



## Lord Rayleigh: Nobel Prize in Physics 1904



Lord Rayleigh

39.35

Ar

18

Lord Rayleigh was born on November 12, 1842 at Langford Grove, Maldon, Essex. Throughout his infancy and youth he was of frail physique; his education was repeatedly interrupted by ill-health. In 1861 he entered [Trinity College, Cambridge](#), where he studied mathematics. With his exceptional abilities, he graduated in the Mathematical Tripos in 1865 as the top First Class student. In 1866 he obtained a fellowship at Trinity College which he held until 1871, the year of his marriage. In 1873, his father died and he succeeded to the barony. However, in 1876 he left the entire estate management to his younger brother.

From then on he devoted all his time to science. In 1879 he succeeded James Clark Maxell as Professor of Experimental Physics and Head of the [Cavendish Laboratory](#) at Cambridge. At first he researched optics and vibrations, both of which are rather mathematical topics. Later, he considered physics as a field of work in itself and investigated wave theory, light scattering, electrodynamics, hydrodynamics, viscosity and photography. His careful, precise work led to the establishment of standards for resistance, current and electromotive force. This attracted many bright students and the number of research students at the Cavendish Laboratory increased from six to seventy under his leadership. Lord Rayleigh was also famous for his Theory of Sound, which was published in two volumes during 1877-1878.

In 1884 he left Cambridge to continue his experimental work at Terling, Essex. For much of his career he divided his time between his laboratory at Terling and the Royal Institution in London, where he was Professor of Natural Philosophy from 1887 to 1905. During this time he also did investigations of the densities of several gases. The experiments for the isolation of argon, for instance, were first carried out at the Royal Institution, but the final production was made at Terling. Lord Rayleigh was awarded the Nobel Prize in Physics 1904, "for investigations of the densities of the most important gases and for his discovery of argon in connection with these studies".

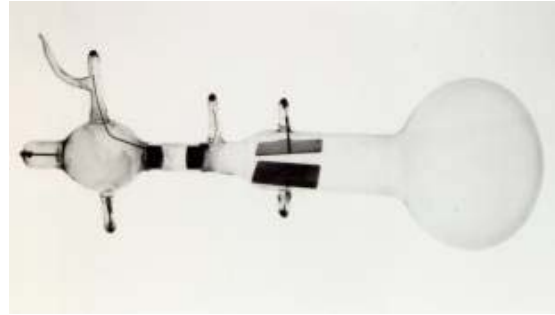
Lord Rayleigh served for six years as President of a Government Committee on Explosives, and from 1896 to 1919 he was Scientific Advisor of the Government. He was a Lord in Essex from 1892 to 1901. He was recipient of the Order of Merit (1902), and in 1905 he was made a Privy Councillor. He was awarded the Copley, Royal, and Rumford Medals of the Royal Society. Lord Rayleigh died on June 30, 1919, at Witham, Essex.



## Sir J.J. Thomson: Nobel Prize in Physics 1906



**Sir J.J. Thomson**



Sir Joseph John (J.J.) Thomson was born in Cheetham Hill, a suburb of Manchester on December 18, 1856. He studied at Owens College, Manchester (now the [University of Manchester](#)), from 1870. In 1876 he entered [Trinity College, Cambridge](#), and became a Fellow of Trinity College in 1880. In 1883 he was appointed as a Lecturer, and as College Master in 1918. He was Cavendish Professor of Experimental Physics at Cambridge, where he succeeded [Lord Rayleigh](#), from 1884 to 1918. He was also appointed as Honorary Professor of Physics by the Royal Institution, London.

Thomson's early interest in atomic structure was reflected in his *Treatise on the Motion of Vortex Rings*, which won him the Adams Prize in 1884. In 1896, Thomson visited America to give four lectures, which summarised his current research, at Princeton. On his return from America, he achieved the most brilliant work of his life: an original study of cathode rays, which eventually assisted him in the discovery of the electron, using the conduction of electricity by gases. J.J. Thomson was awarded the Nobel Prize in Physics 1906 "in recognition of the great merits of his theoretical and experimental investigations on the conduction of electricity by gases".

Thomson, a recipient of the Order of Merit, was knighted in 1908. He was elected Fellow of the Royal Society in 1884 and was President during the years 1916-1920. J.J. Thomson received many awards, including the Royal and Hughes Medals twice, in 1894 and 1902; the Copley Medal in 1914; the Hodgkins Medal (Smithsonian Institute, Washington) in 1902; the Franklin Medal and Scott Medal (Philadelphia), 1923; the Mascart Medal (Paris), 1927; the Dalton Medal (Manchester), 1931; and the Faraday Medal (Institute of Civil Engineers) in 1938. He was President of the British Association in 1909 and he held honorary doctorate degrees from many world-class universities.

In 1890, he married Rose Elisabeth. They had one son, [Sir George Thomson](#), who was awarded the Nobel Prize for Physics in 1937, and one daughter. He died in 1940.



## Lord Rutherford: Nobel Prize in Chemistry 1908



Lord Rutherford



Lord Rutherford was born on August 30, 1871, in Nelson, New Zealand. In 1889, he was awarded a scholarship to study at the University of Wellington where he entered Canterbury College. He graduated in 1893 with a double first in Mathematics and Physical Science. In 1894, he was awarded an 1851 Exhibition Science Scholarship, enabling him to go to [Trinity College, Cambridge](#), and to work 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.

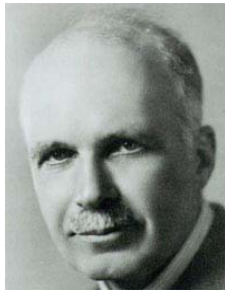
During his first project at the [Cavendish Laboratory](#), he invented a detector for electromagnetic waves. He then worked with J.J. Thomson on the behaviour of the ions observed in gases which had been treated with X-rays. He also worked with Thomson in 1897, on the mobility of ions in relation to the strength of the electric field. In 1898 he reported the existence of alpha and beta rays in uranium. Later, he carried out more experiments to discover the properties of alpha particles. For instance, he measured the specific charge of the alpha particles by deflecting them in electric and magnetic fields, the same method that J.J. Thomson had used to discover the electron. Lord Rutherford eventually won the Nobel Prize in Chemistry 1908, "for his investigations into the disintegration of the elements, and the chemistry of radioactive substances".

In 1907 Rutherford became Langworthy Professor of Physics at the [University of Manchester](#). In 1919 he accepted an invitation to succeed Sir J.J. Thomson as the 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.

As an inspiring leader of the Cavendish Laboratory, he steered numerous Nobel Prize winners towards their great achievements, including [Chadwick](#), [Blackett](#), [Cockcroft](#) and [Walton](#). Other laureates, such as [G.P. Thomson](#), [Appleton](#), Powell, and [Aston](#), worked with him at the Cavendish. Rutherford was knighted in 1914 and was the recipient of many awards. He married Mary Newton in 1900 and they had one daughter. His favourite hobbies were golf and motoring. Rutherford died in Cambridge on October 19, 1937.



## Sir Lawrence Bragg: Nobel Prize in Physics 1915



**Sir Lawrence Bragg**



Sir Lawrence Bragg was born in Adelaide, Australia, on 31st March 1890. He was an impressionable boy and showed an early interest in science. His father, William Henry Bragg, was Professor of Mathematics and Physics at the [University of Adelaide](#). Shortly after starting school aged 5, Sir Lawrence Bragg fell from his tricycle and broke his arm. His father had recently read about Röntgen's experiments in Europe and used the newly discovered X-rays to examine the broken arm. This is the first recorded surgical use of X-rays in Australia.

Sir Lawrence Bragg was a very able student. In 1904, aged 15, he went to the University of Adelaide to study mathematics, chemistry and physics. He graduated in 1908, aged 18. In the same year his father accepted a job at Leeds University, and brought the family back to England. He entered [Trinity College, Cambridge](#) in the autumn of 1909. He received a major scholarship in mathematics, despite taking the exam while in bed with pneumonia. After initially excelling in mathematics, he transferred to the physics course in the later years of his studies, and graduated in 1911.

