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LORD KELVIN (1824 – 1907) by Peter Lamb

Lord Kelvin was born William Thomson and was one of the most notable pioneers of electrical engineering. On my many researches I have undertaken, he crops up everywhere, mainly because he was a consultant with a considerable reputation. How did he get such a formidable reputation? It is appropriate to consider his life at this time, 100years after his death in December 1907.

Thomson was born in Belfast, the second son of James and Margaret Thomson. They had seven children and the father was professor of Mathematics at the Belfast Academical Institution. His mother came from Glasgow (Kelvin Grove) and sadly died when he was only 6 years of age. Following this tragedy, James took up an appointment as Chair of Mathematics at Glasgow College. William had an elder brother, also called James and both boys were exceptionally bright. In Glasgow, they didn't go to school, but were taught at home and even then they both matriculated at age of 10 and 12 respectively (i.e. enabling examination to go to University). The two brothers worked together not only in their studies but also in designing and building machinery.

William eventually attended Cambridge University (Peterhouse College) in 1841 at the age of 17, where he studied mathematics. Despite his keen intellectual intensity, he was also a keen sportsman and became obsessed with rowing winning many trophies. Academically Thomson proved to be a mathematical genius being appointed Fellow of Peterhouse and taking over the editorship of the Cambridge Mathematical Journal at the age of 21. In his late years at Cambridge, he used his considerable knowledge of mathematics to apply it to the theories of electricity and magnetism, being assisted in his last year by James Clerk Maxwell. After graduating, his father sent him to Paris working under Victor Regnault to gain experience in laboratory experimentation at the College de France.

Thomson returned to Cambridge briefly as a college lecturer, but then was elected to the Chair of Natural Philosophy at Glasgow, largely sponsored by his father, in 1846. This post had been neglected for some time, due to the illness of his predecessor, and his first task was to upgrade and replace the existing old physical apparatus. One should explain that Natural Philosophy at that time included the sciences associated with nature, including mostly what we would call Physics these days, such as mechanics, optics, heat, electricity & magnetism. During his early years at Glasgow, he experimented in the the transformation of energy in heat engines and devised the second law of thermo- dynamics. He was very successful and popular as a lecturer, involving considerable amount of experimentation of new areas of research. His researches included trying to establish the absolute temperature at which to

measure the elements. He became obsessed with the idea of the need for a temperature scale with an absolute zero, which he proposed publicly in 1848. This idea was eventually adopted universally as Zero Kelvin, being named after him and being the temperature at which molecular energy is at a minimum i.e. -273.15 degrees Celsius. He was a brilliant mathematician, regularly quoting Fourier's mathematics, which he said suited the analysis of electricity. In fact his whole philosophy throughout his life revolved around accurate measurement and he has been described as "the life and soul of science in its practical application".

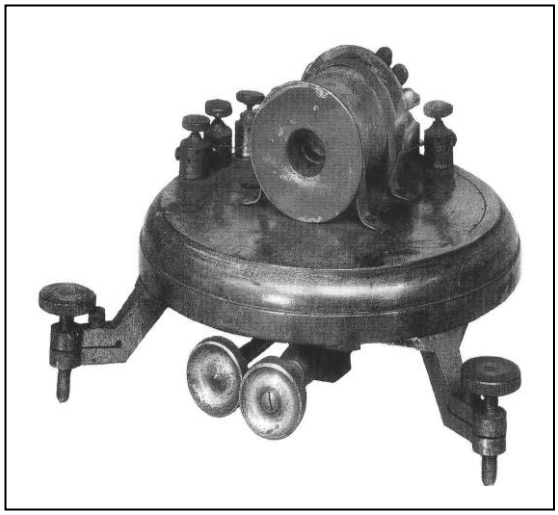
He regularly gave lectures to learned societies and institutions on his views on the latest scientific matters especially with the British Association for the Advancement of Science and wrote papers and books prodigiously. In his early years as a Professor he teamed up with Prof. Peter Tait of St. Andrews University in producing text books, the most well-known being the "Principia Mathematica", emulating Newton's famous similar document. He was fascinated with the Solar system and got embroiled in the controversy about the age of the Earth.

He and his brother James studied in depth hydro-dynamics developing the theories relating to a vortex. James had always wished to take up an engineering career and had worked at various establishments throughout the UK. He developed a water turbine described as the Vortex Turbine, which he patented in 1850 and was in demand as hydro-electric schemes were initiated much later on.

