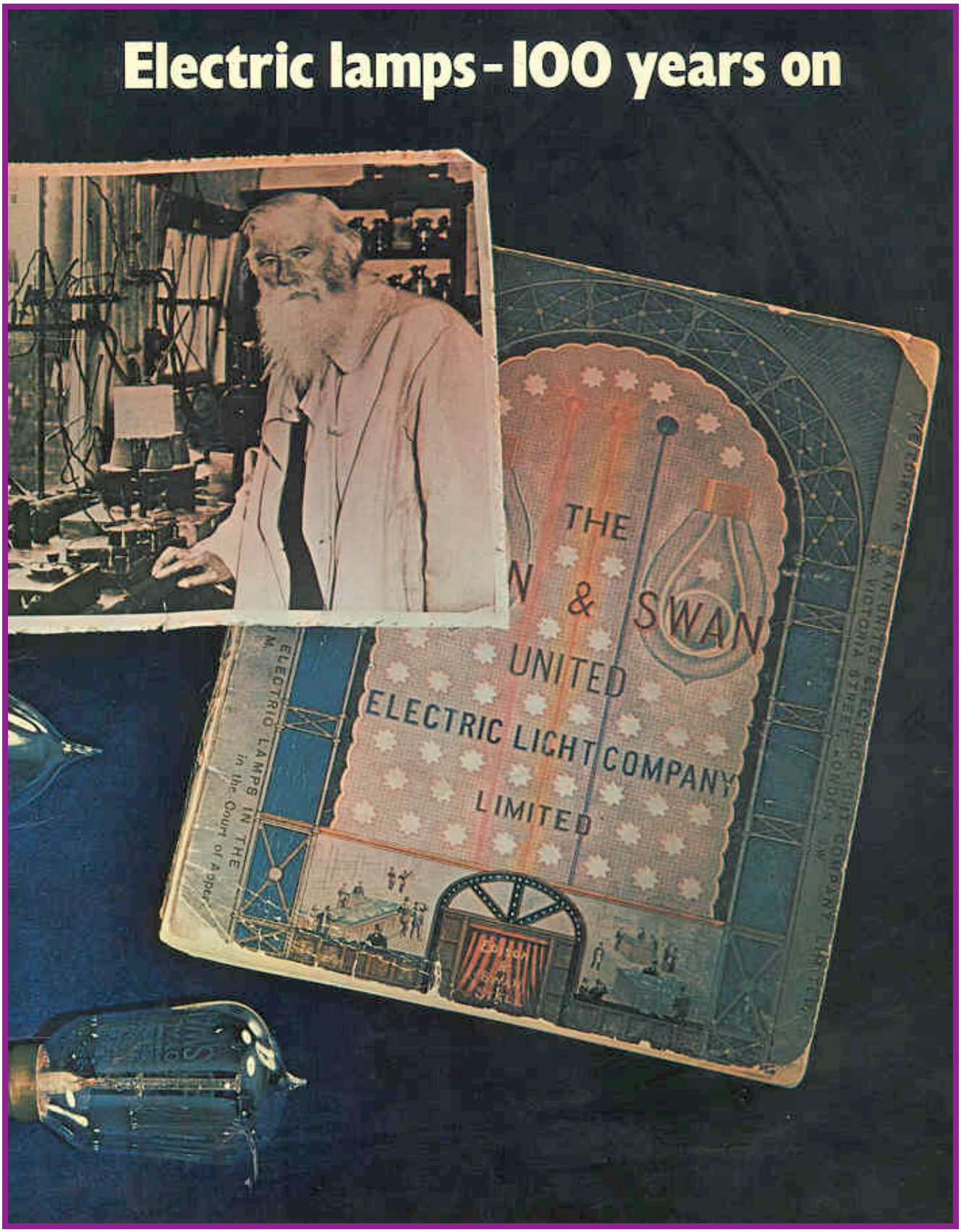
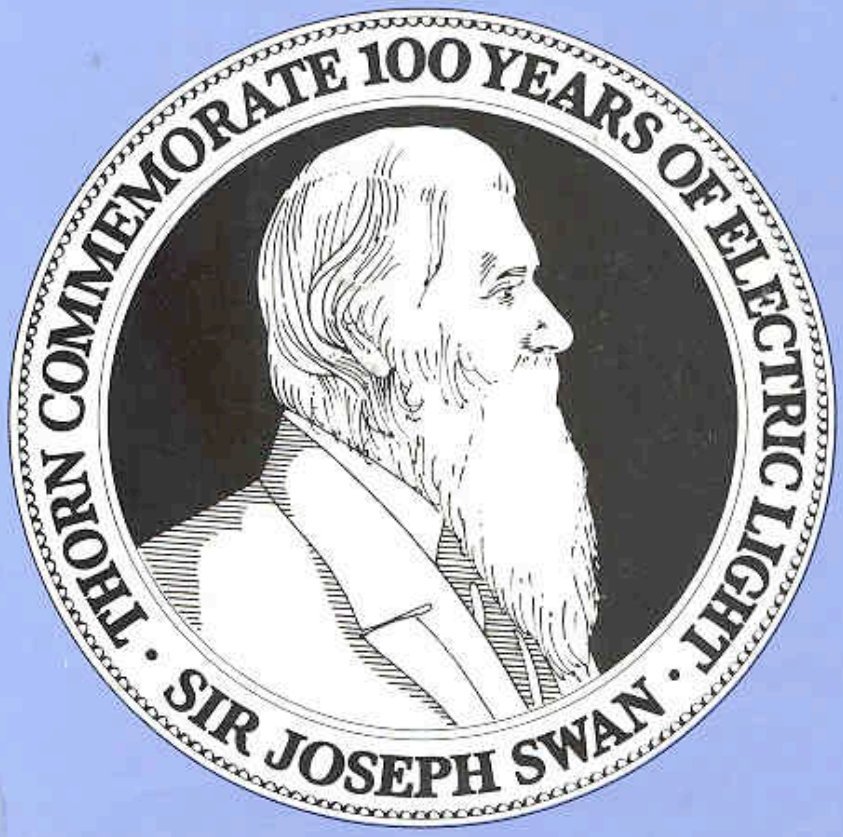


