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Summary of The David Bohm's Work on The Centenary of his Birth

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***Abstract* - David Joseph Bohm was born on December 20, 1917, and obtained the doctorate in physics in 1943 from the University of California, Berkeley, under the guidance of R. Oppenheimer[1]. From 1946 he began teaching at Princeton University. He has published a series of articles on various physics topics, especially on plasma oscillations. He then wrote the book Quantum Theory considered to date a classic in the subject. In 1950 he was indicted and imprisoned for political reasons, and although acquitted in May 1951, Princeton University refused to renew his contract and he was exiled to Brazil. In 1954, David Bohm elaborated the work entitled A proposal for interpretation of quantum theory in terms of "hidden variables"(3), which sought a causal and objective description of quantum phenomena. In 1960 he enthusiastically discovered the thinking of the Indian Jiddu Krishnamurti, and from dialogues between them emerged interesting ideas in the area of the confluence of Physics with the mystical tradition.**
Keywords: David Bohm, hidden variables, holomovement, quantum physics..

I. INTRODUCTION

Bohm was an American physicist of later Brazilian and British citizenship [1]. Bohm's abstract genius was sharp, and as a teenager he was already showing his scholarly tendencies in physics, especially in topics related to atomic energy, a subject for which he was fascinated. Bohm graduated in 1939 and went on to work under Oppenheimer's guidance in theoretical physics, which earned him the doctoral degree he earned in 1943 from the University of California, Berkeley.
From 1946 Bohm became an assistant professor at Princeton University where he worked with Albert Einstein until around 1951 when involved in suspected participation in communist movements left the United States. Bohm, then moved to Brazil, where he held a chair in Physics at the University of São Paulo. In 1957 he moved to Great Britain, working as a researcher at the University of Bristol until 1961, and later became Professor of Theoretical Physics at the University of London until 1987.

II. THEORY OF HIDDEN VARIABLES

Quantum Mechanics (MQ) is one of the main theoretical models for the explanation of physical reality, and one of its difficulties is the indeterminacy that is intrinsic in theory when it proposes to describe the behavior of elementary particles in the structure of matter.

One of the sources of theoretical and philosophical difficulties of MQ is the apparent incompleteness of the theory, to the point that some scientists question its validity by saying that it is not complete. Quantum mechanics is a successful theory in relation to experimental confirmations of its predictions, but has, since its origins, a great controversy as to the interpretation of its foundations. The debates around the foundations of quantum mechanics[2] provoke continuous controversies from the beginning of theory to the present.

According to the Copenhagen interpretation of quantum mechanics, the wave function evolves according to the Schrödinger equation in a linear superposition of different states. However, in the measurement process, the actual measure always assumes a certain value, which means that the measure did something about the process in question, causing the function to collapse. This is replaced the determinism of classical physics by a probability of occurrence. One way to investigate the truth of this assumption is to try to find some other interpretation of the quantum theory in terms of hidden variables, proposed by Bohm, which implies in the non-acceptance of the interpretation given by the Copenhagen School to the MQ. Then, based on these divergences in the interpretations of the MQ, BOHM created the Theory of the Hidden Variables [3].

Indeterminism only appears as in classical theories, that is, it is due to our lack of knowledge. In other words, the cause would be unknown and hidden variables would represent characteristics, properties, which the elementary particles would possess and which have not yet been discovered. Another key point of the model is that such variables are real. This model adopts a realistic and objective view of what we call physical reality. In short, it is a deterministic and real model, where the elementary particles are indeed considered as particles.

It is precisely for this reason that such a model seduces those who do not like, or do not accept, the possibility that reality is not intrinsically deterministic and objective. In theory the field given by the wave function is interpreted as being a real field, in the same sense in which the fields associated with Maxwell's electromagnetic theory are real fields.

From the calculations, it results from Schrödinger's equation, beyond the classical potential, a new potential called "Quantum Potential", which is a new entity with some non-classical properties. First, the Quantum Potential does not decrease as the distance between two particles increases. Second, the Quantum Potential is nonlocal, that is, the particles of a system are instantaneously correlated. Third,

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Quantum Potential depends on the overall quantum state of a system; in the limit the quantum potential may depend on the quantum state of the universe. Fourth, the Quantum Potential does not radiate, that is, the quantum potential does not have a point source.