Thomson married Margaret Crum, his second cousin in 1852, but sadly she died 18 years later in 1870 and there had been no children by the marriage. A year later he was invited to join an Admiralty Committee concerned with the design of warships. This followed the sinking of the so-called "turret ship", which had added armaments, i.e. too much, making the ship design basically top heavy. His mathematical genius came to the fore in the official conclusions.

His first approach towards electrical measurement came about, when he tackled telegraph cables. He devised a more accurate measurement of resistance during manufacture. By 1856 he had become a director of the newly formed Atlantic Telegraph Company. He boarded the cable laying ships, initially HMS Agamemnon, taking with him a marine mirror galvanometer of his own design. The first cable across the Atlantic was laid in July 1858 but by October it had failed. A committee was set up to analyse the reasons for the failure, involving Thomson. He recommended that failure of the insulation and lack of adequate measurement of the cable during manufacture and more care during the installation was the cause and he gained considerable merit from these conclusions. The second attempt in 1865 using Brunel's steam ship Great Eastern was more successful, however the cable snapped half way and they lost the end with the bad weather. At the third attempt in 1866 they were more successful and even picked up the lost end from the previous attempt. Thomson was knighted for his diligent efforts by the Queen at Windsor Castle in 10th November 1866. It is worth noting that much of the finance and technical skill for the great efforts involved in linking America with the UK came from this side of the Atlantic, since the USA was embroiled in their own Civil War from 1861 to 1865.

A partnership with the telegraph engineer, Cromwell Varley was formed in 1869 to establish a company manufacturing measuring instruments patented by Thomson, which included a quadrant electrometer and a mirror galvanometer. These were used in ocean telegraphy all over the World in the next 30 years for all the major ship lines with the partners acting as consulting engineers, which made Thomson a very rich man. Also he designed a siphon recorder, a tide predictor and improved the mariners' compass.



Kelvin Galvanometer

With this additional finance from his patents, he bought himself a yacht in 1870. It was a large yacht of 126 tons called the "Lalla Rookh". He had become a keen seafarer after being on board various cable laying ships. The yacht required a regular crew with a captain and he became an expert in marine navigation. He set up a laboratory on board and wrote many of scientific papers whilst at sea, inviting many scientists to sail with him. The cable ships had called frequently at Funchal, Madeira and he got to know the family of the well-known Portuguese wine merchants, Blandys. He returned in his yacht in 1874 and proposed to one of the daughters Senorita Frances Blandys and in June of that year they were married on his fiftieth birthday. Following this he built himself a large country mansion, commensurate with his new status and income, called Netherhall at Largs near Glasgow.

In the 1870's Sir William patented a great deal of marine equipment, including a standard compass and a depth sounding apparatus, which were much in demand by the mail-liners companies of the day, such as Cunard, White Star and P & O. Most of these instruments were manufactured in Glasgow by an instrument maker, James White. Thomson became a driving force within the company, becoming a partner. With the advent of electric lighting and power in the 1880's, the firm added electrical measuring instruments designed by him to its portfolio and the workforce was increased to 400 strong. The number of measuring instruments and other apparatus designed by him was prolific and can only be gauged by the many patents, which were taken out in his name :-

Electric Telegraphy	12 patents
Marine Navigation	25 patents
Electrical	29 patents

He therefore moved into a pole-position in electrical consultancy. He gave evidence to the House of Commons Select Committee of the Electric Light, when he conjectured that electricity could be economically transmitted through copper wires over long distances say 300 miles, and that was said in 1879!