Sir Lawrence Bragg is most famous for his law on the diffraction of X-rays by crystals. Bragg's law makes it possible to calculate the positions of the atoms within a crystal from the way in which an X-ray beam is diffracted by the crystal lattice. He made this discovery in 1912, during his first year as a research student in Cambridge. He discussed his ideas with his father, who developed the X-ray spectrometer in Leeds. This tool allowed many different types of crystals to be analysed. The collaboration between father and son led many people to believe that the father had initiated the research, a fact that upset the son.

Sir Lawrence Bragg's research work was interrupted by both World War I and World War II. During both wars he worked on sound ranging methods for locating enemy guns. In autumn 1915, his brother Robert was killed. At about the same time Sir Lawrence Bragg received the news that he had become the youngest person ever to receive the Nobel Prize in Physics, aged 25. He was knighted in 1941. After World War II, he returned to Cambridge, splitting the Cavendish Laboratory into research groups. He believed that 'the ideal research unit is one of six to twelve scientists and a few assistants'. In 1948 Sir Lawrence Bragg became interested in the structure of proteins. Although he played no direct part in the 1953 discovery of the structure of DNA, James Watson admits that the X-ray method that Bragg developed forty years before was at the heart of this profound insight into the nature of life itself.

In April 1953 Sir Lawrence Bragg accepted the job of Resident Professor at the Royal Institution in London. He proposed that the [Royal Institution](#) should perform some form of public service, and suggested series of lectures to show experiments to schoolchildren. This idea was met with an enthusiastic response, and by 1965 20,000 schoolchildren were attending these lectures each year. He worked at the Royal Institution until his retirement in September 1966.

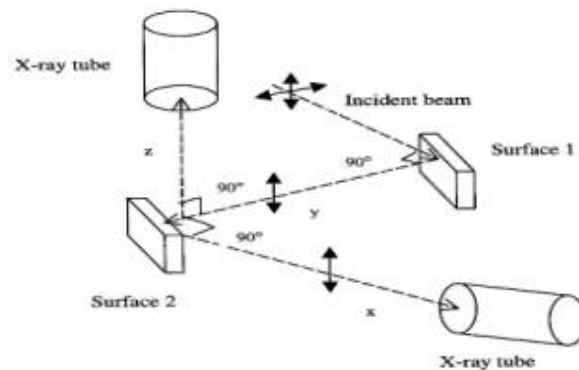
Sir Lawrence Bragg's hobbies included painting, literature and a life-long interest in gardening. He received both the Copley Medal and the Royal Medal of the Royal Society, and in 1967 was made a Companion of Honour by the Queen. He died at a hospital near his home at Waldringfield on 1st July 1971.



## Charles Barkla : Nobel Prize in Physics 1917



Charles Barkla



Charles Barkla was born on June 7, 1877 at Widnes, Lancashire, England. He was educated at the Liverpool Institute and entered [University College, Liverpool](#) in 1894. He graduated with First Class Honours in Physics in 1898 and he obtained his master's degree in the following year. In 1899, he received a scholarship and proceeded to [Trinity College, Cambridge](#), to work in the Cavendish Laboratory with [J. J. Thomson](#).

Barkla's first research concerned the velocity of waves, but in 1902 he began the investigations on Röntgen radiation that occupied almost his entire life. His discovery of homogeneous radiations characteristic of the elements showed that most elements had their characteristic line spectra in the X-ray region of the electromagnetic spectrum. Barkla made valuable contributions to present knowledge on the absorption and photographic action of X-rays. He also showed both the applicability and the limitation of the quantum theory in relation to Röntgen radiation. The results of his findings were recorded in various papers, which had appeared mainly in the Transactions and Proceedings of the Royal Society. Barkla was awarded the Nobel Prize in Physics 1917, "for his discovery of the characteristic Röntgen radiation of the elements".

Barkla was a Fellow of the Royal Society, and had several honorary degrees. He was appointed Bakerian Lecturer (Royal Society) in 1916 and he was awarded the Hughes Medal in the following year.

Barkla married Mary Esther in 1907 and they had two sons and one daughter. His favourite hobby was singing: he had a powerful baritone voice and he was a member of the King's College Chapel Choir, 1901-1902. He was also fond of golf. He moved to [King's College, London](#) during 1900 and in 1902 returned to Liverpool. From 1905 to 1909 he was a demonstrator, an assistant physics lecturer and a special lecturer in advanced electricity at the University. In 1909 he succeeded H. A. Wilson as Wheatstone Professor of Physics in the University of London. In 1913, Barkla accepted the Chair in Natural Philosophy in the University of Edinburgh and he held this position until his death. Barkla died at his home, Braidwood, Edinburgh, on October 23, 1944.



## Francis Aston : Nobel Prize in Chemistry 1922



Francis Aston



Francis Aston was born in September 1877 at Harborne, Birmingham, England. He was educated at Harborne Vicarage School and Malvern College. In 1894 he entered the [University of Birmingham](#) to study Chemistry and Physics. After graduation, he worked as a chemist in the laboratory of a brewery. However, his interest in physics began to dominate at this time. He liked to observe the gas discharge phenomena in evacuated tubes. In 1903 he received a scholarship to the University of Birmingham. In 1910 he began working as an assistant at the [Cavendish Laboratory](#), Cambridge, on studies of positive rays. During this period, he obtained definite evidence for the existence of two isotopes of the inert gas neon. This research was interrupted by World War I.

Returning to the Cavendish Laboratory in 1919, he worked on the problem of the separation of the isotopes of neon. He quickly achieved success through his invention of the mass spectrograph, which could utilize slight differences in the mass of the two isotopes. Extending this principle to other chemical elements, he discovered 212 of the naturally occurring isotopes. From his results, he could formulate the so-called Whole Number Rule which states that “the mass of the oxygen isotope being defined, all the other isotopes have masses that are very nearly whole numbers”. Thus, Aston received the Nobel Prize in Chemistry 1922, “for his discovery, by means of his mass spectrograph, of isotopes, in a large number of non-radioactive elements, and for his enunciation of the whole-number rule”.

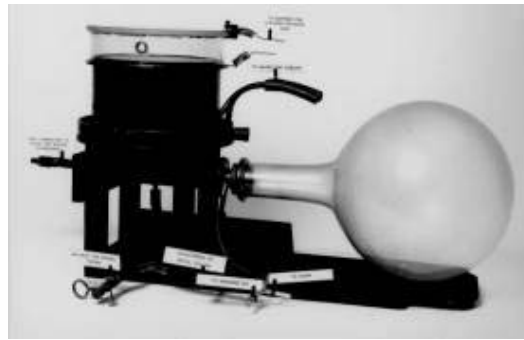
In 1920 Aston received a Fellowship at [Trinity College, Cambridge](#), and also the Mackenzie Davidson Medal. In 1921 he was made a Fellow of the Royal Society, and he was awarded the Society's Hughes Medal in 1922. He also obtained the Royal medal in 1938 and the Duddell medal of the Physical Society in 1941. Aston was a bachelor and also an enthusiastic sportsman. He liked skiing, rock climbing, tennis and swimming. He was also a musician, playing piano, violin and cello. He died in Cambridge on November 20, 1945.



## Charles Wilson: Nobel Prize in Physics 1927



Charles Wilson



Charles Wilson was born on the 14th of February, 1869, in the parish of Glencorse, near Edinburgh. When Wilson was four years old, his father died and his mother moved with the family to Manchester, where he was educated at Owen's College (now the [University of Manchester](#)). Having been granted an entrance scholarship in 1888 he went on to Cambridge ([Sidney Sussex College](#)), where he took his degree in 1892. It was here that he became interested in the physical sciences, especially physics and chemistry.

During the summer of 1896, it was firmly established by [J.J. Thomson](#) and [Lord Rutherford](#) that the conductivity of air was indeed due to ionization of the gas. There was no longer any doubt that ions in gases could be detected. Wilson's appointment as Clerk Maxwell Student, at the end of that year, enabled him to research further. Most of his work on the behaviour of ions as condensation nuclei was carried out in the years 1895-1900. Early in 1911, he was the first person to see and photograph the tracks of individual alpha- and beta-particles and electrons. However it was not until 1923 that the cloud chamber was brought to perfection, leading to his two, beautifully illustrated, classic papers on the tracks of electrons. He was awarded the Nobel Prize in Physics 1927, "for his method of making the paths of electrically charged particles visible by condensation of vapour".

