ERNEST WALTON – IRELAND'S NOBEL SCIENCE LAUREATE
By
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Most people would reckon they had been given an easy question if asked - 'Name Ireland's Nobel Prize Winners'. The names spring readily to mind – William Butler Yeats (1923), George Bernard Shaw (1925), Sam Beckett (1969), Betty Williams and Mairead Corrigan (1976), Seamus Heaney (1995), John Hume and David Trimble (1998). But this answer would be incomplete. Ireland has produced another winner of the Nobel Prize, the only Irish person to win the prize for science, Ernest Thomas Sinton Walton (1903-1995). Walton was awarded the Nobel Prize in Physics in 1951, jointly with J.D. Cockroft, for 'splitting the atom'.

Ernest Walton was born in Dungarvan, Co. Waterford, in 1903, son of Methodist Minister John Walton and Anne E. Sinton. Ernest received early education in Banbridge and Cookstown and secondary education at Methodist College, Belfast. He entered Trinity College Dublin (TCD) in 1922 on scholarship and took a first class honours degree in Physics and Mathematics (1926), followed by an M.Sc. degree in 1927. He won a research scholarship to work with Ernest Rutherford (1871-1937) at the Cavendish Laboratory, Cambridge.

At the time physics was going through a golden era. Albert Einstein had revolutionised the way physics looked at the world with his theory of relativity (1905, 1915). Rutherford had discovered that atoms have a tiny dense central core, the atomic nucleus, in 1910. The atomic nucleus is surrounded by a cloud of electrons and Niels Bohr had described how the electrons orbit the nucleus in 1913. And, in 1925 and 1926 Werner Heisenberg, Paul Dirac and Erwin Schrodinger, founded a new branch of physics called quantum mechanics that describes the behaviour of atoms and sub-atomic particles.

By 1927 the focus of atomic research had moved to the atomic nucleus. In order to prise the nucleus open to examine its internal structure, you must hit it with highly energetic particles of its own size or smaller. Walton's first job in Rutherford's laboratory was to build an apparatus capable of accelerating electrons (much smaller particles than the atomic nucleus) to very high speeds. Although this project worked well, the speeds achieved remained too slow.

Ernest Thomas Sinton Walton

In 1929 Walton was joined by J.D. Cockroft and together they worked to develop an apparatus to accelerate positively charged particles (electrons are negatively charged) to high velocities. Walton's great technical skill and experimental ingenuity greatly helped to develop the apparatus despite the scarce resources available – they relied in part on car batteries and bits of petrol pumps. They built an accelerator capable of developing an accelerating voltage up to 700,000 volts for the acceleration of protons. (Atomic nuclei are composed of two types of particles, protons and neutrons, both of the same size, but the proton has a positive charge whereas the neutron has no charge).

On 14th April 1932, Walton and Cockroft used their proton accelerator to bombard a target made of lithium, the third lightest natural element. The lithium nucleus contains 3 protons and 4 neutrons. The proton bombardment induced the lithium nucleus to disintegrate into 2 alpha particles, each composed of 2 protons and 2 neutrons, and those disintegrations produced little flashes of light on a scintillation screen. This was the first time an artificial disintegration of an atomic nucleus was witnessed. The results were published in the scientific journal Nature on 30th April 1932.

The ‘atom-splitting’ experiment grabbed the public imagination and the significance of the work was immediately appreciated by the scientific community. It was now possible to split the atomic nucleus in a controlled process. The Walton-Cockroft experiment also confirmed a number of scientific predictions arising out of relativity theory and quantum mechanics. It demonstrated that a large amount of energy could be released in a nuclear reaction and provided the first experimental verification of Einstein’s famous mass-energy equivalence equation – E=MC2 - where E is energy, M is mass and C is the speed of light. The combined mass of the two alpha particles is slightly less than the lithium nucleus plus proton, the missing mass being converted into energy.

The Walton-Cockroft particle accelerator sparked off a huge amount of scientific research. Many generations of ever more powerful particle accelerators have since been built and used to powerfully illuminate the fundamental nature of matter.

Ernest Walton returned to Ireland and became a Fellow of TCD in 1934. He married Winifred Wilson and they had two boys and two girls all of whom took up science careers. Alan, the eldest, is a physicist at the Cavendish Laboratory. Marian became a physics schoolteacher, Philip is Professor of Medical Physics at NUI Galway, and Jean became a biology schoolteacher.

Walton was appointed Erasmus Smith Professor of Natural and Experimental Philosophy at TCD in 1946 and was Head of the Physics Department until his retirement in 1974. In addition to his work on disintegration of atomic nuclei he published work on microwaves, hydrodynamics and the focussing of charged particles.

The citation for the award of the Nobel Prize to Walton and Cockroft in 1951 recognised ‘their pioneer work on the transmutation of atomic nuclei by artificially accelerated atomic particles’. It went on to say – ‘their discoveries initiated a period of rapid discovery in atomic physics, and continued – ‘indeed this work may be said to have introduced a totally new epoch in nuclear physics’.

Professor Walton was highly regarded as a teacher. His technical brilliance and manual dexterity made him a master of the lecture-demonstration. He is fondly remembered by the many students who attended his lectures from his return to Ireland in 1934 to his retirement in 1974.

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