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# Optical Models of Consciousness

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In the late 1970s there was enthusiasm over Pribram's holographic model and Bohm's notion of implication. These theories were thought to explain consciousness, the nature of reality and mystical experiences in one fell swoop and to show that science had, at last, accepted spiritual events into its fold. This last sentiment was echoed by Wilber:

> Agree or disagree with the new paradigm(s), one conclusion unmistakably emerges: at most, the new science demands spirit; at least, it makes ample room for spirit. Either way, modern science is no longer denying spirit. And that, that is epochal. As Hans Kung remarked, the standard answer to "Do you believe in Spirit?" used to be, "Of course not, I'm a scientist," but it might very soon become, "Of course I believe in Spirit. I'm a scientist." (1982, p.4)

However, science is far from being homogeneous with regard to the beliefs held by its practitioners and there does not appear to be any acceptance of transcendentalism within science as a whole.

Optical models arose from two separate considerations. Pribram, a neuroscientist, had tried to understand the encoding of information in the brain (Ferguson, 1982b) while the physicist Bohm was trying to understand the nature of physical reality from the point of view of quantum mechanics (Bohm, 1980). The confluence of these streams led to a model of human consciousness that was a radical departure from accepted ideas about reality. Pribram has admitted that this model is a stab in the dark (Ferguson, 1982b).

This paper starts by describing holography, then the relationship of holography to brain functioning and then, problems with the holographic model. Bohm's notions of wholeness and implication are introduced and, finally, Bohm's understanding of the role of consciousness in his theory are discussed. This paper is not meant to be comprehensive, but is rather to provide a summary of the optical theory.

## Holography

The hologram was invented in 1965 by Leith and Upatnieks using the theoretical information provided by Gabor in 1947 (Ferguson, 1982a). It is a means of lensless photography that employs lasers to produce a three dimensional image. To photograph an object, a laserbeam is split, so that half of it passes through a half-silvered mirror before striking the photographic plate and the other half is reflected and strikes an object before striking the same photographic plate. Because a laser is a coherent light beam, meaning that the light waves are all in phase, the half of the beam that is scattered from the object is put out of phase and interferes with the straight-through beam resulting in an interference pattern on the photographic plate (Briggs & Peat, 1984; Ferguson, 1982a).

When the photographic plate is illuminated using a laser beam, a three-dimensional image appears to an observer standing within a small range of angles in the direction of illumination. If any part of the photographic plate is destroyed, the image that appears upon illumination is still an image of the entire object, although lacking in detail. This is due to the fact that information about the whole object is encoded in every part of the interference pattern on the photographic plate (Briggs & Peat, 1984; Ferguson, 1982a).

The process of encoding the information about an object, i.e., of photographing it, can be described mathematically by the use of Fourier transformations. Similarly, Fourier transformations describe the way in which an image is reconstructed from the photographic plate upon illumination (Briggs & Peat, 1984; Ferguson, 1982a).

## Holography in the Brain

The hologram has certain properties that are similar to the properties of memory. Just as large parts of a holographic plate can be destroyed without losing the capacity to produce an entire image, so large parts of the brain can be destroyed without interfering with the recall of a specific memory (Briggs & Peat, 1984; Pribram, 1980; 1982). It was this observation that led Pribram to consider the holograph as a model of human mental functioning (Briggs & Peat, 1984; Pribram, 1982).

Pribram made the observation that there are horizontal networks of nerve cells in the nervous system that appear to modulate the information relayed in the major sensory pathways. It is this horizontal network of cells that realizes a Fourier transformation of incoming sensory information, so that it, in fact, becomes encoded in the brain as an interference pattern, analogous to that produced on a photographic plate in the case of holography.

> Some neurons, now called local circuit neurons, have no long fibers and display no nerve impulses. They function in the graded wave mode primarily and are especially responsible for horizontal connectivities in sheets of neural tissue, connectivities in which holographic-like interference patterns can become constructed. (Pribram, 1982, p. 32)

There are, for example, horizontal and amacrine cells in the eye which are local circuit neurons (Bailey, 1981) and which could begin the Fourier transformation of incoming visual information.

