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## SIR JOSEPH SWAN, MOST BRILLIANT INVENTOR

by *Peter Lamb*

*The story of Swan's invention of the electric filament lamp has always intrigued me, since it involved a battle with Edison in deciding who did it first. Most literature on the subject usually gives the credit to Edison, but in recent times researchers have come to different conclusions!! To my surprise, there are very few books written about him; I could only find two both written by his children Kenneth and Mary.*

Joseph Wilson Swan was born in Sunderland in 1828 at a charming manor house, called Pallion Hall, owned by a rich Limestone Quarry owner. Joseph's father was the Lime Kiln Manager and surprisingly was offered accommodation in his own house. The house was then in a rural setting on the bank of the River Weare a mile up river from Sunderland's industrial heartland, where the family had lived before. The industrial scene then was based on and for shipbuilding on Weareside. At the age of fourteen in 1842 young Swan left school and was apprenticed to a Drug Store owner for three years.

He was mixing with educated customers, one of whom introduced him to electricity and batteries. They would go to meetings at the Athenaeum, to listen to Philosophical Lectures, some of which were on electricity. One of these was by W.E. Staite illustrating his electric lamps, including an arc lamp but also an early attempt at a filament lamp in a partial vacuum. In 1846 young Swan followed his elder brother Alfred into an apprenticeship in the Chemist's shop in Newcastle of his brother-in-law, John Mawson. His initial experimentations were with the new photographic industry enabling the business to be profitable (see later).

In 1850 Swan started work on a light bulb using carbonised paper filament in an evacuated glass bulb. Ten years later he obtained a patent, but since it was only a partial vacuum that he had created, it wasn't that successful with the filament burning out in a short time. His close friend and associate was Barnard Simpson Proctor, son of a nearby Chemist, William Proctor. Barnard married the niece of Michael Faraday, so not surprisingly their son was christened Harold Faraday Proctor, who became Chief Engineer of the Bristol Corporation Electricity Department at around 1892.



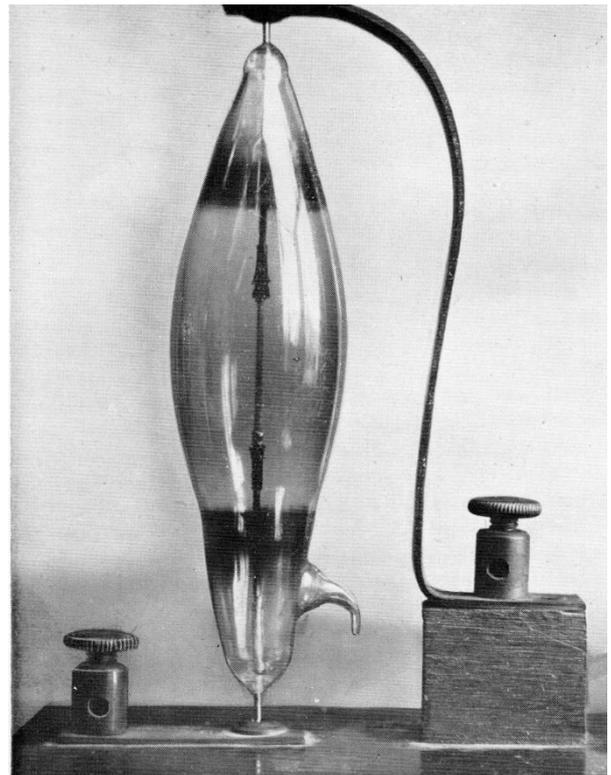
**Joseph as a young man of 21**

There were many scientists throughout Europe and America, who were researching for a practical filament lamp in the 1840's, since the arc lamp was too bright for internal use, and the problems were immense. The two main factors were the design of the filament and how to create a good vacuum to remove as much oxygen as possible. A break-through came when Hermann Sprengel invented a more successful vacuum pump in 1865, which Edison acquired. In Britain, William Crooke also developed a more efficient Sprengel pump in the early 1870's, and with McLeod's pressure gauge enabled Swan to measure the pressure accurately.

Swan spent years perfecting a suitable filament, cutting paper into strips, coating them with treacle and tar and then firing them in a pottery kiln producing carbonised pliable spirals. He also started collaborating with another inventor based in Birkenhead, Charles Henry Stearn, who became a considerable expert in the complex process of glass blowing using a local highly skilled glassblower, Fred Topham. The filaments were initially sent from Newcastle to be set in the glass bulbs at Birkenhead using the vacuum pump. However this was never a factory production line.

