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1961 Nobel Prize Winner - Robert Hofstadter

The 1961 Nobel Prize in Physics was awarded jointly to both Rudolf Ludwig Mössbauer and Robert Hofstadter for "[their] most outstanding contributions for mankind in the field of physics." Each Physicist received one-half of the awarded grant money to pursue further research. The Nobel selection committee chose Hofstadter "for his pioneering studies of electron scattering in atomic nuclei and for his thereby achieved discoveries concerning the structure of the nucleons." Hofstadter's research remains relevant to this day and has provided the foundation for all further research of the structure of the atomic nucleus.

Robert Hofstadter was born on February 5, 1915 to a family of Jewish Immigrants from Poland. Hofstadter was an only child and lived with his father Louis Hofstadter, who was a salesman, and his mother Henrietta Koenigsberg. Hofstadter attended elementary through high school in New York City and was regarded by his teachers as a remarkably bright student. Following high school Hofstadter enrolled in the City College of New York where he graduated *magna cum laude* with a B.S. degree in Physics at the age of 20. Recognized for his brilliance and intellect, Hofstadter was awarded the Kenyon Prize in Mathematics and Physics, and was

granted the Charles A. Coffin Foundation Fellowship from General Electric which provided Hofstadter with near full-funding for graduate schooling.

Following his graduation from the City College of New York, Hofstadter pursued his graduate studies at Princeton University. Hofstadter spent three years at Princeton after which he received both his M.A. and Ph.D. degrees in Physics at the age of 23. Hofstadter's Ph.D. work contributed partially to the discovery of the hydrogen bond and earned him the Procter Fellowship at Princeton University for the pursuit of post-doctoral research. Still in his mid-twenties, Hofstadter had already made a name for himself in the Physics community.

Hofstadter's work was interrupted by the advent of World War II. During the years of combat Hofstadter left academia to work at the National Bureau of Standards and later joined the Norden Laboratory Corporation. Hofstadter worked to develop the proximity fuse which detonated a projectile when it detected approaching bodies using radar, it became a key component in the anti-aircraft weapons of the day. It was during World War II that Hofstadter met his wife Nancy Givan in Baltimore. Together with Nancy, Hofstadter had three children: two daughters Laura and Molly and a son Douglas Hofstadter who went on to become a Pulitzer Prize winning novelist and renowned cognitive psychologist at Stanford University.

In 1939 Hofstadter received the prestigious "Harrison Fellowship" at the University of Pennsylvania to conduct nuclear research alongside some of the top researchers in the field. Hofstadter later returned to Princeton as an assistant professor for a brief period of time before he joined the faculty of the Physics Department as a full professor at Stanford University. At Stanford, Hofstadter was known as a popular lecturer and for his in-depth research towards the

discovery of the fundamental particles which make up the universe. After years of intensive research at Stanford, Dr. Hofstadter and his associates were able to determine the radius of the neutron to a high degree of accuracy. Dr. Hofstadter and his colleagues then performed experiments using a linear particle accelerator to bounce electrons off of various elements to construct a uniform picture of the structure of the atomic nuclei.

In 1961 Hofstadter received the Nobel Prize for "for his pioneering studies of electron scattering in atomic nuclei and for his consequent discoveries concerning the structure of nucleons" which were conducted at Stanford in the same lab previous Nobel Laureate Felix Bloch had used to develop a technique to measure the movement of neutrons. In Hofstadter's Nobel Speech, he discussed the significance of his research. Hofstadter claims the question of composition of matter is one that "Man has puzzled over and sought an understanding of" for the "past two thousand years". Hofstadter's research acts as another stepping stone in this innate human quest for knowledge and understanding of the physical world. Furthermore, Hofstadter's research helped contribute to the model of the atom which we use today. Indeed, the depth and breadth of human knowledge has grown more significantly in the past hundred years than in the previous ten millennia before them.

In his Nobel Lecture, Hofstadter details the procedures he and his colleagues used to construct this model of the atomic nucleus. At the Stanford Physics Laboratory, researchers first built an electron-scattering apparatus to carry out experiments on various nuclei. The apparatus consisted of a circular 190-MeV spectrometer mounted adjacent to a larger module. The larger rectangular module was encased in lead and paraffin shielding to protect researchers from potential harm due to radiation. The apparatus displayed visual scattering patterns on a

spectrometer, which researchers analysed to produce the pioneering model of the atomic nucleus. Researchers operated the machine by placing an elemental target at one end of the accelerator, and activating the machine which generates a high voltage current, propelling electrons towards the target. The atom is comprised mostly of empty space, but in the electron scatterer, electrons will occasionally contact the heavy atomic nucleus and bounce backwards into the spectrometer. The spectrometer generates a graph of electron reflection and energy, allowing the researchers further knowledge into the structure of the nucleus. Dr. Hofstadter and his associates repeated similar experiments numerous times with a variety of elements over the course of almost ten years, and became able to fabricate a consistent model of the atomic nucleus. This is one example of data providing the opportunity to develop theory.

Dr. Hofstadter's discovery answered many previously unsolved questions in Physics, but prompted equally many. The proton and the neutron were once thought to be simple elementary particles, but Dr. Hofstadter's Nobel Prize research demonstrates that they are "highly complex bodies." The Nobel Selection committee deemed Hofstadter's body of research and investigation of the Fundamental Particles deserving of the 1961 Nobel Prize for its significance as an important technical and scientific feat, but more importantly for it's significance to mankind and mankind's quest for knowledge and understanding.

Overall, Hofstadter left behind an astounding legacy in the domain of Physics, and through his research left his mark on both the outcome of World War II, and the fields of modern Physics and Chemistry. Hofstadter is remembered at Stanford today through a yearly series of lectures titled the "Robert Hofstadter Memorial Lectures" which are oriented towards educating

the public in science and research. He also lives on in popular culture, and is the namesake of one of the main characters of the popular TV show “The Big Bang Theory”, Leonard Hofstadter.

Works Cited

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