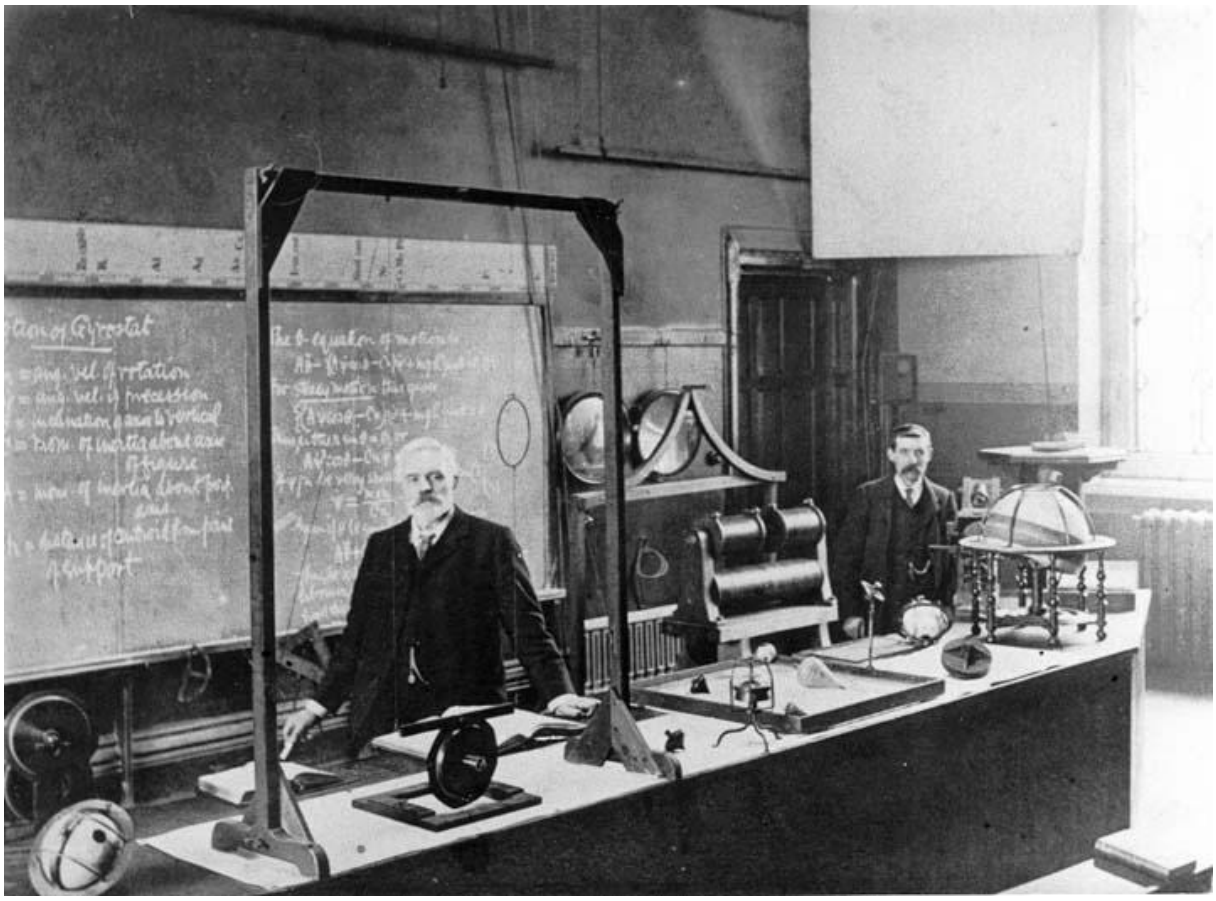
He worked tirelessly as a member of the British Association for the Advancement of Science committee on standards of electrical resistance with close associates "on board" Jenkin, Joule, Balfour Stewart and Maxwell to establish electrical formulae. They also recommended the establishment of the National Physical Laboratories, which wasn't accepted until much later with the NPL opening in 1902, which he did live to see. In 1881 Thomson was invited to attend an International Congress in Paris with himself as Vice-President to establish electrical standards. At this Congress the titles of the various units of electricity were agreed internationally and they were the ohm, volt, ampere farad and coulomb.

He had designed an alternator in 1881 and found that Sebastian de Ferranti's design was very similar, so they decided to pool their expertise and manufactured a Thomson/Ferranti alternator at a firm established by Ferranti – Ferranti, Thompson & Ince (Thompson was Alfred Thompson, an Engineer). In the 1890's he was invited to act as Chairman of a committee of consultants to advise on the hydro-electric scheme of Niagara in the USA, the largest hydro-electric scheme of the day. He was also scientific adviser to the British Aluminium Company, which was establishing a smelter at the Falls of Foyers, Scotland, where it was proposed to

build a hydro-electric installation to power the smelter. Not the first hydro-electric station in Scotland, possibly the fourth but certainly the largest at that time. He joined a committee of the Lords and Commons to advise on the electrification of the London Underground and many other electric traction and train systems and so it goes on. It is quite staggering how he found the time to do so much consultancy work, since he must have spent a considerable time on trains and boats!

In his later years he also got involved in politics becoming President of the West of Scotland Liberal Unionist Association, he became embroiled in the home rule for Ireland debate about which he was strongly opposed. Indirectly this earned him a peerage in 1892, the first scientist to be so ennobled. He took the title of Baron Kelvin of Largs, due to the University's location being adjacent to the River Kelvin. In the same year he was elected to the presidency of the Royal Society. He was Past President of the IEE three times and a member of 80 institutions and scientific societies.

I think that we can conclude that William Thomson was the <u>first</u> most prominent British electrical scientist and engineer and when he died in 1907 as Lord Kelvin it was appropriate that he was buried alongside Sir Isaac Newton in Westminster Abbey.



Kelvin in his Glasgow University lecture theatre

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