In 1862 Swan married Fanny White and had two children, Cameron in 1863, Mary Edmund 1864 and then two twin boys in 1867. However the mother died shortly afterwards and also did the boys. The year 1867 was a tragic year for Swan, since at the end of the year his partner was killed trying to dispose of a hoard of nitroglycerine for the Town Council. By then the firm had changed to Mawson & Swan and as a partner, he didn't hesitate in making the widow, his sister Elizabeth, a partner in the business. In 1869 Swan moved house to "Underhill, Low Fell, Gateshead with his wife's two sister keeping house for the family. He eventually married

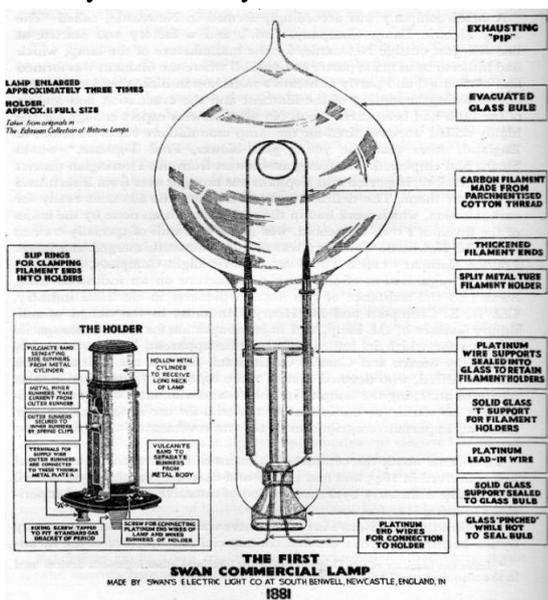
one sister, Hannah and had five more children by her. So he had another side to him than being talented inventor!



**Swan's First successful Lamp 1878**

In 1875 Swan later returned to the problem using a carbonised thread as a filament with a better vacuum as above. However his filament had a low resistance requiring heavy duty wiring to connect it up. He demonstrated this device to the Chemical Society in 1878 and in the following year 17<sup>th</sup> January 1879 to 700 people in a lecture theatre of the Literary and Philosophical Society of Newcastle with Sir William Armstrong (Later Lord Armstrong) in the chair. However he then turned his attention to producing a better filament and devised a method of treating cotton to produce carbonised thread, which he patented on 27<sup>th</sup> November 1880, both in Britain and the US. In 1881 he set up the Swan Electric Light Company and started commercial production, setting up a factory at Benwell, just outside Newcastle, bringing the glassblower from Liverpool to oversee the glassblowing technique. His house Underhill, Low Fell, Gateshead was the first house in the

world to be lighted with the electric light. Other places followed Sir William Armstrong's house at Cragside (now National Trust) was lighted first in 1880. In London the Savoy Theatre was being replaced by Richard D'Oyly Carte and Swan produced 1200 lamps for the theatre powered by an 88.3kW generator on 29<sup>th</sup> December 1881, the first public building to be so lighted. Other places in London followed in 1882 such as the Mansion House, the British Museum and the Royal Academy.



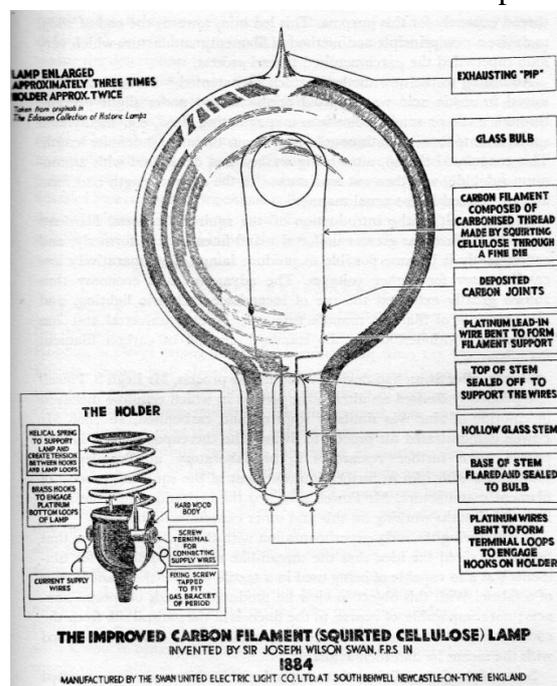
### Swan's First Commercial Lamp

On the other side of the Atlantic, Edison also obtained a similar patent in the US in 1880, but the patent was invalidated in 1883. Edison took Swan to court for patent infringement and lost. As a settlement Swan was made a partner in the Edison company renaming it, the Edison and Swan United Electric Light Company. Both Swan and Edison exhibited their filament lamps at the Paris exhibition in 1881 and it was Swan who was invested with the "Chevalier de la Legion d'Honneur".

