Biography: Ernest Rutherford, 1st Baron Rutherford of Nelson

The man who formulated the nuclear model of the atom didn't have a typical childhood. Ernest Rutherford came from a large family. He was one of twelve children born to James and Martha Rutherford, and as a young boy his father's work often caused the whole family to move. Possibly due to the flexibility he needed in childhood to adapt to his changing surroundings, he grew up to be exceptionally open-minded and innovative. Later in life, he stepped up to every challenge, was never scared away, and became one of history's most prominent scientists. In 1908, he received the Nobel Prize in Chemistry. This biography shows how, step by step, he came to his amazing discoveries.

Ernest Rutherford (1871 – 1937), later called the Baron of Nelson and one of the most prominent scientists of all time, was born on August 30, 1871 in New Zealand. He was the second son and fourth child of twelve born to James and Martha Rutherford. His father worked making wheels for carts, and as an engineer. Later, his father worked as a flax-miller. In contrast, his mother was an English teacher in a provincial school in Spring Grove. She had excellent teaching results and was prized by the provincial school inspector.

As we can imagine, as a young boy Ernest was not only educated in the traditional way, but was able to learn technical skills from his father and develop a sense of humanistic sensitivity from his mother. Education was very important to his parents. James Rutherford's work was also very important to the development of his son's personality. His father's work required the family to move quite often. In 1876, James moved his family to Foxhill for farming and railway construction. Later, they moved to Havelock in the Marlborough Sounds for flax-milling and finally, in 1888, to Taranaki, also for flax milling.

At the age of 10, Ernest read his first science book and started performing his first experiments. In 1887, Ernest won a scholarship to Nelson College, an all-boys private school where he boarded for the next three years.

The next step in his education was Canterbury College in Christchurch, New Zealand. There, he became a very active student, not only in science, but also playing for the rugby team. He also participated in the Dialectic Society (a student debating group) and the graduation day celebrations, for which he co-wrote a song, a talent that was likely passed down from his mother. Despite talents in many different areas, he chose a career in science.

In 1892, he obtained a Bachelor of Arts (BA) degree in Pure Mathematics, Latin, Applied Mathematics, English, French, and Physics.

A significant moment in his science career was winning the only Senior Scholarship in Mathematics available in New Zealand. This success led to him meet Alexander Bickerton, a liberal freethinker who had an enormous impact on his decision to take physics courses the following year.

In 1893, Rutherford obtained a Master of Arts degree with double First Class Honours, in Mathematics, Mathematical Physics, and Physical Science (specifically Electricity and Magnetism).

After graduation, he had problems finding a permanent job. He applied to be a school teacher, but after multiple failed attempts to obtain a permanent teaching position, he started doing research in the field of electrical science. At the time, there were scholarships initiated by The Royal Commissioners for the Exhibition of 1851 that allowed graduates of universities to go anywhere in the world and work on research of importance to their home country's industries. Rutherford applied for the scholarship and, through a fortunate turn of events, received it.

As a result, the next stage in Ernest Rutherford's life took place in Cambridge. In 1895, he left New Zealand. He was only 23 years old, but had a reputation as being an outstanding researcher and innovator working at the forefront of electrical technology. He chose to work with Professor Joseph John Thomson at Cambridge University's Cavendish Laboratory. It was a very successful venture, and it marked the first time that a non-Cambridge-graduate research student worked at Cambridge University. In Cambridge, he was inspired by the work of Sir Robert Ball and J. J. Thomson.

In 1898, Ernest Rutherford accepted a professorship at McGill University in Montreal, Canada. The laboratories there were very well equipped and gave

him the chance to make significant progress in his research.

In 1900, Rutherford came back to New Zealand to marry Mary Georgina Newton, the daughter of his landlady in Christchurch. They had one child together, a daughter whom they named Eileen.

At McGill, Rutherford began to receive worldwide recognition for his research. His work became increasingly more widely known and he was elected a Fellow of the Royal Society of Canada in 1900 and of London in 1903. His first book, *Radioactivity*, was published in 1904. In 1908, he was awarded the Nobel Prize in Chemistry due to his research into the radioactive decay of elements and the chemical properties of radioactive substances. Rutherford said then: "All science is either physics or stamp collecting."

Although he received many propositions from American universities and institutions (Yale and the Smithsonian Institute, for example), he remained at McGill for quite a long time. This changed when he received an enticing offer from Professor Schuster from Manchester University, who offered to step down if Rutherford would take over his position as Chair. Rutherford accepted the offer, and began working there in 1907. In the Manchester laboratory, the famous gold foil experiment was conducted by Hans Geiger and undergraduate student Ernest Marsden in 1909, under Rutherford's supervision.

In 1909, Geiger needed an experiment for Marsden. Rutherford gave him the task of looking for alpha-particle scattering at large angles. Geiger and Marsden then investigated the scattering of alpha particles, which came from radioactive radon-222 and were directed at a piece of gold foil. The scattering of the alpha particle should have only been deflected by one or two degrees. A few days later, Marsden reported that he saw about one in 10,000 alpha particles scattered at larger angles, even directly backwards, which surprised Rutherford. Geiger and Marsden published their measurements in July, 1909 issue of the *Proceeding of the Royal Society*. Such huge deflections could not be explained by Thomson's model of the atom, where charge was distributed evenly throughout the atom. Rutherford, who at that time was also the head of the Physics Department at Manchester University, interpreted the experimental results in a famous paper, "The scattering of alpha and beta particles by matter and the structure of the atom." In this paper Rutherford described and explained the experiments which led him to formulate the nuclear model of the atom, definitively rejecting J. J. Thomson's plum pudding model of the atom.

In 1919, Rutherford arrived in Cambridge, where he became the Director of Cambridge University's Cavendish Laboratory. It was there that he gained international fame. Twice he spoke in the House of Lords. As a famous scientist, he often spoke publicly, and his opinion was highly respected by many people. He campaigned for Cambridge University to grant women the same privileges as men and defended the award of scholarships to overseas universities. In 1933, when Hitler carried out his non-Aryan policy, Ernest Rutherford helped displaced academics.

Ernest Rutherford died on October 19, 1937, at the age of 66. His remains were interred at Westminster Abbey in London.

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