David Bohm

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December 31, 2004

David Bohm was a major twentieth-century physicist, one of the world's leading authorities on quantum theory and its conceptual foundations. He was born in Wilkes-Barre, Pennsylvania, on December 20, 1917, and died on October 27, 1992, in London.

A student of J. Robert Oppenheimer, Bohm received his Ph.D. from the University of California at Berkeley in 1943. While still a graduate student, Bohm discovered a particular collective movement of electrons in a plasma, now called Bohm-diffusion. At Princeton in 1950, he completed the first of his six books, *Quantum Theory*, which became the definitive exposition of the orthodox (Copenhagen) interpretation of quantum mechanics, the development of which was led by the Danish physicist Niels Bohr between 1925 and 1930. Here Bohm presented his reformulation of the paradox of Albert Einstein, Boris Podolsky, and Nathan Rosen (EPR) concerning the possibility of simultaneous values of position and momentum for a pair of separated particles.

Bohm's version of the EPR analysis, involving components of spin in place of position and momentum, has been the basis of the enormous expansion of research on the foundations of quantum theory, focusing on nonlocality and the possible incompleteness of the quantum description (the question of "hidden variables"), that has occurred during the past several decades. Bohm and Yakir Aharonov, in 1957, made the first major step in this research when they demonstrated the existence of a "rather strange kind of correlations in the properties of distant things." This work was a forerunner of the seminal work of John Bell on quantum nonlocality (→Bell's theorem).

In 1951 Bohm accomplished what physicists at the time regarded as impossible: He constructed, as an alternative to the prevailing observer-oriented Copenhagen interpretation of quantum theory, an objective, fully deterministic account of nonrelativistic quantum phenomena in terms of a theory describing a motion of particles under an evolution choreographed by the wave function (→Bohmian mechanics). The theory Bohm proposed was in fact a rediscovery of Louis de Broglie's 1927 pilot-wave model, of which Bohm had been unaware. However, unlike de Broglie, Bohm fully appreciated the significance of the model. In particular, he showed how the predictions of the quantum measurement formalism, involving a non-commutative algebra of operators as observables, could be entirely explained.

In 1959 at Bristol, England, Bohm again collaborated with Aharonov, this time on a paper concerned with a very different sort of nonlocality. The result was the Aharonov-Bohm effect: In quantum mechanics a magnetic field can influence the behavior of electrons confined far away from the field, a phenomenon incompatible not only with classical physics but with the spirit of the Copenhagen interpretation of quantum theory as well. The Aharonov-Bohm effect remains, some four decades after its discovery, a subject of intense research.

Bohm was a person of extraordinary commitment to principle, both moral and scientific. He refused in 1951 to testify against colleagues before the House Un-American Activities Committee, an act which led to his indictment for contempt of Congress and his banishment from Princeton and, indeed, from all of American academia. During most of his last forty years he was engaged in an often lonely pursuit of scientific truth, showing little regard for prevailing fashion or orthodoxy.

Bohm's interests were not confined to physics. In particular, he was profoundly concerned with philosophical issues, ranging from the philosophy of science and the philosophy of mind to ethics and moral philosophy. Late in his life he was also inspired by mysticism. He saw a all-encompassing unity in the world and thought that quantum physics was but a manifestation of a deeper underlying "wholeness" of nature, an idea that he developed in his 1980 book *Wholeness and the Implicate Order*.

Shortly after his death Bohm's last book, *The Undivided Universe*, was published. Written in collaboration with Basil Hiley, his long-time colleague at London's Birkbeck College, where Bohm had for three decades been a professor, the book provided an exposition of his 1951 pilot-wave theory, together with later developments including his thoughts on the implicate order.

Bohmian mechanics is today an area of increasingly active research. However, very few scientists working in this field see an operational connection between Bohmian mechanics and Bohm's ideas on the implicate order. Nonetheless, these ideas remain an inspiration for many others.

References

[1] F. David Peat. *Infinite Potential: The Life and Times of David Bohm.* Helix (Addison-Wesley), Reading, MA, 1996.