Essay on Nobel prize winner: Sir James Chadwick (1935)

Sir James Chadwick was born October 20th, 1891 in the United kingdom. In his career he worked with Hans Geiger and Ernest Rutherford. When World War 1 began, he was just outside of Berlin, fortunately, he was given the liberty to set up a laboratory in the stables and worked with Charles Ellis, we worked with the ionization of phosphorus and the photo-chemical reaction of carbon monoxide and chlorine. He was stuck in the Ruhleben P.O.W. camp until Geiger's laboratory came in and negotiated his release. The malnourishment he suffered there however endured his entire lifetime with sickness.

In 1932 Chadwick did the important work of discovering the previously unknown elementary particle, the neutron. It had remained undiscovered to this point due to it's electrical neutrality. This discovery was crucial to the fission of Uranium 235 because these neutral particles could penetrate the atom without being repelled by electrical forces. For this he won the hughes medal of the Royal Society in 1932 and later the Nobel prize for physics in the year 1935.

Thanks to his discovery, he was brought into the British effort to create an atomic bomb, because his very discovery proved its possibility. Early on, he thought the research for such a bomb would not be completed until after the war, but later developments on its creation's feasibility made him realize "that a nuclear bomb was not only possible, it was inevitable. (he) had to then take sleeping pills. It was the only remedy." At which point, he joined the Manhattan Project which eventually was a success and ended the war. He was then knighted in 1945.

Prior to his discovery, physicists were baffled by the hidden mass of the nucleus. Rutherford has laid the ground work out of atoms having minute and dense nuclei. Also he had determined that the nucleus held the positive charge of the atom. He had also discovered the proton and electron. However, he was unable to provide proof as to why the atomic number of an atom didn't match the atomic mass, for example, the atomic number of helium is two, but its atomic mass is 4. The neutron's existence hadn't been proved at that point, though Rutherford did theorize it. Another theory was that there were additionally protons and electrons in the nucleus, creating an electrically neutral effect on the nucleus, but adding mass, which to a degree is true. (see beta decay) But before Chadwick's experiments, they had no proof.

Chadwick had been inspired by work done by Irene Curie (daughter of Pierre Curie and Marie Curie) who had discovered that by exposing beryllium to alpha radiation created a new radiation, which when incident on a proton rich surface, paraffin wax being their ideal, it would emit protons, which could then be measured using a Geiger counter. She had been close to discovering it, but Chadwick finally put it all together.

The experiment he performed to discover the neutron proceeded thus. Chadwick bombarded alpha particles (helium nuclei) into beryllium and exposed paraffin wax to the resulting radiation,

this radiation of neutrons had been confused with gamma radiation before this point. When the beryllium radiation hit the hydrogen atoms of the wax, the atoms were sent off to the detecting chamber. Since it took a particle of nearly the same mass as a hydrogen atom could effect hydrogen in the way it was effected in this experiment, the collision showed that when bombarded, beryllium would produce massive neutral particles (not a neutrino), which Chadwick named neutrons, for their neutrality. He confirmed their neutrality by demonstrating in his experiment prior that the radiation was unaffected by magnetic fields. He also differentiated them against gamma radiation by showing that photoelectric effect didn't occur, which does occur when gamma radiation is incident on a metallic surface. This discovery explained the hidden mass of atoms which didn't match the mass of just the protons. This idea of neutron bombardment later led to nuclear fission, by applying nearly the same idea, of hitting the atom with a neutron, but in the case of Uranium it resulted in nuclear fission. Which also proved Einstein's $E=mc^2$ as the released energy from the bomb. He labeled his findings modestly as "Possible Existence of Neutron"