The article [4] "An ontological basis for the Quantum Theory" deals with the Bohm's interpretation of non-relativistic MQ, which involves the hidden variables, based on the existence of particles describing trajectories in space according to a law of motion that can be obtained from the wave function. He reports to development in the limitations of the usual interpretation of the theory although with its own focus in approaching the problem of measurement, one of the most sensitive problems of the interpretation of quantum theory.

It is important to note that Bohm's model is deterministic, and the wave function in terms of Bohm's proposal establishes an analogy between quantum physics and classical physics when he deduces a sort of Newton's second law for a quantum particle. Bohm's work triggered strong repercussions in the scientific community. Great scientists analyzed this controversial work, as, Einstein, De Broglie, Pauli, Halpern, Epstein, Takabayasi, Keller, Vigier, Schatzman, Freidstadt, Rosenfeld, Destouches, generating criticism and praise.

III. BOHM E KRISHNAMURTI

The expansion of the ideas of hidden variable theory led BOHM to develop the idea that there is holism, or wholeness in the world. Thus, in 1959, he related his ideas about quantum mechanics to Krishnamurti's philosophical thinking and, from that, he proposed dialogues[5] between the human sciences and physics. David Bohm defines holomovement as a dynamic process of wholeness, a single, unbreakable integrity in flowing motion. Everything is connected to everything and in dynamic flow, each part contains the flow as a whole. We can consider holism as the basic nature of reality. According to this important physicist, nothing is disconnected and everything connects to everything, in a dynamic flow where each part of this flow contains it in its totality. Bohm's first contact with Krishnamurti's work was in 1959, after reading the book [6], "The First and Last Freedom," which deals especially with the question of the observer and the observed. This question was for a long time the center of Bohm's work as a theoretical physicist, since the main interest was focused on the presence of the observer during the measurement process in the MQ. In this theory, for the first time in the development of physics, the assumption was made that the measuring apparatus and observer cannot exist separately, and this important fact has been established as necessary for the understanding of the fundamental laws of matter in general.

In Book [7], “Thought as a System”, Bohm draws attention to the need for the understanding of thought as a system, even if it is limited and incomplete, because it acts to consider only some aspects of reality and not its totality.

He then emphasizes the importance of considering reality not in a fragmented, but complete, way.

In view of this, Bohm conceives the existence of a deeper intelligence perceptual capacity, called self-perception, linked to attention, through which our thinking may become less incoherent and more adept at avoiding fragmented situations, always preferring complete actions.

These ideas are related to another book [8], titled, “Wholeness and the Implicate Order” where Bohm develops a theory which shows that any part, element or aspect that we can abstract in thought continues to involve the whole and is therefore intrinsically related to the whole from which it has been abstracted.

The theory of wholeness and the implicate order consists of a new look at quantum physics and reveals analytical categories that facilitate understanding of the phenomena of nature.

The author draws attention to the perception of the world at the two-dimensional and three-dimensional level of objects, thoughts that must be operated not in a fragmented way, but in its entirety, since the universe is indivisible, therefore, such objects are strongly interconnected with each other.

IV. HOLONOMIC MODEL OF THE BRAIN

Bohm also made significant theoretical contributions to the development of the holonomic model of brain functioning [9]. In collaboration with Karl Pribram, a Stanford neuroscientist, he laid the foundation for the theory that the brain works in a hologram-like way. Bohm has found evidence that the universe is a hologram from the experiences of the physicist Aspect and his collaborators who have discovered that subatomic particles are able to instantly communicate with each other regardless of the distance that separates them. It does not matter if this distance is one or a billion meters. Somehow one particle always knows what the other is doing. Analyzing this fact, Bohm believes that Aspect's findings imply that objective reality does not exist, and that the universe is at the center of a huge, complex hologram. In addition to Bohm, the neurophysiologist Karl Pribram, is also believed in the holographic nature of reality. He presented a holographic model to uncover how and where memories are stored in the brain. For Pribram the brain itself is a hologram and this explains how the human brain can hold so many memories in such a small space. The connection of Pribram's holographic brain model [9] and Bohm's theory was called the "Bohm and Pribram holographic paradigm," and generated many controversies, for although many scientists did not accept it, others became euphoric. It may be said that after the ideas of Bohm and Pribram, many researchers say that parapsychological phenomena become much more understandable, others mention that telepathy may simply be the holographic level access.

In Pribram's opinion, if psychology wants to understand the conditions that produce the world of appearances, it must incorporate the proposals of physicists like Bohm. That is, this line of reasoning offered people a possible answer to controversial topics, such as the validity of alternative medicine, transpersonal psychology, spirituality, yoga, and esoteric themes. At least in theory, science should serve people, let us then consider these uses become customary and can serve them, within the focus of their preferences, including in the choice of such controversial topics as, for

example, quantum healing .

