

# David Bohm, Implicate Order and Holomovement

*By David Storoy*

*“Space is not empty. It is full, a plenum as opposed to a vacuum, and is the ground for the existence of everything, including ourselves. The universe is not separate from this cosmic sea of energy.” – David Bohm.*

David Bohm was one of the most distinguished theoretical physicists of his generation, and a fearless challenger of scientific orthodoxy.

His interests and influence extended far beyond physics and embraced biology, psychology, philosophy, religion, art, and the future of society. Underlying his innovative approach to many different issues was the fundamental idea that beyond the visible, tangible world there lies a deeper, implicate order of undivided wholeness.

David Bohm was born in Wilkes-Barre, Pennsylvania, on December 20, 1917. He went to Pennsylvania State University to study physics, and later to the University of California at Berkeley to work on his PhD thesis with J. Robert Oppenheimer.

While at Berkeley, Bohm, an idealist, became involved in politics and he was labeled a communist by the FBI led by J. Edgar Hoover. This prevented him from getting a clearance to work with Oppenheimer on the Manhattan Project at Los Alamos to produce the first atomic bomb during the World War II. However, while working on his doctorate at Berkeley, he discovered “*the scattering calculations of collisions of protons and deuterons*” which was used by the Manhattan Project team, and was immediately classified. As a result, Bohm was denied access to his own work and wasn’t allowed to write or defend his thesis. Oppenheimer had to certify before the faculty of the university that Bohm had indeed successfully completed his research. Bohm was awarded his PhD in physics.

Bohm was surprised to find that once electrons were in a plasma, they stopped behaving like individuals and started behaving as if they were part of a larger and interconnected whole. He later remarked that he frequently had the impression that the sea of electrons was in some sense alive.

In 1947, he became an assistant professor at Princeton University, where he met Albert Einstein. Einstein found Bohm to be a kindred spirit, a like-minded colleague with whom he could have fascinating conversations about the nature of the universe. He extended his research to the study of electrons in metals. Once again the seemingly haphazard movements of individual electrons managed to produce highly organized overall effects. Bohm’s innovative work in this area established his reputation as a theoretical physicist.

In 1951 Bohm wrote a classic textbook entitled *Quantum Theory*, in which he presented a clear account of the orthodox, Copenhagen interpretation of quantum physics. The Copenhagen interpretation was formulated mainly by Niels Bohr and Werner Heisenberg in the 1920s and is still highly influential today. But even before the book was published, Bohm began to have doubts about the assumptions underlying the conventional approach.

The **holomovement** is a key concept in David Bohm's interpretation of quantum mechanics and for his overall worldview. It brings together the holistic principle of "*undivided wholeness*" with the idea that everything is in a state of process or becoming (or what he calls the "universal flux») For Bohm, wholeness is not a static oneness, but a dynamic wholeness-in-motion in which everything moves together in an interconnected process. The concept is presented most fully in *Wholeness and the implicate order* published in 1980.

Referring to quantum theory, Bohm's basic assumption is that "*elementary particles are actually systems of extremely complicated internal structure, acting essentially as amplifiers of information contained in a quantum wave.*" As a consequence, he has evolved a new and controversial theory of the universe. A new model of reality that Bohm calls the "*Implicate Order.*"

The theory of the Implicate Order contains an ultra-holistic cosmic view; it connects everything with everything else. In principle, any individual element could reveal "*detailed information about every other element in the universe.*" The central underlying theme of Bohm's theory is the "*unbroken wholeness of the totality of existence as an undivided flowing movement without borders.*"



During the early 1980s Bohm developed his theory of the Implicate Order in order to explain the bizarre behavior of subatomic particles. Behavior that quantum physicists have not been able to explain. Basically, two subatomic particles that have once interacted can instantaneously "*respond to each other's motions thousands of years later when they are light-years apart.*" This sort of particle interconnectedness requires superluminal signaling, which is faster than the speed of light. This odd phenomenon is called the EPR effect, named after the Einstein, Podolsky, and Rosen thought experiment.

Bohm believes that the bizarre behavior of the subatomic particles might be caused by

unobserved subquantum forces and particles. Indeed, the apparent weirdness might be produced by hidden means that pose no conflict with ordinary ideas of causality and reality.