(Electric Lamps-100 Years On, Cyril Phillips, Thorn Lighting, 1979)

Electric lamps - 100 years on

by Cyril Phillips



Preface

In 1879 the British inventor, chemist and businessman, Joseph Wilson Swan, demonstrated the first successful electric filament lamp.

This was the most significant step in lighting since man had learnt to thread fibrous 'wicks' through dead fishes and birds to make primitive oil lamps, as it was to bring cheap and convenient light to millions and roll back the night for ever.

But the harnessing of the mysterious new force of electricity to produce flameless light for the many, depended not only on the pioneers who first produced electric lamps, but also on the entrepreneurs and mass producers who were to take this light source, develop it, and make it available to everyone at a cost of only a few shillings per bulb.

This booklet is published in 1979 to celebrate the centenary of Swan's achievement and to celebrate fifty years in which Thorn Lighting has developed as the leading force in the huge modern lighting industry we have today.

Newcastle~birthplace of the light bulb

The packed hall is hushed. All eyes focus on one man, Joseph Swan.

He makes a connection and a small glass bulb begins to glow with surprising brilliance, and stays glowing. Swan speaks, telling the audience of his flameless light; his 'electric incandescent vacuum lamp'. Few members of the audience could have been in any doubt that they were watching history being made.

This demonstration, on February 3rd 1879, before 700 members and guests of the Newcastle Literary and Philosophical Society, is now a legend in the north-east of England. Oddly, not many people realise that Newcastle is the birthplace of the light bulb. But the history of lighting is full of surprises.

There is no doubt that it was Swan who first demonstrated a practical filament lamp, an invention every bit as revolutionary as the wheel or the steam engine. But Swan was also the first to recognise that he was only the catalyst – the one who had succeeded in focusing several strands of developing technology towards the final brilliant achievement. Swan reached the summit; others before him had set up the base camp and marked the route.

But let's start the story a little further back – in the so-called 'age of elegance'.