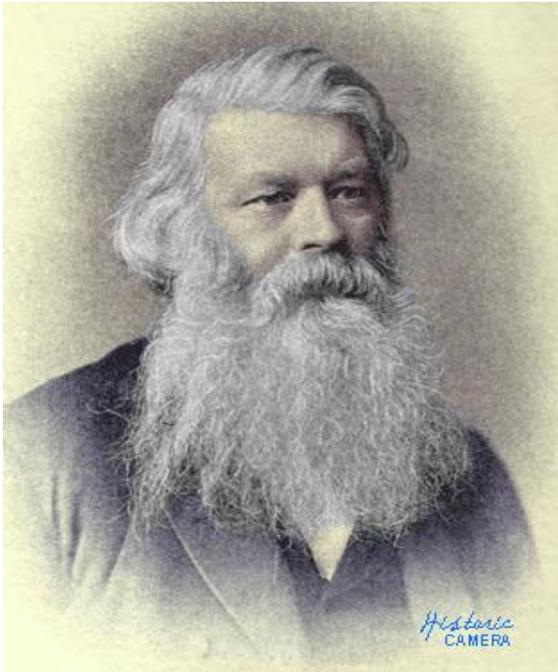
In 1882 Swan did an extraordinary thing by selling his patent rights to the Brush Electrical Company of USA. I haven't been able to find the reason for doing this: maybe he was wishing to spite Edison in some way?

By 1883 his business interests were demanding his presence in the capital, so the family moved to Bromley in Kent, 12 miles from London. He then started to experiment to develop an improved filament and was helped by a new permanent assistant John Rhodin, a clever Swedish chemist, who had recently graduated. Swan came up with a product, which became known as "Squirted Cellulose" in 1886, using nitrocellulose dissolved in acetic acid squirted through a small hole with methylated spirit becoming a homogeneous artificial thread, which was then carbonised. He patented this method which became a major product in the textile industry as the product was seen as artificial silk. He invented a new Miner's Lamp and later refined the electrolytic processes.

The new company eventually set up a new factory in 1886 at Ponders End in North London in the Lea Valley, manufacturing Royal Ediswan bulbs, having got a Royal Warrant. In Britain, Swan produced lamps made with his cellulose filament whereas in America, Edison continued with his bamboo filament until both patents were merged in 1892 and a cellulose filament was adopted.



### Swan's Squirted Filament



**Swan at about 50 years of age**

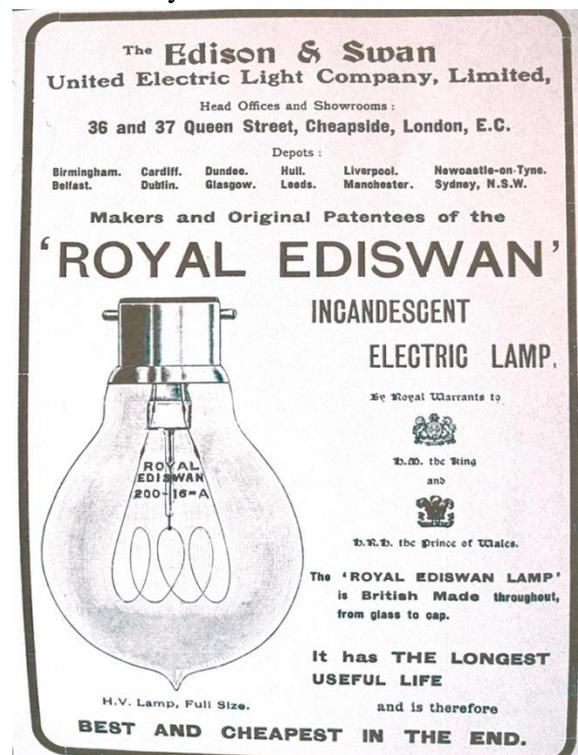
Although concentrating on Swan's development of the filament lamp, everyone should be aware that he did invent and develop other processes being a trained chemist. When Swan joined his brother-law John Mawson's chemist business, he got involved in the early photographic processes. He developed a chemical called Collodion which was used in the then wet-process of photographic development. This success turned the business around and Swan then went onto develop a dry carbon printing process, allowing permanent prints to be made using Bromide paper patenting this in 1879. Swan became a partner in the business, now Mawson & Swan and over 70 patents associated with photography were taken out in his name. He also wrote many papers on other research projects he undertook.

Swan was great traveller in Europe going to Paris many times and in 1885 went to Germany to visit his old associate Charles Stearn who was setting up lamp bulb manufacturing outfit at Kalk near Cologne.

In 1894 Swan was elected a Fellow of the Royal Society. He was finding the need to be

in central London more frequently and moved the family to Holland Park, where he set up a research laboratory in the basement taking on a new assistant, AC Hyde. Increasingly he found himself involved with the many institutions that demanded his attention. He was made President of the Institute of Electrical Engineers in 1898 and was on the Council of the Royal Society and the Board of the National Physical Laboratories and lastly the Council of the Chemical Industry.

In 1904 he was knighted, and four years later at the age of 80, he moved out of London to a pretty village of Warlingham in Surrey and died there 10 years later.



**Advert for the United Electric Light Co.**

History hasn't been kind to Swan, generally giving all the credit to Edison, largely due to Edison being a great publicist. But today however it is generally recognised that Joseph Swan was the original inventor of the modern incandescent light bulb. Although he only beat Edison by one year, Edison's filaments were inferior using bamboo, whereas Swan's squirted cellulose filament was universally adopted at the time.