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Period 2

P-IB Physics

John Bardeen

Only one individual has won the Nobel Prize in field of physics twice. John Bardeen was one of three people (John Bardeen (himself), Leon Cooper, and Robert Schrieffer) to win the noble prize in 1973 and 1956 (Walter H Brattain, William Shockley, and Bardeen). Bardeen was born in the month of May on the 23rd day, in Madison Wisconsin. "John Bardeen was the most intelligent human-being I've ever met." (Bob Brattain) Upon his entry into college, Bardeen attended numerous physics and math classes at the University of Wisconsin. He took time away from his classes with a job at the Western Electric Company. He received his B.S in electric engineering in 1928. (The Nobel Prize in Physics 1972) Bardeen then returned to the University of Wisconsin, where he became a research assistant in electric engineering and applied his skills to research geophysics and on radiation that comes from antennas. This period of research is where he met Professor J.H. Van Vleck, and began to develop a strong interest in the quantum theory.

Bardeen began to focus on electrical conduction in semiconductors, theory of superconductivity, and the diffusion of atoms in solids in the year of 1945 (The Nobel Prize in Physics 1972). This is the topic of research which earned him the Nobel Prize in 1956.

Experiments on semiconductors were performed and the transistor effect was established. A transistor is a semiconductor device, which amplifies and switches electronic signals. The transistor was revolutionary to electronically powered devices as this new development would lead to various radios, calculators, and computers. Bardeen was awarded the prestigious prize on November 1, 1956. He found out he had successfully attained the award while cooking eggs for breakfast, most likely scrambled. The ceremony then occurred on Monday, December 10 of the same year. Following this successful venture in semiconductors, Bardeen, with colleagues, began to focus on explaining superconductivity, which had never been correctly done until the conclusion of Bardeen and his colleagues on the task in 1957. This theory included how extremely cold metals are able to conduct electricity so efficiently.

Furthermore, Bardeen was rewarded for his research on superconductivity with Nobel Prize once again in 1972. This time he had help from Leon Cooper and Robert Schrieffer. The theory that was created by the three in which explained the reason that extremely cold metals were able to conduct electricity became known as the BCS theory. Bardeen had studied superconductivity at an earlier date, mostly in the 1930s, but his work on the subject was delayed as he was asked for assistance from Washington DC in 1941. Bardeen's focus soon shifted back towards superconductivity after he made an article that reviewed the previous theory, *Handbuch der Physik*, on superconductivity in 1956. He concluded that London's notion that an "ordered phase in which quantum effects extend over large distances in space." (John Bardeen and the Theory of Superconductivity).

He characterized superconductors by a parameter which goes to zero at the transition. Bardeen also pointed out the diamagnetic origin of super currents, and debated between the second order phase transition between a normal and superconducting state. Like London, Bardeen stressed that energy had a gap which was caused by the rigidity of the wave function in respect to magnetic perturbation. This is how he was able to approximate the gap of energy and interpret electrodynamics' properties of superconductors and a generalization of the equations created by London. The equations were similar to a non-local formulation of superconductor electrodynamics put forth by Pippard. Bardeen believed the importance of electrons being screened. He states that, "A framework for an adequate theory of superconductivity exists, but the problem is an exceedingly difficult one. Some radically new ideas are required." (Bardeen, John Bardeen and the Theory of Superconductivity). Although the project on developing a new theory was truly a group effort, Bardeen was the one who set problems, organized the approach of the group, and planted theories to motivate members. Finally, the group was able to create a theory on superconductivity. The theory explains: the infinite conductivity discovered by Kamerlingh Onnes; the diamagnetic effect found by Meissner and Ochsenfeld; the second-order phase transition at the critical temperature; (4) the isotope effect; and the energy gap. Bardeen was always looking out for his students, and feared that they would not receive their due credit because the comitee that awards the Nobel Prize, in most cases, did not allow a single person to win the prestige prize twice in the same field. This rule was overlooked and ingored, giving the two other member their first Nobel Prize and making Bardeen the first person in history to win the Nobel Prize twice in the same field, including physics.

In conclusion, John Bardeen made many contributions with the use of physics. The creation of the transitor became a major asset in the increased development of things such as the radio. After receiving the Nobel Prize in 1972 for his accomplishments in the BCS theory, Bardeen continued to try to improve the theory until his death in 1991. He is one of the few in the history of the Nobel Prize to win twice in the same category. His BCS theory still has ywet to be disproven and is the most accurate portrayal of superconductivity to date. John Bardeen was an intelligent man who ended up with the Nobel Prize for two very honorable reason, the BCS theory and the creation of the transitor.

Works Cited

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