If the brain is the equivalent of a photographic plate with encoded interference patterns, then "illumination" of the brain, applying a Fourier transformation to the encoded material, could explain the presence of mental imagery (Pribram, 1980). Going one step further and using the fact that a holographic image is three-dimensional, Pribram has postulated that, in fact, the real world itself, is only a holographic image, that appears three-dimensional to us (Pribram, 1982). In both cases, however, the question arises, of what it is that illuminates the interference pattern in the brain, and for whom this illumination takes place. Pribram has suggested that perhaps the physiological cybernetic systems of the brain which are implicated in "selective attention, intentional behavior, and the ability to make discriminative and delayed responses" (Pribram, 1980, p. 58) serve this function. However, such an explanation does not adequately account for the sense of a self as observer of images.

## Implication

Holography is an example of a more general phenomenon described by Bohm. To understand it, consider the following example. Suppose one were to take a piece of paper and fold it a number of times. While it is folded up, one takes a pair of scissors and cuts off a corner. At this point, Bohm would maintain that one is in the implicate order. In unfolding the paper, one would be moving from the implicate order to the explicate order, and the single cut in the folded paper would now correspond to a pattern of holes in the paper (Factor, 1985). The implicate order is a domain in which the diversity of physical and mental reality is enfolded so as to produce a whole.

> In terms of the implicate order one may say that everything is enfolded into everything. This contrasts with the explicate order now dominant in physics in which things are unfolded in the sense that each thing lies only in its own particular region of space (and time) and outside the regions belonging to other things. (Bohm, 1980, p. 177)

Hence the physical world, and the three-dimensional images that result from illumination in holography, are analogous to the explicate order; the interference pattern on a holographic plate corresponds to the implicate order.

## Implication and Consciousness

Bohm used the term "consciousness" to refer to "thought, feeling, desire, will, impulse to act and an unspecified set of further features, such as awareness" (Factor, 1985, p. 15). As mentioned before, he thought that physical reality and cognition are explications of an implicate order.

> Matter as a whole can be understood in terms of the notion that the implicate order is the immediate and primary actuality (while the explicate order can be derived as a particular, distinguished case of the implicate order). The question that arises here, then, is that of whether or not (as was in a certain sense anticipated by Descartes) the actual 'substance' of consciousness can be understood in terms of the notion that the implicate order is also its primary and

> immediate actuality. If matter and consciousness could in this way be understood together, in terms of the same general notion of order, the way would be opened to comprehending their relationship on the basis of some common ground. Thus we could come to the germ of a new notion of unbroken wholeness, in which consciousness is no longer to be fundamentally separated from matter. (Bohm, 1980, p. 197)

To make his point, however, Bohm brought in arguments from his own introspected experience which are highly suspect. Nonetheless, the idea remains that that which we are conscious of, that which constitutes our conscious experience, is the unfoldment of patterns in the implicate domain (Briggs & Peat, 1984,; Factor, 1985).

There is a second use that Bohm makes of the implication/explication model with regard to conscious experience. He maintains that conscious experience itself enfolds a wealth of information that is available upon explication. Any conscious experience presupposes, for example, one's remembered past, certain information about world conditions and various rational and imaginal consequences (Factor, 1985).

## Conclusions

All of this is far from the usual understanding of reality, and opens the door for the explanation of mystical experiences. The claim is made that a mystical experience may be the way in which one's direct participation in the implicate order becomes described (Ferguson, 1982b). Even more radical conjectures involve the possibility that conscious functioning at the level of the implicate order gives rise to all of physical reality as a reflection of its own functioning (Briggs & Peat, 1984,; Ferguson, 1982b).

This brings us back to the point at which we began. There is scope for the use of one's imagination in the optical models, but I would need to see the details of these models, which I have yet to see published, in order to assess their validity.

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