Bohm believes that this “*hiddenness*” may be reflective of a deeper dimension of reality. He maintains that space and time might actually be derived from an even deeper level of objective reality. This reality he calls the *Implicate Order*. Within the Implicate Order everything is connected; and, in theory, any individual element could reveal information about every other element in the universe.

Borrowing ideas from holographic photography, the hologram is Bohm’s favorite metaphor for conveying the structure of the Implicate Order. Holography relies upon wave interference. If two wavelengths of light are of differing frequencies, they will interfere with each other and create a pattern. “*Because a hologram is recording detail down to the wavelength of light itself, it is also a dense information storage.*” Bohm notes that the hologram clearly reveals how a “*total content—in principle extending over the whole of space and time—is enfolded in the movement of waves (electromagnetic and other kinds) in any given region.*” The hologram illustrates how “*information about the entire holographed scene is enfolded into every part of the film.*” It resembles the Implicate Order in the sense that every point on the film is “completely determined by the overall configuration of the interference patterns.” Even a tiny chunk of the holographic film will reveal the unfolded form of an entire three-dimensional object.

Proceeding from his holographic analogy, Bohm proposes a new order—the Implicate Order where “*everything is enfolded into everything.*” This is in contrast to the explicate order where things are unfolded. Bohm puts it thus:

*“The actual order (the Implicate Order) itself has been recorded in the complex movement of electromagnetic fields, in the form of light waves. Such movement of light waves is present everywhere and in principle enfolds the entire universe of space and time in each region. This enfoldment and unfoldment takes place not only in the movement of the electromagnetic field but also in that of other fields (electronic, protonic, etc.). These fields obey quantum-mechanical laws, implying the properties of discontinuity and non-locality. The totality of the movement of enfoldment and unfoldment may go immensely beyond what has revealed itself to our observations. We call this totality by the name holomovement.”*

Bohm believes that the Implicate Order has to be extended into a multidimensional reality; in other words, the holomovement endlessly enfolds and unfolds into infinite dimensionality. Within this milieu there are independent sub-totalities (such as physical elements and human entities) with relative autonomy. The layers of the Implicate Order can go deeper and deeper to the ultimately unknown. It is this “*unknown and undescrivable totality*” that Bohm calls the holomovement. The holomovement is the “*fundamental ground of all matter.*”

## THE HOLOGRAM AND HOLONOMY

In collaboration with Stanford neuroscientist Karl Pribram, Bohm was involved in the early development of the holonomic model of the functioning of the brain, a model for human cognition that is drastically different from conventionally accepted ideas. Bohm worked with Pribram on the theory that the brain operates in a manner similar to a hologram in accordance with quantum mathematical principles and the characteristics of wave patterns.

The **holonomic brain theory or model**, developed by neuroscientist Karl Pribram initially in

collaboration with physicist David Bohm, is a model of human cognition that describes the brain as a holographic storage network. Pribram suggests these processes involve electric oscillations in the brain's fine-fibered dendritic webs, which are different from the more commonly known action potentials involving axons and synapses. These oscillations are waves and create wave interference patterns in which memory is encoded naturally, in a way that can be described with Fourier Transformation equations. Pribram and others noted the similarities between these brain processes and the storage of information in a hologram, which also uses Fourier Transformations (mathematical). In a hologram, any part of the hologram with sufficient size contains the whole of the stored information. In this theory, a piece of a long-term memory is similarly distributed over a dendritic arbor so that each part of the dendritic network contains all the information stored over the entire network. This model allows for important aspects of human consciousness, including the fast associative memory that allows for connections between different pieces of stored information and the non-locality of memory storage (a specific memory is not stored in a specific location, i.e. a certain neuron).

A main characteristic of a hologram is that every part of the stored information is distributed over the entire hologram. Both processes of storage and retrieval are carried out in a way described by Fourier transformation equations. As long as a part of the hologram is large enough to contain the interference pattern that part can recreate the entirety of the stored image, except with more unwanted changes, called noise.

An analogy to this is the broadcasting region of a radio antennae. In each smaller individual location within the entire area it is possible to access every channel, similar to how the entirety of the information of a hologram is contained within a part.

Another analogy of a hologram is the way sunlight illuminates objects in the visual field of an observer. It doesn't matter how narrow the beam of sunlight is. The beam always contains all the information of the object, and when conjugated by a lens of a camera or the eyeball, produces the same full three-dimensional image. The Fourier transform formula converts spatial forms to spatial wave frequencies and vice versa, as all objects are in essence vibratory structures. Different types of lenses, acting similarly to optic lenses can alter the frequency nature of information that is transferred.

