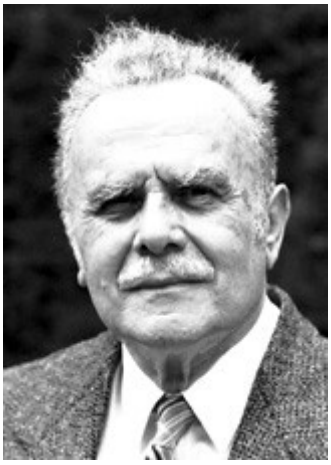
## *Famous Canadians Info Sheet*



**Bertram Brockhouse (1918-2003)**
The Nobel Prize in Physics 1994

Bertram Neville Brockhouse was born July 15, 1918 in Lethbridge, Alberta, the son of Israel and Mable Brockhouse. At age eight he moved with his family to Vancouver, British Columbia. After graduating from high school in 1935, he worked as a laboratory assistant, and then as a self-employed radio repairman, both in Vancouver and in Chicago. He spent the war years in the Royal Canadian Navy Volunteer Reserve as an electronics technician repairing submarine detection equipment at a base in Nova Scotia. In 1945, thanks to financial support provided by Veterans Affairs to help ex-soldiers make the move back to civilian life, Brockhouse enrolled at the University of British Columbia, from which he graduated in 1947 with first class honours in mathematics and physics. He entered the University of Toronto later that same year and obtained his Ph.D. in 1950, with a thesis entitled *The Effect of Stress and Temperature upon the Magnetic Properties of Ferromagnetic Materials.*

In July 1950 Brockhouse joined the staff of the Atomic Energy Project of the National Research Council of Canada, later to become Canadian Nuclear Laboratories (CNL), at the Chalk River Nuclear Laboratories about 200 kilometres northwest of Ottawa. Brockhouse's first work at Chalk River involved him in a series of studies of the resonant scattering of slow neutrons by strong absorbers such as cadmium and samarium.

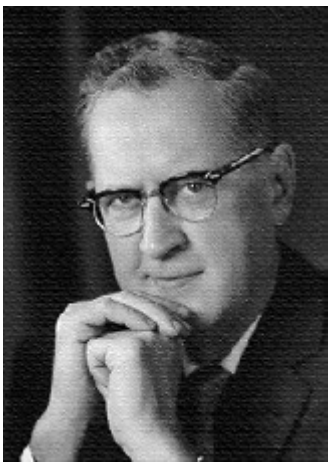
Later that year it was decided that the study of the inelastic scattering of slow neutrons was feasible at the Chalk River NRX (National Research Experimental) reactor, which was at the time the world's highest flux beam reactor. In the early months of 1952 Brockhouse put together what he described as a "large aperture double spectrometer," in reality a triple-axis machine, hoping to be able "to measure the as yet unknown frequency distribution of normal modes" in a crystal. In the late 1950s and early 1960s scientists from a number of countries visited Chalk River in order to observe and learn the new *Methods for Neutron Spectrometry* that Brockhouse and his colleagues had developed.

Brockhouse did not have very much spare time during his highly productive years at Chalk River, but he did find time to take part in a number of amateur dramatic presentations, operettas and musical productions. He enjoyed music enormously and was known for singing musical excerpts, whether from an opera or a Broadway musical, while working at one of his neutron experiments.

In 1962 Brockhouse moved to McMaster University where he served as Professor of Physics until his retirement in 1984. He was chairman of the Department from 1967 to 1970. At McMaster he took an active part in teaching and was able to communicate his enthusiasm for physics to undergraduate and graduate students alike. He was influential in building up the Department, and he and his graduate students built new spectrometers at the McMaster Nuclear Reactor, and later at the Chalk River NRU reactor.

Brockhouse received many honours over the years, including the Tory Medal of the Royal Society of Canada, the Buckley Prize of the American Physical Society and the Order of Canada. In 1994, some 35 years after the original research was conducted, Brockhouse shared the Nobel Prize in Physics for his work in the 1950s at NRX, which advanced the detection and analysis techniques used in the field of neutron scattering for condensed matter research. Brockhouse spent his retirement years in Ancaster, Ontario, until his death on October 13, 2003.


