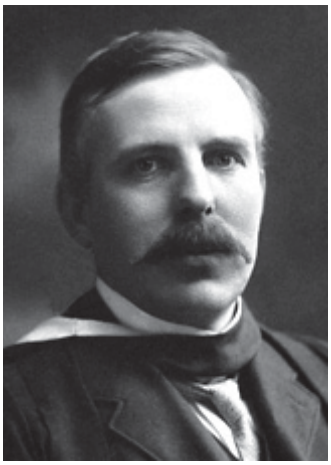
Ernest Rutherford - Biographical



Ernest Rutherford was born on August 30, 1871, in Nelson, New Zealand, the fourth child and second son in a family of seven sons and five daughters. His father James Rutherford, a Scottish wheelwright, immigrated to New Zealand with Ernest's grandfather and the whole family in 1842. His mother, née Martha Thompson, was an English schoolteacher, who, with her widowed mother, also went to live there in 1855.

Ernest received his early education in Government schools and at the age of 16 entered Nelson Collegiate School. In 1889 he was awarded a University scholarship and he proceeded to the University of New Zealand, Wellington, where he entered Canterbury College*****. He graduated M.A. in 1893 with a double first in Mathematics and Physical Science and he continued with research work at the College for a short time, receiving the B.Sc. degree the following year. That same year, 1894, he was awarded an 1851 Exhibition Science Scholarship, enabling him to go to Trinity College, Cambridge, as a research student at the Cavendish Laboratory under **J.J. Thomson**. In 1897 he was awarded the B.A. Research Degree and the Coutts-Trotter Studentship of Trinity College. An opportunity came when the Macdonald Chair of Physics at McGill University, Montreal, became vacant, and in 1898 he left for Canada to take up the post.

Rutherford returned to England in 1907 to become Langworthy Professor of Physics in the University of Manchester, succeeding Sir Arthur Schuster, and in 1919 he accepted an invitation to succeed Sir Joseph Thomson as Cavendish Professor of Physics at Cambridge. He also became Chairman of the Advisory Council, H.M. Government, Department of Scientific and Industrial Research; Professor of Natural Philosophy, Royal Institution, London; and Director of the Royal Society Mond Laboratory, Cambridge.

Rutherford's first researches, in New Zealand, were concerned with the magnetic properties of iron exposed to high-frequency oscillations, and his thesis was entitled *Magnetization of Iron by High-Frequency Discharges*. He was one of the first to design highly original experiments with high-frequency, alternating currents. His second paper, *Magnetic Viscosity*, was published in the *Transactions of the New Zealand Institute* (1896) and contains a description of a time-apparatus capable of measuring time intervals of a hundred-thousandth of a second.

On his arrival at Cambridge his talents were quickly recognized by Professor Thomson. During his first spell at the Cavendish Laboratory, he invented a detector for electromagnetic waves, an essential feature being an ingenious magnetizing coil containing tiny bundles of magnetized iron wire. He worked jointly with Thomson on the behaviour of the ions observed in gases which had been treated with X-rays, and also, in 1897, on the mobility of ions in relation to the strength of the electric field, and on related topics such as the photoelectric effect. In 1898 he reported the existence of alpha and beta rays in uranium radiation and indicated some of their properties.

In Montreal, there were ample opportunities for research at McGill, and his work on radioactive bodies, particularly on the emission of alpha rays, was continued in the Macdonald Laboratory. With R.B. Owens he studied the "emanation" of

thorium and discovered a new noble gas, an isotope of radon, which was later to be known as thoron. **Frederick Soddy** arrived at McGill in 1900 from Oxford, and he collaborated with Rutherford in creating the "disintegration theory" of radioactivity which regards radioactive phenomena as atomic - not molecular - processes. The theory was supported by a large amount of experimental evidence, a number of new radioactive substances were discovered and their position in the series of transformations was fixed. **Otto Hahn**, who later discovered atomic fission, worked under Rutherford at the Montreal Laboratory in 1905-06.