This non-locality of information storage within the hologram is crucial, because even if most parts are damaged, the entirety will be contained within even a single remaining part of sufficient size. Pribram and others noted the similarities between an optical hologram and memory storage in the human brain. According to the holonomic brain theory, memories are stored within certain general regions, but stored non-locally within those regions. This allows the brain to maintain function and memory even when it is damaged. It is only when there exist no parts big enough to contain the whole that the memory is lost. This can also explain why some children retain normal intelligence when large portions of their brain—in some cases, half—are removed. It can also explain why memory is not lost when the brain is sliced in different cross-sections.

A single hologram can store 3D information in a 2D way. Such properties may explain some of the brain's abilities, including the ability to recognize objects at different angles and sizes than in the original stored memory.

Pribram proposed that neural holograms were formed by the diffraction patterns of oscillating electric waves within the cortex. It is important to note the difference between the idea of a

holonomic brain and a holographic one. Pribram does not suggest that the brain functions as a single hologram. Rather, the waves within smaller neural networks create localized holograms within the larger workings of the brain. This patch holography is called holonomy or windowed Fourier transformations.

A holographic model can also account for other features of memory that more traditional models cannot. The Hopfield Memory model has an early memory saturation point before which memory retrieval drastically slows and becomes unreliable. On the other hand, holographic memory models have much larger theoretical storage capacities. Holographic models can also demonstrate associative memory, store complex connections between different concepts, and resemble forgetting through lossy storage.

## INFORMATION

Bohm: *“The actual nature of the information and the way it is carried is not yet entirely clear. Is it really correct, for example, to speak of a ‘field’ of information, since information does not fall off with distance, neither is it associated with energy in the usual sense. Possibly the notion of field should be widened or, at the quantum level, we should be talking about pre-space structures, or about algebraic relationships that precede the structure of space and time.”*

Bohm’s notion of “active information” is tied to his “Ontological Interpretation” (formerly the Causal or Hidden Variable Interpretation). I propose it be freed from any particular theory and raised to the level of a General Principle. Bohm never considered his Ontological Interpretation to be the last word on quantum theory, rather that it would suggest insights and avenues for further research. I believe that one of the most valuable is this notion of information.

*“Yes, if you say that all matter actually works from information, not merely matter in the nervous system or DNA matter working in the cell, but even the electron is forming from empty space being informed as it were by some unknown source of information which may be all over the space. And then we can not have, there is no sharp division between thought, emotion and matter. You see that they flow into each other. Even in ordinary experience you have thought and emotion flow into a movement of matter in the body. Or the movement of matter in the body gives rise to emotion and thought right. Now the only point is that present science has no idea how thought could directly affect an object which is not in contact with the body you see, or directly through some system. But if you say that the entire ground of existence is enfolded in space, that all matter is coming out of that space, including ourselves, our brains, our thoughts ... then the information might gradually vades the space so that matter starts to, you could say that matter is always forming according to whatever information it has and therefore the thought process could alter that information content. So I would say that it does look possible though I think very careful experiments have to be done before we say that it actually does take place.”*

*“Because a hologram is recording detail down to the wavelength of light itself, it is also a dense information storage.”* Bohm notes that the hologram clearly reveals how a *“total content, in principle extending over the whole of space and time, is enfolded in the movement of waves (electromagnetic and other kinds) in any given region.”* **The hologram illustrates how “information about the entire holographed scene is enfolded into every part of the film.”** It resembles the Implicate Order in the sense that every point on the film is *“completely determined by the overall configuration of the interference patterns.”* Even a tiny chunk of the holographic film will reveal the unfolded form of an entire three-dimensional object.

## MATTER, ANIMATE AND INANIMATE

Right off, Bohm refers to the particle, the most essential building-block of matter. He considers the particle, fundamentally, to be only an *“abstraction that is manifest to our senses.”* Basically, for Bohm, the whole cosmos is matter; in his own words: *“What is, is always a totality of ensembles, all present together, in an orderly series of stages of enfoldment and unfoldment, which intermingle and interpenetrate each other in principle throughout the whole of space.”*

Bohm’s explicate order, however, is secondary—derivative. It flows out of the law of the Implicate Order, a law that stresses the relationships between the enfolded structures that interweave each other throughout cosmic space rather than between the *“abstracted and separate forms that manifest to the senses.”*

Bohm’s explanation of *“manifest”* is basically that in certain sub-orders, within the *“whole set”* of Implicate Order, there is a *“totality of forms that have an approximate kind of recurrence, stability and separability.”* These forms are capable of appearing tangible, solid, and thus make up our manifest world.