*Brockhouse at work.*



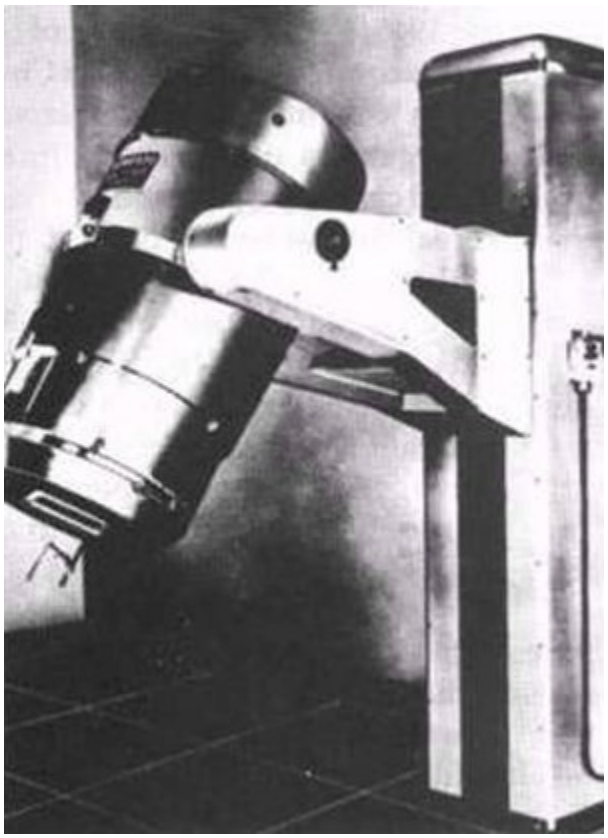
**Harold Johns (1915-1998)**
Built one of the first two cancer-treatment machines using cobalt-60 radioisotopes in 1951

Harold Elford Johns was born in Szechuan, China, on July 4, 1915, the son of educational missionaries from Ontario. His family stayed there until 1926 when they had to leave due to the political turmoil in China. Upon returning to North America, the family moved to Tacoma, Washington, Brandon, Manitoba and eventually Hamilton, Ontario where Johns attended McMaster University and obtained a Bachelor of Science in Mathematics and Physics in 1936. He then attended the University of Toronto where he received a MA in 1937 and a Ph.D. in Physics in 1939.

From 1939 to 1945 Johns served as Professor in the Physics Department at the University of Alberta. In 1945, he was invited to join the Physics Department of the University of Saskatchewan in Saskatoon and to spend half his time starting the medical physics group at the new Saskatchewan Cancer Commission in Regina. Johns' most obvious achievement during this phase of his career was the development of the cobalt-60 cancer therapy unit in 1951. The cobalt bomb, as it is known, is a nuclear radiation device which revolutionized the treatment of cancers located deep in the body, where previous radiation therapies had proven ineffective.

In 1956 Johns moved to Toronto to become head of the Physics Division at the Ontario Cancer Institute. He also joined the faculty of the University of Toronto where he taught and researched in the Departments of Medical Biophysics, Radiology and Physics. During his scientific career, he published over 200 peer-reviewed papers, trained over 100 graduate students, many of whom hold key positions in the medical radiation research field in Canada and around the world, won many prestigious awards including the Order of Canada, and published four editions of *The Physics of Radiology*, the premier textbook in its field.

After a lengthy battle with Parkinson's Disease, Johns passed away on August 23, 1998 in Kingston, Ontario.



*Cobalt-60 cancer therapy unit.*

**Source:**

**Harold Elford Johns (1915-1998) – Canadian Nuclear Society**

## George Laurence (1905-1987)

George Craig Laurence was born in Charlottetown, Prince Edward Island on January 21, 1905. He was educated at Dalhousie University in Halifax, Nova Scotia and later at Cambridge University in England where he earned a Ph.D. under the guidance of Ernest Rutherford at the Cavendish Laboratory. After graduating, Laurence joined the staff of the National Research Council of Canada (NRCC) in 1930 and became active in improving the measurement of radiation dosage in the treatment of cancer and in promoting safety from radiation exposure. He helped to develop radiation safety regulations for North America, co-authoring the first bulletin of the Radiological Society of North America's Standardization Committee.

Pivotal in the Canadian nuclear power story was his pioneering work in 1940 on nuclear chain reactions after the discovery of nuclear fission in January 1939. He was the first person in the world to induce fission by neutrons in a very large quantity of uranium surrounded by carbon, to investigate the possibility that the fission chain reaction needed for a useful release of nuclear energy could be produced with these materials. Foiled by lack of funds, he was unable to obtain uranium or graphite of satisfactory purity to continue his work; however, his initial studies enabled and encouraged Canada to enter into a scientific partnership with a distinguished group of British and European scientists to form the National Research Council's Montreal Laboratory Division. George Laurence joined that group in 1942 as the senior Canadian scientist. With others, he assembled a sub-critical mock-up of the National Research Experimental (NRX) lattice and measured some of the constants needed for the design of the reactor.