Some of the most important achievements using the Wilson chamber were:

- the demonstration of the existence of Compton recoil electrons, ([Compton](#) shared the Nobel Prize with Wilson in 1927);
- the discovery of the positron by Anderson (who was awarded the Nobel Prize for 1936 for this feat);
- the visual demonstration of the processes of "pair creation" and "annihilation" of electrons and positrons by Blackett and Occhialini, and;
- the demonstration of the transmutation of atomic nuclei carried out by [Cockcroft](#) and [Walton](#).

Thus, Rutherford's remark that the cloud chamber was "the most original and wonderful instrument in scientific history" has been fully justified.

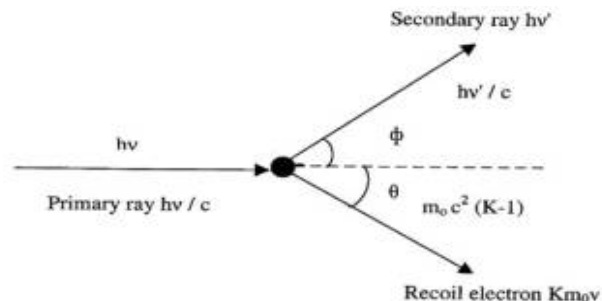
In 1908, Wilson married Jessie Fraser, daughter of Rev. G. H. Dick of Glasgow. They had two sons and two daughters. He died on the 15th of November, 1959, in the midst of his family.



## Arthur Compton : Nobel Prize in Physics 1927



**Arthur Compton**



Arthur Compton was born in Wooster, Ohio, on September 10th, 1892. In 1913, he graduated with Bachelor of Science from Wooster College. He spent three years in postgraduate study at [Princeton University](#), receiving his M.A. degree in 1914 and his Ph.D. in 1916. After spending a year as a physics instructor at the University of Minnesota, he took a position as a research engineer with the Westinghouse Lamp Company in Pittsburgh. In 1919 he moved to work at [University of Cambridge](#) as a National Research Council Fellow.

At Princeton, Compton developed the theory that the intensity of X-ray reflections from crystals can be used as a means of studying the arrangement of electrons and atoms within the crystals, and in 1918 he started a study of X-ray scattering. This led to his discovery, in 1922, of the increase of wavelength of X-rays due to scattering of the incident radiation by free electrons. This implies that the scattered quanta (free electrons) have less energy than the quanta of the original beam. This effect, known as the Compton effect, clearly illustrates the particle concept of electromagnetic radiation. This work was supported [C. T. R. Wilson's](#) research in his cloud chamber, in which he showed the presence of the tracks of the recoil electrons. Compton was awarded the Nobel Prize in Physics 1927, "for his discovery of the effect named after him".

In addition, Compton discovered (with C. F. Hagenow) the phenomenon of total reflection of X-rays and their complete polarization, which led to a more accurate determination of the number of electrons in an atom. He was also the first (with R. L. Doan) to obtain X-ray spectra from ruled gratings, which offers a direct method of measuring the wavelength of X-rays.

In 1916, he married Betty Charity McCloskey. They had two sons, Arthur and J.J. In 1920, he was appointed as the Head of the Department of Physics at [Washington University, St. Louis](#). In 1923 he moved to the [University of Chicago](#) as Professor of Physics. Until his retirement in 1961 he was Distinguished Service Professor of Natural Philosophy at Washington University.

Compton's favourite hobbies were tennis, astronomy, photography and music. He died on March 15th, 1962, in Berkeley, California.



## Sir Owen Richardson : Nobel Prize in Physics 1928



Sir Owen Richardson

$$i = AT^{\frac{1}{2}}e^{-w/kT}$$

Sir Owen Richardson was born on the 26th of April, 1879, in Yorkshire, England. Educated at Batley Grammar School, he proceeded to Cambridge in 1897, having obtained a scholarship at [Trinity College](#). He graduated with dual First Class Honours in Natural Science from [University of Cambridge](#) and [University of London](#) respectively. In 1900, he began to investigate the emission of electricity from hot bodies at the [Cavendish Laboratory](#). In 1902 he was elected a Fellow of Trinity College, Cambridge.

Richardson's Law was first announced by him in a paper on the 25th November, 1901, in the following words: "If then the negative radiation is due to the corpuscles coming out of the metal, the saturation current,  $s$ , should obey the law  $s = AT^{\frac{1}{2}} e^{-b/T}$ . This law is fully confirmed by the experiments to be described." Richardson continued working on this subject at Cambridge until 1906, when he was appointed Professor of Physics at [Princeton University](#) in America. He remained at Princeton until the end of 1913, working on thermionic emission, photoelectric action, and the gyromagnetic effect. In 1914, he returned to England as Wheatstone Professor of Physics at King's College, continuing his thermionic research. He was awarded the Nobel Prize in Physics 1928, "for his work on the thermionic phenomenon and especially for the discovery of the law named after him".

He was awarded the Hughes Medal by the Royal Society (1920), especially for work on thermionics; elected President, Section A, of the British Association (1921) and President of the Physical Society, London (1926-1928); appointed Yarrow Research Professor of the Royal Society, London (1926-1944); and knighted in 1939. In 1906 he married Lilian Maud Wilson. They had two sons and one daughter. After the death of his wife in 1945, Richardson married the physicist Henriette Rupp in 1948. He died in 1959.



## Sir James Chadwick: Nobel Prize in Physics 1935



Sir James Chadwick



Sir James Chadwick was born in Cheshire, England, on 20th October, 1891. He attended Manchester High School before entering [Manchester University](#) in 1908. He graduated from the Honours School of Physics in 1911, and then spent two years in the Physical Laboratory in Manchester, where he worked on various radioactivity problems for Professor (later Lord) Rutherford. In 1913 he graduated with a M.Sc. degree and received a scholarship to work for Professor Geiger in the Physikalisch Technische Reichsanstalt at Charlottenburg, Berlin.

In 1919, he returned to England and resumed working for Rutherford, who had moved to the [Cavendish Laboratory](#), Cambridge. Rutherford had succeeded in disintegrating atoms (spontaneous emission by a nucleus of photons or particles) and Chadwick joined Rutherford in his studies of the properties and structure of atomic nuclei. In 1932, Chadwick made a fundamental discovery in the domain of nuclear science: he proved the existence of neutrons - elementary particles devoid of any electrical charge. He was awarded the Nobel Prize in Physics 1935, "for the discovery of the neutron". This discovery provided a new tool for inducing atomic disintegration, since neutrons, being electrically uncharged, could penetrate into the atomic nucleus without deflections whereas protons cannot do so.

Chadwick remained at Cambridge until 1935 when he was elected to the Lyon Jones Chair of Physics at the [University of Liverpool](#). From 1943 to 1946 he worked in the United States as Head of the British Mission for the development of the atomic bomb. He was knighted in 1945. He returned to England and, in 1948, became the Master of [Gonville and Caius College](#), Cambridge. He retired in 1959. From 1957 to 1962 he was a part-time member of the United Kingdom Atomic Energy Authority.

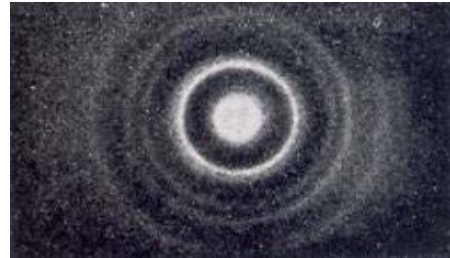
In 1925, he married Aileen Stewart-Brown of Liverpool. They had twin daughters, and the family lived at Denbigh, North Wales. His favourite hobbies were gardening and fishing. He died in 1974.



