considerable and convincing evidence. Should such be forthcoming, however, the acceptance of this theory will have implications that are nothing short of revolutionary.

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[2]International prize competitions in two countries have been established to promote research on Sheldrake's hypothesis of formative causation. In the United States, a $10,000 prize for the best scientific test will be awarded by New York's Tarrytown Group; *New Scientist* magazine will offer a prize of 250 English pounds for the best suggestion for such a test. In announcing the Tarrytown test—proof or disproof of the theory—chairman Robert Schwartz said:

> We want to draw serious scientific attention to evidence that is being ignored for lack of an adequate explanation using current hypotheses. We also want to stretch scientific thought and research designs beyond the ordinary. (Ferguson, 1982, p. 3)

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