In 1945 Laurence moved to Chalk River where he continued his work on nuclear reactor design with the ZEEP, NRX and NRU units. During 1946-47 he served as scientific advisor to the Canadian delegation to the United Nations Atomic Energy Commission in New York. In 1950 when ideas for a distinctive Canadian nuclear power system were being developed, it was Laurence who insisted that a non-breeder power plant suitable for Canadian requirements should be designed and constructed. That persistence paid off with the natural uranium reactor, cooled and moderated by heavy water, which became the Canadian nuclear power system.

In 1961 Laurence left Atomic Energy of Canada Limited (AECL, now Canadian Nuclear Laboratories) to become President of the Atomic Energy Control Board where he served as Chairman of the Reactor Safety Advisory Committee that advised on the health and safety of nuclear reactors and power stations.

Laurence, one of Canada's pioneering nuclear scientists, died in Deep River, Ontario on November 7, 1987.

In 1966 the Canadian Association of Physicists awarded him its Medal for Achievement in Physics. In 1975 the Canadian Nuclear Association presented him with the W.B. Lewis Medal. In 1988 at the annual meeting of the American Nuclear Society a special plaque was awarded posthumously to Laurence.

**Dr. Wilfrid Bennett (W.B.) Lewis (1908-1987)**
The Father of the CANDU Reactor

Wilfrid Bennett Lewis was the physicist who dominated nuclear research and the development of nuclear power in Canada for nearly three decades, from the end of World War II until his retirement in 1973. The development of the CANDU reactor was his most stunning achievement.

He was born at Castle Carrock in Cumberland, England on June 24, 1908, the second of four children in a family with a long lineage of engineers. As a child, Ben (as he was known to family and friends) enjoyed designing models out of Meccano sets and building wireless radio systems from electronic parts that he scrounged together.

After graduating from Haileybury College in Hertford, England in 1926, Lewis spent a year as a laboratory research assistant working with optical glass. Given his profound interest in electronics and physics, it is not surprising that in the fall of 1927, Lewis chose to attend Cambridge University, the home of the world-famous Cavendish Laboratory for experimental physics.

After three years of undergraduate physics study at the Cavendish Laboratory, Lewis was approached by the lab's chair, Ernest Rutherford, and asked to join his research group as a graduate student expert on wireless technology. Since much of the experimental equipment employed at the Cavendish in the early 1930s was increasingly electronic in nature, Lewis was often called upon as the resident expert, requiring him to troubleshoot and subsequently repair faulty electronic apparatus.

Over the next four years, Lewis absorbed the atmosphere of an academic scientific laboratory at its best, working on cutting-edge experiments dedicated to alpha particle research; specifically in the area of the electronic detection and counting of alpha particle emissions. In 1934, he was awarded both a masters and a doctoral degree for his work.

From 1934 to 1939, Lewis served as a research fellow at Gonville and Caius College at Cambridge, working with John Douglas Cockcroft on nuclear disintegrations of particles accelerated by high voltages and, later, on the operation of the Cambridge Cyclotron. When World War II broke out in 1939, Lewis was asked by the British Government to join the Air Ministry's Telecommunications Research Establishment to work on the development of radar systems for the purpose of defending England from German air attacks. Based on his abilities in this area, Lewis quickly rose to the position of Superintendent – a role considered by many to be that of "senior military scientist."

Lewis had proven himself to be an able experimental physicist during his Cavendish years, but he had discovered through his work during the war on radar that his true talents lay in synthesizing the research efforts of others. In 1946, with the war over, he was offered the opportunity to do just that as the director of the National Research Council of Canada's Atomic Energy Division (now Canadian Nuclear Laboratories) at Chalk River.

Lewis tackled both the scientific and management challenges of the new job with vigour, studying all areas of reactor design, recruiting excellent scientists, and expanding laboratories and equipment.

His detailed interest and knowledge in many aspects of the research, including physics, chemistry, biology and metallurgy made it possible for him not only to direct but inspire numerous projects.

Lewis' drive, intelligence and remarkable organizational skills placed him at the forefront of Canada's nuclear program. As a proponent of pure research; existing for the simple purpose of increasing knowledge on a particular subject with no specific application in mind, Lewis encouraged the scientists working under his direction to exploit the world-class facilities at Chalk River. In the period from the late 1940s to the late 1950s the National Research Experimental (NRX) and the National Research Universal (NRU) reactors built at Chalk River were utilized for a variety of important experiments on neutron behaviour, shielding, flux and scattering.