## Sir George Thomson: Nobel Prize in Physics 1937



Sir George Thomson



Sir George Thomson was born in 1892 in Cambridge, the son of the physicist Sir J.J. Thomson. George studied in Cambridge from his primary school to university, including University of Cambridge, where he attended [Trinity College](#) and majored in mathematics and physics. Under his father's supervision in atomic structure, he also worked for a year at the Cavendish Laboratory until World War I. After the war he spent three years as Fellow and Lecturer at [Corpus Christi College, Cambridge](#), and continued his physics research. He was then appointed Professor of Natural Philosophy (Physics) at the [University of Aberdeen](#), a post he held for eight years.

At Aberdeen he carried out experiments on the behaviour of electrons as they passed through very thin films of metals, which showed that electrons could behave as waves in spite of being particles. For this work he later shared the Nobel Prize, with C.J. Davisson of the Bell Telephone Laboratories, who had arrived at the same conclusions by a different kind of experiment. They shared the Nobel Prize in Physics in 1937, "for their experimental discovery of the diffraction of electrons by crystals". The process of electron diffraction, which these experiments established, has been widely used in the investigation of the surfaces of solids.

In 1930 he was appointed as a Professor at [Imperial College](#), University of London. Soon, he became interested in nuclear physics. When the fission of uranium was discovered at the beginning of 1939, he predicted its military and other functions, and persuaded the British Air Ministry to procure a ton of uranium oxide for experiments. Later he became the Chairman of the British Committee, investigating possibilities of making atomic bombs. This committee reported in 1941 that it was possible to make a bomb, and Thomson was authorized to give this report to two American scientists: Vannevar Bush and James Conant. After the war he returned to work at Imperial College. He continued his nuclear research and published many papers.

He left atomic bomb research in 1952 and became the Master of [Corpus Christi College](#), Cambridge, retiring from the latter in 1962. In 1924 he married Kathleen Buchanan. They had two sons and two daughters. His favourite hobby was making model ships. He died in 1975.



## Sir Edward Appleton: Nobel Prize in Physics 1947



Sir Edward Appleton



Sir Edward Appleton was born in Bradford, England, on 6th September 1892. He was educated at Hanson Grammar School, and then took his B.A. degree in Natural Science at [St. John's College, Cambridge](#), in 1913. In 1914, he specialised in physics and also won a scholarship, working for both [Sir J.J. Thomson](#) and [Lord Rutherford](#). His research was interrupted by World War I. After the war, he returned to Cambridge and took up research on radio waves. Appleton devoted himself to scientific problems in atmospheric physics, using mainly radio techniques. In 1920 he became an assistant demonstrator in experimental physics at the [Cavendish Laboratory](#). Two years later he became sub-rector at Trinity College.

In late 1924 Appleton began a series of experiments which proved the existence of an ionised layer in the upper atmosphere, now called the ionosphere. With the co-operation of the British Broadcasting Corporation, he used their Bournemouth transmitter to shoot radio waves up to the layer to see if they were reflected by it and came back. The experiment was very successful as the radio waves were reflected by the ionised layer. By a slight change of wavelength, it was possible to measure the time taken by the waves to travel to and from the layer. Thus, the position of the reflecting layer could be identified and its height (60 miles above ground) determined. This method is called "frequency-modulation radar". The ionosphere was the first "object" detected by radiolocation, and this led to a great development of radio research. Appleton received the Nobel Prize in Physics 1947, "for his investigations of the physics of the upper atmosphere especially for the discovery of the so-called Appleton layer".

In 1924 Appleton was appointed Professor of Physics at [London University](#) and served there for twelve years, returning to Cambridge in 1936 to become Professor of Natural Philosophy. He was knighted in 1941, acknowledging his contributions to British military research. In 1956 he gave the Reith Lectures for the B.B.C. on "Science and the Nation". His awards included the Gunning Victoria Jubilee Prize of the Royal Society, Edinburgh, in 1960, and the Medal of Honour of the Institute of Radio Engineers of America in 1962. In 1915 Appleton married Jessie and they had two daughters. He died in 1965.



## Lord Blackett: Nobel Prize in Physics 1948



Lord Blackett



Lord Blackett was born on 18th November, 1897. He was originally trained as a regular officer for the Navy at Osborne Naval College, having started his career as a naval cadet in 1914. He took part in the battles of Falkland Islands and Jutland during World War I. At the end of the war he resigned with the rank of Lieutenant, and took up studies of physics with [Lord Rutherford](#) at Cambridge.

In 1921, he started research with cloud chambers, which resulted in the first photographs of the transmutation of nitrogen into an oxygen isotope in 1924. In 1932, together with a young Italian scientist, G.P.S. Occhialini, he designed the counter-controlled cloud chamber, which could take photographs during experiments, including images of cosmic rays. In the spring of 1933 Occhialini and Blackett not only confirmed Anderson's discovery of the protons, but also demonstrated that both protons and electrons in an element had approximately equal numbers. In 1945, after World War II, he resumed his work on cosmic ray investigations at the [University of Manchester](#), focusing on the further study of cosmic ray particles by the counter-controlled cloud chamber in a strong magnetic field, built and used before the War. Lord Blackett received the Nobel Prize in Physics 1948, "for his development of the Wilson cloud chamber method, and his discoveries therewith in the fields of nuclear physics and cosmic radiation".

In 1948 Blackett followed up discussions about the isotropy of cosmic rays and began working on the origin of the interstellar magnetic fields, and in so doing revived interest in 30-year old speculations of Schuster and H. A. Wilson, and others, on the origin of the magnetic field of the earth and sun. He was awarded the Royal Medal by the Royal Society in 1940 and the American Medal for Merit in 1946. He was appointed Head of the Physics Department of the [Imperial College](#), London, in 1953 and retired in July 1963. In 1924 he married Constanza Bayon and they had one son and one daughter. He died in 1974.



## Sir John Cockcroft: Nobel Prize in Physics 1951



Sir John Cockcroft



Sir John Cockcroft was born in Todmorden, England, on May 27th, 1897. He was educated at Todmorden Secondary School and studied mathematics at [Manchester University](#). After serving in the Royal Field Artillery he returned to Manchester to study electrical engineering at the [College of Technology](#). After two years' apprenticeship he went to [St. John's College, Cambridge](#), and took the Mathematical Tripos in 1924. He then worked for Lord Rutherford in the [Cavendish Laboratory](#).

He first collaborated with Kapitsa in the production of intense magnetic fields and low temperatures. In 1928 he switched to work on the acceleration of protons by high voltages, and Ernest Walton soon joined in this work. In 1932 they succeeded in transmuted lithium and boron into high energy protons. In 1933, they managed to produce radioactivity and a wide variety of transmutations produced by protons and deuterons (the nucleus of the  $H^+$  atom). In 1934 Cockcroft took charge of the Royal Society Mond Laboratory in Cambridge and continued pioneering research in transmutation of atomic nuclei. They built the famous "Cockcroft-Walton" machine to enable them to continue their research. Sir John Cockcroft and Ernest Walton received the Nobel Prize in Physics 1951, "for their pioneer work on the transmutation of atomic nuclei by artificially accelerated atomic particles".

In 1929 Cockcroft was elected to a Fellowship at [St. John's College, Cambridge](#) and became successively University demonstrator, lecturer and in 1939 Jacksonian Professor of Natural Philosophy. He was knighted in 1948. For the period 1954-1959 he was scientific research member of the U.K. Atomic Energy Authority, and afterwards continued this function on a part-time basis. He became the Master, [Churchill College, Cambridge](#), in October 1959. In addition he was Chancellor of the [Australian National University](#), Canberra, and President of the Institute of Physics, the Physical Society (1960 to 1962) and the British Association for the Advancement of Science (1961 to 1963).

He married Eunice Elizabeth Crabtree in 1925 and they had four daughters and a son. He died in 1967.



## Ernest Walton: Nobel Prize in Physics 1951



Ernest Walton



Ernest Walton was born at Dungarvan, on the south coast of Ireland on October 6th, 1903. In 1915 he began studying at the Methodist College, Belfast, where he excelled in mathematics and science, and in 1922 he entered [Trinity College, Dublin](#). He graduated in 1926 with first class honours in mathematics and physics. He went on to receive his M.Sc. degree in 1927, and in the same year, he received a scholarship to work in the [Cavendish Laboratory](#), Cambridge, for [Lord Rutherford](#). He studied indirect methods for producing fast particles, working on the linear accelerator and on what was later to become known as the betatron.