At Manchester, Rutherford continued his research on the properties of the radium emanation and of the alpha rays and, in conjunction with H. Geiger, a method of detecting a single alpha particle and counting the number emitted from radium was devised. In 1910, his investigations into the scattering of alpha rays and the nature of the inner structure of the atom which caused such scattering led to the postulation of his concept of the "nucleus", his greatest contribution to physics. According to him practically the whole mass of the atom and at the same time all positive charge of the atom is concentrated in a minute space at the centre. In 1912 **Niels Bohr** joined him at Manchester and he adapted Rutherford's nuclear structure to **Max Planck**'s quantum theory and so obtained a theory of atomic structure which, with later improvements, mainly as a result of Heisenberg's concepts, remains valid to this day. In 1913, together with H. G. Moseley, he used cathode rays to bombard atoms of various elements and showed that the inner structures correspond with a group of lines which characterize the elements. Each element could then be assigned an atomic number and, more important, the properties of each element could be defined by this number. In 1919, during his last year at Manchester, he discovered that the nuclei of certain light elements, such as nitrogen, could be "disintegrated" by the impact of energetic alpha particles coming from some radioactive source, and that during this process fast protons were emitted. **Blackett** later proved, with the cloud chamber, that the nitrogen in this process actually could be transformed into an oxygen isotope. **G. de Hevesy** was also one of Rutherford's collaborators at Manchester.

An inspiring leader of the Cavendish Laboratory, he steered numerous future Nobel Prize winners towards their great achievements: **Chadwick**, Blackett, **Cockcroft and Walton**; while other laureates worked with him at the Cavendish for shorter or longer periods: **G.P. Thomson**, **Appleton**, **Powell**, and **Aston**. C.D. Ellis, his co-author in 1919 and 1930, pointed out "that the majority of the experiments at the Cavendish were really started by Rutherford's direct or indirect suggestion". He remained active and working to the very end of his life.

Rutherford published several books: *Radioactivity* (1904); *Radioactive Transformations* (1906), being his Silliman Lectures at Yale University; *Radiation from Radioactive Substances*, with James Chadwick and C.D. Ellis (1919, 1930) - a thoroughly documented book which serves as a chronological list of his many papers to learned societies, etc.; *The Electrical Structure of Matter* (1926); *The Artificial Transmutation of the Elements* (1933); *The Newer Alchemy* (1937).

Rutherford was knighted in 1914; he was appointed to the Order of Merit in 1925, and in 1931 he was created First Baron Rutherford of Nelson, New Zealand, and Cambridge. He was elected Fellow of the Royal Society in 1903 and was its President from 1925 to 1930. Amongst his many honours, he was awarded the Rumford Medal (1905) and the Copley Medal (1922) of the Royal Society, the Bressa Prize (1910) of the Turin Academy of Science, the Albert Medal (1928) of the Royal Society of Arts, the Faraday Medal (1930) of the Institution of Electrical Engineers, the D.Sc. degree of the University of New Zealand, and honorary doctorates from the Universities of Pennsylvania, Wisconsin, McGill, Birmingham, Edinburgh, Melbourne, Yale, Glasgow, Giessen, Copenhagen, Cambridge, Dublin, Durham, Oxford, Liverpool, Toronto, Bristol, Cape Town, London and Leeds.

Rutherford married Mary Newton, only daughter of Arthur and Mary de Renzy Newton, in 1900. Their only child, Eileen, married the physicist R.H. Fowler. Rutherford's chief recreations were golf and motoring.

He died in Cambridge on October 19, 1937. His ashes were buried in the nave of Westminster Abbey, just west of Sir Isaac Newton's tomb and by that of Lord Kelvin.

From ***Nobel Lectures***, *Chemistry 1901-1921*, Elsevier Publishing Company, Amsterdam, 1966

This autobiography/biography was written at the time of the award and first published in the book series ***Les Prix Nobel***. It was later edited and republished in ***Nobel Lectures***. To cite this document, always state the source as shown above.

* Canterbury College (now Canterbury University) was located in Christchurch, but was administered from the University of New Zealand, Wellington.

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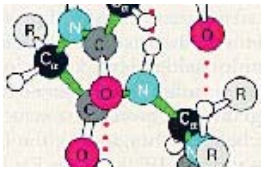

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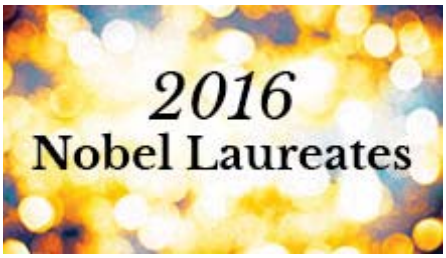
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