Bohm also declares that the *“implicate order has to be extended into a multidimensional reality.”* He proceeds: *“In principle this reality is one unbroken whole, including the entire universe with all its fields and particles. Thus we have to say that the holomovement enfolds and unfolds in a multidimensional order, the dimensionality of which is effectively infinite. Thus the principle of relative autonomy of sub-totalities is now seen to extend to the multi-dimensional order of reality.”*

Bohm illustrates this higher-dimensional reality by showing the relationship of two televised images of a fish tank, where the fish are seen through two walls at right angles to one another. What is seen is that there is a certain *“relationship between the images appearing on the two screens.”* We know, Bohm notes, that the two fish tank images are interacting actualities, but they are not two independently existent realities. *“Rather, they refer to a single actuality, which is the common ground of both.”* For Bohm this single actuality is of higher dimensionality, because the television images are two-dimensional projections of a three-dimensional reality, which *“holds these two-dimensional projections within it.”* These projections are only abstractions, but the *“three-dimensional reality is neither of these, rather it is something else, something of a nature beyond both.”*

If there is apparent evolution in the universe, it is because the different scales or dimensions of reality are already implicit in its structure. Bohm uses the analogy of the seed being *“informed”* to produce a living plant. The same can be said of all living matter. *“Life is enfolded in the totality and—even when it is not manifest, it is somehow implicit.”* The holomovement is the ground for both life and matter. There is no dichotomy.

What lies ahead? For Bohm it is the development of consciousness!

## CONSCIOUSNESS

Bohm conceives of consciousness as more than information and the brain; rather it is information that enters into consciousness. For Bohm consciousness *“involves awareness, attention, perception, acts of understanding, and perhaps yet more.”* Further, Bohm parallels the activity of consciousness with that of the Implicate Order in general.

Consciousness, Bohm notes, can be *“described in terms of a series of moments.”* Basically, *“one moment gives rise to the next, in which context that was previously implicate is now explicate while the previous explicate content has become implicate.”* Consciousness is an interchange; it is a feedback process that results in a growing accumulation of understanding.

Bohm considers the human individual to be an *“intrinsic feature of the universe, which would be incomplete, in some fundamental sense”* if the person did not exist. He believes that individuals participate in the whole and consequently give it meaning. Because of human participation, the *“Implicate Order is getting to know itself better.”*

Bohm also senses a new development. The individual is in total contact with the Implicate Order, the individual is part of the whole of mankind, and he is the *“focus for something beyond mankind.”* Using the analogy of the transformation of the atom ultimately into a power and chain reaction, Bohm believes that the individual who uses inner energy and intelligence can transform mankind. The collectivity of individuals have reached the *“principle of the consciousness of mankind,”* but they have not quite the *“energy to reach the whole, to put it all on fire.”*

Continuing with this theme on the transformation of consciousness, Bohm goes on to suggest that an intense heightening of individuals who have shaken off the *“pollution of the ages”* (wrong worldviews that propagate ignorance), who come into close and trusting relationship with one another, can begin to generate the immense power needed to ignite the whole consciousness of the world. In the depths of the Implicate Order, there is a *“consciousness, deep down—of the whole of mankind.”*

It is this collective consciousness of mankind that is truly significant for Bohm. It is this collective consciousness that is truly one and indivisible, and it is the responsibility of each human person to contribute towards the building of this consciousness of mankind. *“There’s nothing else to do, there is no other way out. That is absolutely what has to be done and nothing else can work.”*

Bohm also believes that the individual will eventually be fulfilled upon the completion of cosmic noogenesis. Referring to all the elements of the cosmos, including human beings, as projections of an ultimate totality, Bohm notes that as a *“human being takes part in the process of this totality, he is fundamentally changed in the very activity in which his aim is to change that reality, which is the content of his consciousness.”*

David Peat is a theoretical physicist and a friend and colleague of David Bohm. Together they wrote *Science, Order and Creativity* and were working on *The Order Between and Beyond* until Bohm’s death in 1992. More at <https://www.infinitepotential.com/>