He worked on the direct method of producing fast particles by the use of high voltages, in collaboration with [Sir John Cockcroft](#). This was the turning point in his life. They built an apparatus, known as the Cockcroft-Walton Machine, which could show that various light elements could be disintegrated by bombardment with fast protons. This made it possible to disintegrate the nucleus of the lithium atom by bombardment with accelerated protons, and identify the products as helium nuclei. Their pioneering work on nuclei earned Walton the Nobel Prize in Physics 1951 (together with Cockcroft), "for their pioneer work on the transmutation of atomic nuclei by artificially accelerated atomic particles".

Walton was Clerk Maxwell Scholar at Cambridge from 1932 to 1934 when he returned to Trinity College, Dublin as a Fellow. He was appointed Erasmus Smith's Professor of Natural and Experimental Philosophy in 1946, and in 1960 he was elected Senior Fellow of Trinity College, Dublin. He was awarded the Hughes Medal, jointly with Sir John Cockcroft, by the Royal Society of London in 1938.

Walton married Freda Wilson in 1934 and they had two sons and two daughters, Alan, Marian, Philip, and Jean. He died in 1995. His son Alan is currently working in the Physics and Chemistry of Solids Group at the Cavendish Laboratory.



## Francis Crick: Nobel Prize in Medicine 1962



Francis Crick



Francis Crick was born in a small town near Northampton, England. As a child, he was very inquisitive and he loved to read all kinds of books. His favourite books were ones about science. The science books inspired him to do experiments at home in his kitchen. His interest in science continued and he went on to study physics at University College London. Unfortunately the physics he learned in class was already out of date. He overcame this by continuing to teach himself at home, by reading more books and doing more experiments. His studies were interrupted by World War II. During the war he worked for the Admiralty, mostly designing and improving mines.

After the war he continued to work at the Admiralty, but he knew he did not want to design weapons for the rest of his life. The problem was that he was not sure what he did want to do. He liked reading, thinking, and talking about the new discoveries being made in biology. In the end, he decided that he wanted to study biology in more detail. He visited several labs and scientists to help him decide exactly where he wanted to work and exactly what he wanted to study. He finally settled at [Strangeways Laboratory](#) in Cambridge, where he worked on the effects of magnetism on cells.

In 1947, he moved to the [Cavendish Laboratory](#) in [Cambridge](#) to study proteins. He talked louder and faster than anyone else and was interested in all the experiments going on around him, not just his own study of proteins. Unfortunately his loud laugh would often annoy Professor Bragg, his supervisor!

Francis Crick was very interested in how genetic information was communicated, and believed that DNA could be the key. When [James Watson](#) arrived in Cambridge in 1951 they became friends immediately. They began working together to discover the structure of DNA. In 1953 they built the first accurate model of the structure of DNA. Their model showed that the structure of DNA is a double helix, like a twisted ladder. In 1962, Francis Crick shared the Nobel Prize for Physiology or Medicine with James Watson and [Maurice Wilkins](#) who, with [Rosalind Franklin](#), provided the data on which the structure was based.

Even after the discovery of the structure of DNA, there were still questions about how DNA stored and used information. Francis Crick continued to study DNA to try and figure out how it helps to build molecules. In 1961, Francis Crick and Sydney Brenner showed how RNA is used to read the information stored in DNA.

For most of his career, Francis Crick worked for the [Medical Research Council](#) in Cambridge. In 1976, he moved to the [Salk Institute](#) in California, and began studying how the brain develops. In 1988, he wrote about his experiences in *What Mad Pursuit: A Personal View of Scientific Discovery*. He is generally described as being very bright and having a dry, British sense of humour. He swims every day to keep healthy and still loves to talk about science.



## James Watson: Nobel Prize in Medicine 1962



**James Watson**



James Watson was born in Chicago in 1928. From an early age he was bright and inquisitive and wasn't satisfied with simple answers. As a child he spent a lot of time bird-watching with his father.

He began studying for an undergraduate degree in Zoology at University in Chicago at the age of 15. He did well in courses that interested him, like biology and zoology, and not as well in other courses. At this time his ambition was to go to graduate school and study to become the curator of ornithology at the Field Museum of Natural History in Chicago. He went to graduate school at Indiana University and received a doctorate in 1950. While he was studying, he became very interested in genetics. In September 1950 he moved to Copenhagen to begin studying the effect of DNA on viruses.

From Copenhagen he moved to Cambridge to work at the Cavendish Laboratory to learn more about how X-rays were used to study large molecules. At the Cavendish Laboratory he shared an office with Francis Crick, a Ph.D. student who was also interested in the structure of DNA. Although both were supposed to be working on other projects, they continued to study DNA. In 1953 they built the first accurate model of the structure of DNA. In 1962, James Watson shared the Nobel Prize for Physiology or Medicine with [Francis Crick](#) and [Maurice Wilkins](#) who, with [Rosalind Franklin](#), provided the data on which the structure was based.

Following the discovery of the structure of DNA, James Watson continued to work in molecular genetics. He left Cambridge in 1956 and went to work in the Biology department at [Harvard University](#). He became Director of [Cold Spring Harbor Laboratory](#) in 1968. He wrote *The Double Helix: A Personal Account of the Discovery of the Structure of DNA*, which was first published in 1968. This book was the first to describe how scientists work, and has never been out of print. He has played a significant role in many important areas, from fighting diseases like cancer to the Human Genome Project and he is now President of [Cold Spring Harbor Laboratory](#).

One of his major interests is education and he has written many biology text books. He is actively exploring new approaches to education through projects being developed at the [DNA Learning Center](#), the educational arm of Cold Spring Harbor Laboratory.

One of his other major interests is tennis, which he began playing regularly at Indiana University, and he still tries to play every day.



## Max Perutz: Nobel Prize in Chemistry 1962



**Max Perutz**



Max Perutz was born in Vienna, Austria on May 19th, 1914. Both his parents came from families of textile makers that had become rich by introducing mechanical spinning and weaving into the Austrian Monarchy in the 19th century. He went to a grammar school called the Theresianum in Vienna. His parents suggested that he should study law in preparation for entering the family business, but he was inspired to study chemistry by one of his teachers. He easily persuaded his parents to let him follow his own interest.

Max Perutz began studying chemistry at Vienna University in 1932. He did not enjoy some parts of the course, such as inorganic analysis. However, he was very interested in other parts, such as organic chemistry, and especially by organic biochemistry. He decided that he wanted to come to Cambridge to study more organic biochemistry and work for his Ph.D. thesis. He came to the [Cavendish Laboratory](#) in Cambridge to work with John Desmond Bernal in 1936, with financial support from his father. He has stayed working in Cambridge for the rest of his career.

After Hitler's invasion of Austria and Czechoslovakia, Max Perutz's parents became refugees, and his own sources of money were soon exhausted. Fortunately, he was appointed research assistant to [Sir Lawrence Bragg](#) from January 1st, 1939, paid for by the Rockefeller Foundation. His work was interrupted several more times for various reasons during the war. His career became more stable in 1945, when he was given an Imperial Chemical Industries Research Fellowship. Then, in October 1947, he was made head of the newly created Medical Research Council Unit for Molecular Biology. The only other member of staff when the Unit opened was Sir John Kendrew. The Unit is now incorporated in the Medical Research Council's Laboratory of Molecular Biology (LMB) on Hills Road in Cambridge, along with other groups working on similar problems that were previously scattered around Cambridge. In 1962 he was made Chairman of the LMB, which now houses over 400 people.

Max Perutz's interest in organic biochemistry led him to study biological molecules using X-ray diffraction. In 1953, shortly after the discovery of the structure of DNA, he realised that attaching a single large atom (e.g. Mercury) to a molecule would change the X-ray diffraction pattern obtained from the crystal, making it possible to completely solve the structure of that molecule. He and [Sir John Kendrew](#) used this doping technique to discover the structures of haemoglobin and myoglobin. Max Perutz shared the Nobel Prize in Chemistry in 1962 with Sir John Kendrew for this work. He was also made Companion of the British Empire in 1962. Following his "retirement" in 1979 he continued to work at the LMB almost every day. He continued to study haemoglobin to help develop useful drugs for cancer treatments. He also studied other biological molecules to try and help develop treatments for Huntington's disease.