V. THE QUANTUM COMPANY

On the other hand, from the points discussed in this study, some scholars consider that companies are living beings because they are formed by people, so this view of quantum physics can be useful for companies. There is even a book published by RIBEIRO[10] entitled "The Quantum Company", where the author mentions that the people who work with the organization must have the same culture, that is, have the same way of being, thinking and acting forming an indivisible group, where all are strongly interconnected. The quantum management approach proposes a non-fragmented view of reality where sensation, feeling, reason, and intuition balance and strengthen. It respects what each has of importance and understands that diversity is not only acceptable but even commendable and essential for the richness and fertilization of thought. Finally, the important thing about the quantum approach is that, as a way of looking at reality, its concepts can be applied to the most different areas of knowledge. As we change our look on the world, we begin to see new possibilities, impossible to be seen before. It is a different way of looking at health and illness, of understanding healing and also of death; the understanding of what goes on during the teaching-learning process, and strategies to obtain a better return from our schools. Even more, it means taking more advantage of the infinite potentialities of our brain; new approaches in psychology that extrapolate the boundaries of the personal and plunge us into levels called transpersonal, where we connect with the cosmic consciousness.

VI. FINAL CONSIDERATIONS

Bohm's interpretation of MQ received a lot of criticism, but they did not have the character of a direct refutation, that is, no discrepancies were noted between Bohm's interpretation and experimental results, but to the physical consistency of the model or to its epistemological posture. For this reason he remained in ostracism for years. One of the reasons for such a situation is the resurgence of classical determinism which the description in terms of hidden variables presents, ie the indeterministic description could be transformed into a deterministic one. However, more recently, interest in Bohmian mechanics has been renewed, recognizing good perspectives for its application in different areas of physics. Another important point is to restate that the subjectivity of the orthodox version, present in the necessary reference to the "observer", could be eliminated. Finally, the use of the word quantum in interpersonal, administrative, and mystical relations consists of a metaphorical sense, for it is somewhat different from its physical meaning.

REFERENCES

[1] JAMMER, M. David Bohm and his work on the occasion of his seventieth birthday, Foundations of Physics,v.18, n.7, 1988, p.691-699
[2] OMNES, R. The Interpretation of Quantum Mechanics, Princeton University Press, Princeton-New Jersey 1994, available in https://www.amazon.com/Interpretation-Quantum-Mechanics-Roland-Omn%C3%A8s/dp/0691036691
[3] D. BOHM. A suggested interpretation of the quantum theory in terms of hidden variables, Physical Review, v.85, n.2,1952, p.166-179 e 80-193.
[4] BOHM, D., HILEY, B.J. and KALOYEROU, P.N.; Physics Reports, v.144, n.6. North-Holland, Amsterdam, 1987.Available in http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.800.4990&rep=rep1&type=pdf, acess in 10/07/2017
[5] KRISHNAMURTI, J. and BOHM, D.; The Future of Humanity; Two Public Meetings at Brockwood Park – 1983; Copyright by the Krishnamurti Foundation, available in https://krishnamurti-teachings.info/series/the-future-of-humanity.pdf, acess in 12/06/2017
[6] KRISHNAMURTI, J. The first and last freedom Translation of Hugo Veloso; editora cultrix São Paulo- Brazil, 1997, book available in http://www.lojadharma.org.br/textos_Doc/A%20primeira%20e%20%C3%BAltima%20liberdade%20-%20J%20Krishnamurti.pdf
[7] BOHM, D.; Thought As a System , first edition Publishing company Madras, São Paulo, Brazil, 2006.
[8] BOHM, D. The totality and the implicate order: a new perception of reality . 12 ed. translator Mauro de Campos Silva. Publishing company Cultrix, São Paulo, Brazil 2001, availablle in https://revistas.ufg.br/bgg/article/viewFile/4137/3640, acess in 20/06/2017.
[9] JOYE, S.R.; The Pribram-Bohm Holoflux Theory of Consciousness, Dissertation, California Institute of Integral Studies, 2016, available in://www.heartmath.org/research/research-library/dissertations/pribram-bohm-holoflux-theory-of-consciousness/, acess in 22/07/2017
[10] RIBEIRO, C.R.M. The Quantum Company. Petrópolis vozes Publishing Company , Rio de Janeiro, Brazil 1993.

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