Convinced that nuclear energy could be used economically for generating electricity, Lewis fostered a collaboration between Atomic Energy of Canada Limited (AECL, now Canadian Nuclear Laboratories) and Ontario Hydro (now Ontario Power Generation) that led to the development of the CANDU; the uniquely Canadian nuclear power reactor system. Considered by many to be the "Father of the CANDU," Lewis was at the centre of all major planning and decisions for the project, from the conceptual phase, through proposal developments and construction, to the successful commercialization of the reactor in Canada as well as its export abroad.

After his retirement from AECL in 1973, Lewis moved to Kingston where, for the next nine years, he wrote and lectured on nuclear energy as a distinguished professor at Queen's University. A steadfast proponent of nuclear power as a solution to the energy crises of his time, Lewis professed the energy that could be harnessed from nuclear fission was enough to sustain all of the world's population for thousands of centuries.

In 1981, Lewis was awarded the coveted Fermi award for his outstanding lifetime contributions to energy science research. Later that same year he was diagnosed as having Alzheimer's disease. Lewis died in Deep River, Ontario on January 10, 1987.

**Sources:**

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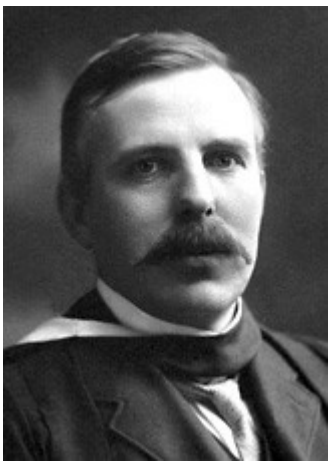

**Ernest Rutherford (1871-1937)**
The Nobel Prize in Chemistry 1908

Ernest Rutherford was born on August 30, 1871, in Spring Grove, New Zealand, eventually becoming one of the most illustrious scientists of all time. He is to the atom what Darwin is to evolution, Newton to mechanics, Faraday to electricity and Einstein to relativity and a significant part of his pathway to greatness was navigated in Canada.

In 1894 Rutherford received a Bachelor of Science Degree from Canterbury College in New Zealand with a double major in Mathematics and Physical Science. Later that year he received a scholarship to the University of Cambridge in England where he served as a research student at the Cavendish Laboratory under J.J. Thomson. During his investigations of radioactivity there, he coined the terms alpha, beta and gamma rays. In 1897 Rutherford was awarded his BA Research Degree.

When the Chair of Physics at McGill University in Montreal became vacant in 1898, Rutherford left for Canada to take up the post. McGill then became the hotbed for early work in subatomic physics. Rutherford and his team were on the forefront of a new science. The research carried out revolved around investigations into the phenomenon of natural radiation, a form of which, the x-ray, had been discovered a few years earlier by Röntgen. At McGill, Rutherford did the work that gained him the 1908 Nobel Prize in Chemistry, demonstrating that radioactivity was the spontaneous disintegration of atoms. This is ironic given his famous remark, “In science there is only physics; all the rest is stamp collecting.” He noticed that in a sample of radioactive material, it invariably took the same amount of time for half the sample to decay – a measurement he called its half-life – and created a practical application for this phenomenon using this constant rate of decay as a clock, which could then be used to help determine the actual age of the Earth that turned out to be much older than most scientists at the time believed.

In 1907, Rutherford took the Chair of Physics at the University of Manchester in England. By 1911, after studying the deflection of alpha particles shot through gold foil, Rutherford had established the nuclear theory of the atom. In June of 1919, Rutherford announced his success as the World’s first “alchemist” by artificially disintegrating nitrogen into hydrogen and oxygen by alpha particle bombardment. Later that year, he succeeded his mentor Sir Joseph Thomson as Cavendish Professor of Physics at Cambridge University where he spent several years directing the development of proton accelerators.

Under Rutherford’s directorship, Nobel Prizes were awarded to James Chadwick for discovering the neutron, Cockcroft and Walton for splitting the atom using a particle accelerator and Appleton for demonstrating the existence of the ionosphere. Ernest Rutherford died in Cambridge on October 19, 1937, and his ashes were later buried at Westminster Abbey, in London near the remains of other scientific giants Sir Isaac Newton and Lord Kelvin.