Max Perutz was a keen mountaineer, and his other interests included walking, skiing and gardening. He died of cancer on 6th February 2002.



## Sir John Kendrew: Nobel Prize in Chemistry 1962



Sir John Kendrew



Sir John Kendrew was born in Oxford on 24th March, 1917. He attended the Dragon School in Oxford (1923-1930) and then Clifton College in Bristol (1930-1936), where he was inspired by an outstanding chemistry teacher. He came to [Trinity College, Cambridge](#), in 1936 and graduated in Chemistry in 1939.

Sir John Kendrew spent the first few months of the war studying reactions in the Department of Physical Chemistry at Cambridge. He then worked for the Air Ministry Research Establishment (later the Telecommunication Research Establishment) developing radar, and went on to do operational research for the Royal Air Force, working in Coastal Command, the Middle East, and South East Asia (where he was Scientific Adviser to the Allied Air Commander-in-Chief). During his time in Ceylon (now Sri Lanka) he met John Desmond Bernal and they spent time discussing X-ray diffraction by proteins. He decided that he would like to work at the [Cavendish Laboratory](#) studying proteins when the war was over. He returned to Cambridge in 1946 and began studying proteins with Max Perutz at the Cavendish Laboratory, under the direction of [Sir Lawrence Bragg](#). He began by studying haemoglobin from sheep, and went on to study myoglobin from horses, diving mammals and birds. He also developed new techniques in X-ray crystallography.

Sir John Kendrew shared the Nobel Prize in Chemistry in 1962 with [Max Perutz](#) for their discoveries of the structures of myoglobin and haemoglobin, and the development of the new technique they used to make these discoveries. He was also made Companion of the British Empire in 1962, and knighted in 1974.

Max Perutz described Sir John Kendrew as “outstandingly able, resourceful, meticulous, brilliantly organised, knowledgeable, hard worker and a stimulating companion with wide interests in science, literature, music and the arts”.

Sir John Kendrew and Max Perutz were the first two members of the Medical Research Council Unit for Work on Molecular Structure of Biological Systems, which was created at the Cavendish Laboratory in 1947. The Unit is now incorporated in the Medical Research Council's Laboratory of Molecular Biology (LMB) on Hills Road in Cambridge, along with other groups working on similar problems that were previously scattered around Cambridge. John Kendrew was Deputy Director of the LMB from its opening in 1962 until 1974.

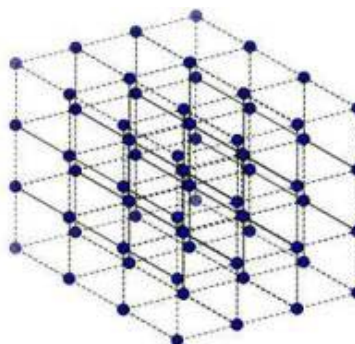
Sir John Kendrew was also a talented diplomat. He spoke fluent German, French and Italian and was a devoted European. He was the main advocate for the creation of the European Laboratory of Molecular Biology in Heidelberg, and became its first director in 1974. This great laboratory stands as testament to his skills both as a scientist and as a diplomat. He died in August 1997 in Cambridge aged 80.



## Dorothy Hodgkin: Nobel Prize in Chemistry 1964



**Dorothy Hodgkin**



Dorothy Hodgkin was a British descendant, born in Cairo, Egypt, on May 12th, 1910. She became interested in chemistry at about the age of 10, and this interest was encouraged by a doctorate friend of her parents. Dorothy was allowed to join the boys doing chemistry at school. Before entering university, she had decided to study chemistry and biochemistry. She studied at [Somerville College, Oxford](#), from 1928 to 1932. At Oxford, she attended a special course in crystallography and decided to do research in X-ray crystallography in Cambridge, working from 1932 to 1936 with John Desmond Bernal at the [Cavendish Laboratory](#). In 1933, Somerville College gave her a research fellowship and in 1937, she obtained her PhD at the [University of Cambridge](#).

Dorothy is known as a founder of the science of protein crystallography. She and her mentor, J.D. Bernal, were the first to successfully apply X-ray diffraction to crystals of biological substances, especially steroids, in 1934. Dorothy's contributions to crystallography included discoveries of the structures of cholesterol, tobacco mosaic virus, penicillin, vitamin B-12, and insulin (a solution on which she worked for 34 years), with the aid of X-ray diffraction techniques. Her discoveries were important because these could determine the best methods of production of penicillin, which was used to prevent wound infection during World War II. Dorothy was awarded the Nobel Prize in Chemistry 1964, "for her determinations by X-ray techniques of the structures of important biochemical substances".

Dorothy spent most of her working life as a Fellow and Tutor in Natural Science at Somerville College, Oxford, responsible mainly for teaching chemistry in the women's colleges. She became a University lecturer and demonstrator in 1946, University Reader in X-ray Crystallography in 1956 and Wolfson Research Professor of the Royal Society in 1960.

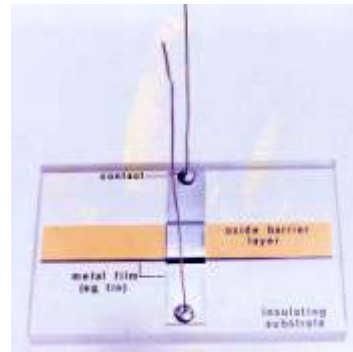
In 1937 she married Thomas Hodgkin, a historian. They had three children and three grandchildren. She died in 1994.



## Brian Josephson: Nobel Prize in Physics 1973



**Brian Josephson**



Brian Josephson was born in Cardiff, Wales, on January 4th, 1940. He grew up in Cardiff and attended Cardiff High School. In 1957 he entered [Trinity College, Cambridge](#), specialising in physics. He received his BSc in 1960 and became a research student at the [Cavendish Laboratory](#), receiving his Ph.D. in 1964, publishing his first work while still an undergraduate.

While still an undergraduate, Josephson became interested in superconductivity, and he explored the properties of a junction between two superconductors that later came to be known as a Josephson junction. Josephson extended the earlier work of Esaki and Giaever in tunneling, the phenomenon by which electrons functioning as radiated waves can penetrate solids. He showed theoretically that tunneling between two superconductors could have very special characteristics, for example, flowing across an insulating layer without the application of a voltage. If a voltage is applied, the current stops flowing and oscillates at high frequency. This is now known as the Josephson effect. Experimentation confirmed Josephson's theory, and its confirmation in turn reinforced the earlier theories of superconductor behaviour. He received the Nobel Prize in Physics 1973, "for his theoretical predictions of the properties of a super-current through a tunnel barrier, in particular those phenomena which are generally known as the Josephson effects"

By 1980, researchers at IBM had assembled an experimental computer switch structure applying Josephson's discoveries with superconductors. This improved switching speeds from 10 to 100 times faster than those of conventional silicon-based chips, increasing data processing capabilities by a vast amount.

Josephson was elected a fellow of Trinity College in 1962. He was a visiting professor at the University of Illinois in 1965-66. In 1967 he returned to Cambridge as an assistant director of research. He became a Professor of Physics in 1974. Eventually Josephson grew interested in the discovery of the cross-relevance between Eastern mysticism and scientific understanding. Over the past 20 years, he has published many papers about Mind-Matter relationships. Currently, he is working at the Cavendish Laboratory, Cambridge, and he is the director of the [Mind-Matter Unification Project](#).



## Sir Martin Ryle: Nobel Prize in Physics 1974



Sir Martin Ryle



Sir Martin Ryle was born in Brighton, Sussex, England, on September 27, 1918. He was educated at Bradfield College and the [University of Oxford](#), where he graduated in 1939. During the war periods, he worked on the development of radar and other radio systems for the Royal Air Force.

In 1945 J.A. Ratcliffe invited Ryle to work at the [Cavendish Laboratory](#), Cambridge, starting an investigation of the radio emission from the Sun, which had recently been discovered accidentally with radar equipment. In 1948 Ryle was appointed to a Lectureship in Physics and in 1949 elected to a Fellowship at [Trinity College](#), Cambridge. In 1959 he was appointed as a new Professor of Radio Astronomy, and in 1972 was appointed Astronomer Royal.

Ryle enjoyed working at the Cavendish, where both Ratcliffe and [Sir Lawrence Bragg](#) gave him enormous support and encouragement. Through many years of hard work and testing, Ryle developed revolutionary radio telescope systems, including the aperture synthesis technique, using them for accurate location of weak radio sources. With this novel equipment, he observed the most distant known galaxies of the universe. His contributions led to the discovery of numerous radio galaxies and quasars (quasi-stellar radio sources). Ryle and [Antony Hewish](#) shared the Nobel Prize for Physics 1974, the first Nobel prize awarded in recognition of astronomical research, “for their pioneering research in radio astrophysics: Ryle for his observations and inventions, in particular of the aperture synthesis technique, and Hewish for his decisive role in the discovery of pulsars”.

In 1947 he married Rowena Palmer, and they had two daughters and a son. Ryle received many medals, including the Gold Medal, Royal Astronomical Society, London, in 1964, and the Royal Medal, Royal Society of London in 1973. He was knighted in 1966. Ryle had honorary doctorate degrees from University of Strathclyde, University of Oxford and Nicholas University of Torun, Poland. His favourite hobbies were sailing and building small boats. He died in 1984.



## Anthony Hewish: Nobel Prize in Physics 1974



Anthony Hewish



Anthony Hewish was born in Fowey, Cornwall, England, on 11 May 1924. He was educated at King's College, Taunton and went to the [University of Cambridge](#) in 1942. From 1943-46 he was engaged in war service at the Royal Aircraft Establishment, Farnborough and also at the Telecommunications Research Establishment, Malvern. He was involved with airborne radar-counter-measure devices and he also worked with [Martin Ryle](#). Returning to Cambridge in 1946, he continued his studies. After graduating in 1948, he joined Ryle's research team at the [Cavendish Laboratory](#). He obtained his Ph.D. in 1952, became a Research Fellow at Gonville and Caius College, and in 1961 transferred to [Churchill College](#) as Director of Studies in Physics. He was a Lecturer during 1961-69, Reader during 1969-71 and Professor of Radio Astronomy from 1971 to 1989.

With colleagues, he confirmed in 1964 that the solar wind caused quasars to scintillate, and he exploited this discovery to make the first ground-based measurements of the solar wind-speed. In 1967 he completed the construction of a unique radio telescope specially designed to observe quasars at very high angular resolution by means of the same scintillation. With this telescope, and the help of his graduate student, Jocelyn Bell, Hewish detected the first pulsar, a new classification of stars. Hewish shared the Nobel Prize for Physics in 1974 with Ryle, the first Nobel prize awarded in recognition of astronomical research, "for their pioneering research in radio astrophysics: Ryle for his observations and inventions, in particular of the aperture synthesis technique, and Hewish for his decisive role in the discovery of pulsars".

From 1982-88, Hewish was the head of the Cambridge Radio Astronomy Group and was also the head of the Mullard Radio Astronomy Observatory. Hewish was married in 1950. He has one son and one daughter. He officially retired in 1989, but he continues to work part-time in the [Astrophysics Group](#) at the Cavendish Laboratory.



## Sir Nevill Mott: Nobel Prize in Physics 1977



**Sir Nevill Mott**



Sir Nevill Mott was born in Leeds, England, on September 30th, 1905. He was educated at Clifton College, Bristol and entered [St. John's College, Cambridge](#) in 1924, where he studied mathematics and theoretical physics. At the [Cavendish Laboratory](#) he worked on collision theory and nuclear problems. In 1933 he became the chair of theoretical physics at Bristol, and changed his research interests to the properties of metals and semiconductors. His work included theoretical studies of transition metals, rectification and hardness of alloys and also the physics of photographic images.

In the 1960s, Mott's studies of electrical conduction in various metals led him to explore the conductivity potential of amorphous materials, which are so called because their atomic structures are irregular or unstructured. He devised formulas describing the transitions that glass and other amorphous substances can make between electrically conductive (metallic) states and insulating (non-metallic) states, thereby functioning as semiconductors. These glassy substances, which are relatively simple and cheap to produce, eventually replaced more expensive crystalline semiconductors in many electronic switching and memory devices, and this in turn led to more affordable electronic devices, such as personal computers. He was awarded the Nobel Prize in Physics 1977 (shared with [Anderson](#) and van Vleck), "for their fundamental theoretical investigations of the electronic structure of magnetic and disordered systems".

In 1954 Mott was appointed Cavendish Professor of Physics, a post that he held until 1971, serving on numerous government and university committees. He also became the Master of [Gonville and Caius College](#), Cambridge, from 1959-66. He was President of the International Union of Physics from 1951 to 1957. Mott was knighted in 1962.

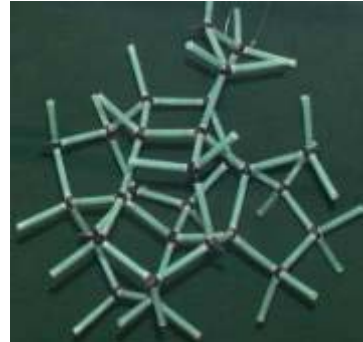
Outside physics research he took a leading part in the reform of science education in the United Kingdom and was actively involved in dealing with educational problems. In 1930 he married Ruth Eleanor Horder. They had two daughters and three grandchildren. He died on August 8, 1996.



## Phillip Anderson: Nobel Prize in Physics 1977



**Phillip Anderson**



Phillip Anderson was born in Urbana, Illinois, USA, in 1923. His happiest moments as a child and adolescent were spent hiking, canoeing, vacationing, picnicking, and singing around the campfire. Later, he received a national scholarship and went to [Harvard University](#). After graduation, he worked in the Naval Research Laboratory during 1943-45. He went back to Harvard Graduate School in 1945 and spent four years there. After getting his PhD in 1949, he worked at [Bell Laboratories](#), where he was involved in many solid-state physics projects.

A turning point in his research career was his arrival in Cambridge, England, in 1961. He first spent a year at the [Cavendish Laboratory](#) and [Churchill College](#). He met [Brian Josephson](#), and began working on a project based on the Josephson effect. In 1967 [Nevill Mott](#) invited him to work at the Cavendish Laboratory, jointly leading the [Theory of Condensed Matter Group](#) with Volker Heine. He did this for eight years, being actively involved in research, administration and teaching.

Anderson investigated the inter-atomic effects that influence the magnetic properties of metals and alloys, devising a theoretical model known as the Anderson model to describe the effect of the presence of an impurity atom in a metal. He also described the movements of impurities within crystalline substances by a method now known as Anderson localization. He also studied the relationship between superconductivity, superfluidity, and laser action, and predicted the existence of resistance in superconductors. His studies of disordered glassy solids indicate that they could be used instead of the expensive crystalline semiconductors in many electronic devices, such as computer memories and electronic switches. He was awarded the Nobel Prize in Physics 1977 (shared with Mott and van Vleck), "for their fundamental theoretical investigations of the electronic structure of magnetic and disordered systems".

Anderson married Joyce Gothwaite during his Harvard Graduate School years. They have a daughter. Since his retirement in 1984 from Bell Laboratories, he has enjoyed relaxing, writing and travelling.



## Pjotr Kapitsa: Nobel Prize in Physics 1978



Pjotr Kapitsa



Pjotr Kapitsa was born in Kronstadt, Russia, on the 9th July 1894. After completing his studies in 1918 at the Electromechanics Department of the Petrograd Polytechnical Institute, Kapitsa began his scientific career at that institute. He proposed a method for determining the magnetic moment of an atom interacting with an inhomogeneous magnetic field. This method was later widely used in magnetic physics.

In 1921 Kapitsa came to the [Cavendish Laboratory](#), Cambridge, to work with [Rutherford](#), researching in nuclear physics. After a few years in Cambridge, Kapitsa turned to low-temperature research. He began with a critical analysis of the traditional methods for obtaining low temperatures and developed a new and original apparatus for the liquefaction of helium in 1934. Kapitsa began a series of experiments to study the properties of liquid helium that led to the discovery of the superfluidity of helium in 1937. In 1939 he developed a new method for liquefaction of air with a low-pressure cycle using a special high-efficiency expansion turbine. He then wrote a series of papers investigating this new state of matter. Late in the 1940's he began working on physical problems for low-temperature physics. He also invented high-power microwave generators and discovered a new kind of continuous high-pressure plasma discharge with electron temperatures over a million K. Thus, he was awarded the Nobel Prize in Physics 1978, "for his basic inventions and discoveries in the area of low-temperature physics".

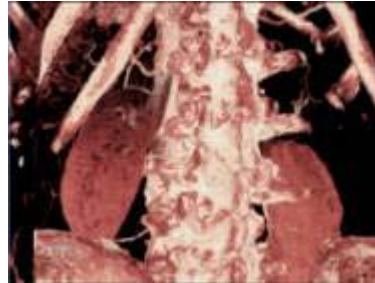
Kapitsa was a Clerk Maxwell Student at the [University of Cambridge](#) (1923-1926), Assistant Director of Magnetic Research at the Cavendish Laboratory (1924-1932), Messel Research Professor of the Royal Society (1930-1934), and Director of the Royal Society Mond Laboratory (1930-1934). Kapitsa was one of the founders of the Moscow Physico-Technical Institute (MFTI). He was also an honorary member of the Russian Academy of Sciences. He married Anna Krylova in 1927. They had two sons. He died in 1984.



## Allan Cormac: Nobel Prize in Medicine 1979



Allan Cormac



Allan Cormac was born in Johannesburg, South Africa, in 1924. He attended the Rondebosch Boys High School. He went to the [University of Cape Town](#) and studied electrical engineering. Later, he turned to physics and graduated with bachelor and master degrees in physics. After graduation, he went to [St. John's College](#), Cambridge and worked at the [Cavendish Laboratory](#) under Prof. Otto Frisch on problems connected with  $\text{He}^6$ , which is an important component in Biological Physics. He returned to Cape Town in 1950, accepting a post as a Lecturer in Nuclear Physics.

At Cape Town, Cormac specialised in nuclear physics. In 1956 he became interested in medical physics, especially an area known as computerized axial tomography (CAT) scanning. In 1963, by the ingenious use of mathematical techniques which he first encountered in X-ray crystallography, he generalised his CAT theory substantially. His interest in X-ray technology led him to develop the theoretical foundations that made computerized axial tomography (CAT) scanning possible. He published his results in two papers in 1963–64, but these generated little interest until the first CAT scan machine, built under the leadership of Godfrey Hounsfield, was introduced in 1972 in a London hospital. Now CAT scanning machines have become standard and are widely used in hospitals around the world. Cormac received the Nobel Prize in Medicine 1979 (shared with Hounsfield), "for the development of computer assisted tomography".

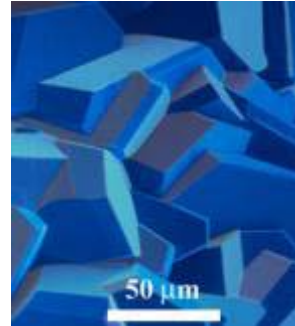
Outside academic research, Cormac was very actively involved in a wide range of activities: tennis, travelling, swimming, sailing and his favourite hobby, reading. From 1958 onwards, Cormac began working for the Physics Department, [Tufts University](#), MA, USA, where he became the Chairman from 1968 to 1976. He married Barbara Seavey during his time as a research student at the Cavendish Laboratory and they had two daughters and one son. He died in 1998.



## Sir Aaron Klug: Nobel Prize in Chemistry 1982



Sir Aaron Klug



Sir Aaron Klug was born in 1926 in Zelveas, Lithuania. His family moved to South Africa in 1928 and he grew up there. He entered Durban High School and then the University of Witwatersrand in Johannesburg, taking the pre-medical course. However, he turned to general science (chemistry, physics and mathematics) and then he did a master degree in physics research at the [University of Cape Town](#). In 1949, he became a PhD student at [Trinity College](#), Cambridge, and began his research at the [Cavendish Laboratory](#), working on a theoretical problem in the study of steel. After completing his PhD, he spent a year in the Colloid Science department in Cambridge. By 1954, he had accepted a job at Birkbeck College, London, where he worked in virus research.

In 1962 Klug moved to the newly built MRC Laboratory of Molecular Biology in Cambridge, continuing his virus research specialising in spherical viruses. The [MRC Laboratory](#), under the leadership of [Perutz](#), was to house the original unit from the Cavendish Laboratory ([Perutz](#), [Kendrew](#), [Crick](#) and, later, Brenner), and the [Biochemistry Department](#) of the University of Cambridge. It was difficult to understand the structure of viruses in 1960s. Through consistent hard work, Klug finally developed a technique called crystallographic electron microscopy and also used structural modelling to study the three-dimensional nature of poliovirus and other viruses. This new method was very efficient and it provided scientists with important information about viruses. He was awarded the Nobel Prize in Chemistry 1982, "for his development of crystallographic electron microscopy and his structural elucidation of biologically important nucleic acid-protein complexes".

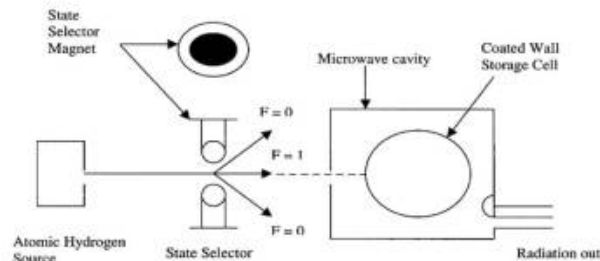
Klug enjoyed teaching, as he liked interacting with young minds, but he has become less involved in teaching in recent years. He is still a Director of Studies in Natural Science at [Peterhouse College](#), Cambridge, a position he has held for about 20 years. Klug was knighted in 1988. He married Liebe Bobrow in Cape Town, before moving to Cambridge in 1949. They have two sons.



## Norman Ramsey: Nobel Prize in Physics 1989



**Norman Ramsey**



Norman Ramsey was born on August 27, 1915 in Washington, D.C. During his childhood, his family moved around due to his father's job duties as an army officer. He graduated from high school with distinctions at the age of 15. He entered Columbia College in 1931 and studied mathematics. After his graduation in 1935, he turned to physics and came to the [Cavendish Laboratory](#), Cambridge, where he studied for his second bachelor degree. He was inspired by great physicists such as [J.J. Thomson](#), [Rutherford](#), [Chadwick](#), [Cockcroft](#), Eddington, and [Appleton](#) from the Cavendish Laboratory and wished to become a great physicist and inventor. Later, he returned to Columbia for his PhD and worked for Isidor Rabi in molecular beam research. For the next few years, Ramsey worked in many places, including Illinois, MIT, Columbia and Brookhaven National Laboratory, before moving to [Harvard University](#) where he worked for 40 years.

At Harvard he established a molecular beam laboratory for his molecular beam magnetic resonance experiments. After many attempts, he invented the separated oscillatory field method that allowed him to achieve the desired accuracy. In order to get improvements, he consulted with various groups that applied his method to atomic clocks. He later built a separated oscillatory field electric resonance apparatus and used it to study polar molecules. With the help of a student, Daniel Kleppner, Ramsey invented the atomic hydrogen maser, which is useful equipment for atomic research and it is used in many research centres. Ramsey received the Nobel Prize in Physics 1989, "for the invention of the separated oscillatory fields method and its use in the hydrogen maser and other atomic clocks".

In 1940 he married Elinor Jameson. After Elinor died in 1983, he married Ellie Welch. He has a combined family of seven children and six grandchildren. Ramsey officially retired from Harvard in 1986, but he still remains active in physics. After his retirement, he was a visiting researcher at the University of Colorado and a visiting professor at the University of Chicago, Williams College and the University of Michigan. He now enjoys his life as a part-time teacher, researcher and visiting professor.