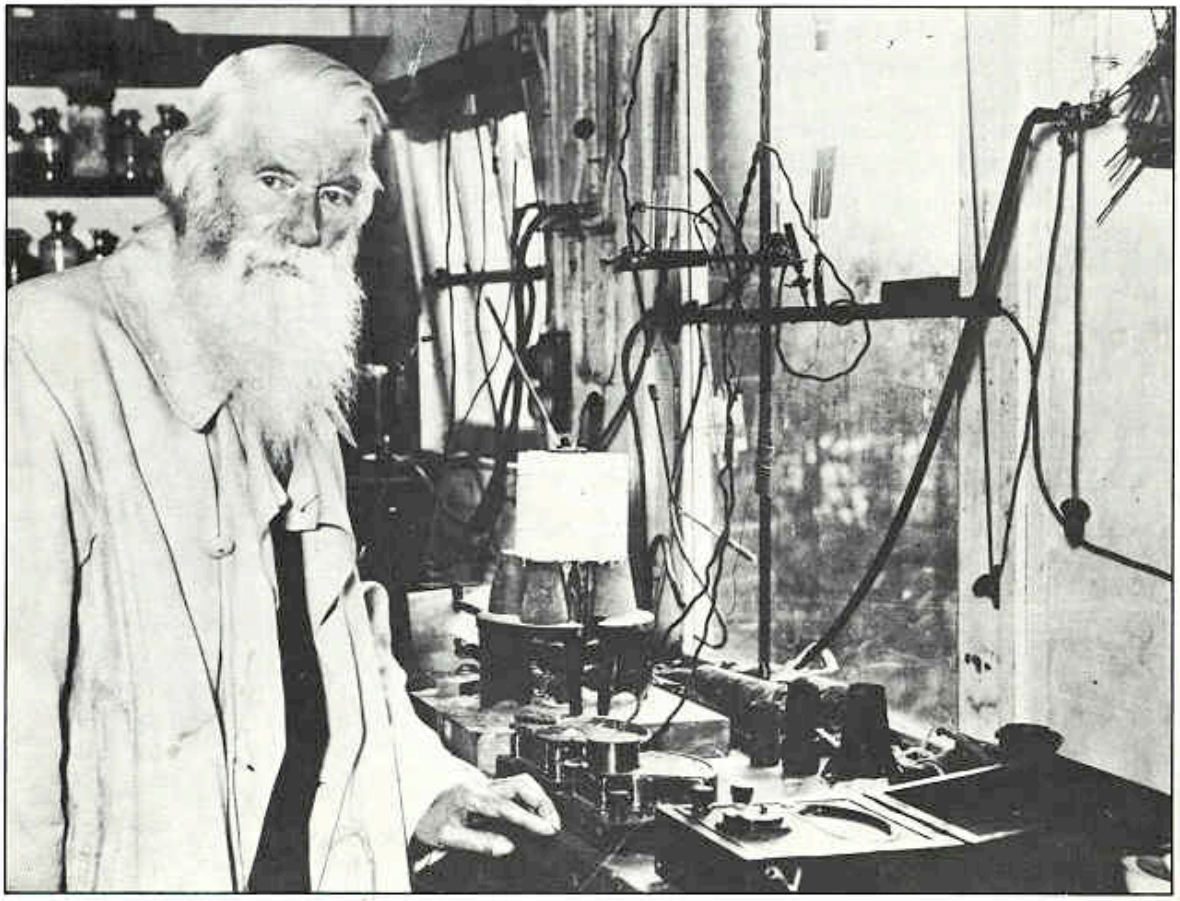
Before electricity

For several thousand years man used oil lamps – or wax candles – as his main artificial light source. Nobody could call them technically interesting; though doubtless in their day they were indispensible and even now some of the most brilliant people in lighting research would probably admit that for romance and atmosphere the candle is still a very attractive light source.

The use of coal gas was a major development, though it had its drawbacks because it was both poisonous and explosive, but nevertheless the 18th and 19th centuries did bring effective gas lighting to many towns and this was a major advance on what had gone before. Very superior types of oil lamp were developed. But all these light sources had one thing in common. They worked by burning fuel to produce light from a flame.

In the 19th century 'chemical light' was discovered. Instead of simply burning fuel, experimenters found that better light could be made by using the fuel indirectly to heat a chemical which then glowed brightly.

One of the first examples of this method of producing light worked by heating quicklime to incandescence. It was used in early



theatre floodlighting (hence the expression 'in the limelight'). Later it was found that certain materials glowed even more brightly than quicklime when heated, but only when in 1885 Count Aver von Welsbach invented the incandescent gas mantle, using thorium, was the idea widely applied. However, light was still being produced indirectly, by the use of a flame, with all the mess and inconvenience that went with it.

But by now man had discovered – and started to learn to harness – the most fundamental energy source of all. Clean, without smell, invisible, almost intangible but incredibly powerful – **Electricity.**

The invisible force

It was Dr. William Gilbert, physician to Elizabeth I, who first coined the word 'electricity', from the Greek word 'elektron', meaning amber. Gilbert was interested in phenomena associated with magnetism and what we now call 'static' electricity and he used amber in his experiments at court.

Far Left *Sir Joseph Swan at work in his laboratory.*
Above *Count Aver von Welsbach brought about an improvement in the light produced by the burning of a fuel when he invented the incandescent gas mantle, in 1885.*
Above Left *For thousands of years before the 19th century, man had relied on burning natural fats and oils in candles; and oil lamps such as this.*
Below *Dr. William Gilbert demonstrating static electricity to Queen Elizabeth I. It was Gilbert who first coined the word 'electricity', from the Greek word 'elektron' meaning amber. Amber was one of the materials he used to demonstrate static.*

Regrettably he died without ever understanding the full significance of his parlour tricks; and nobody knew what electricity was – only what it did.

To a large extent this is still true today. Our knowledge of electricity (despite Einstein's revelations about the relationship between energy and matter) is still largely empirical. But world-wide curiosity about electricity was unquenchable and it is worth noting the next famous name in our story – Benjamin Franklin.

Franklin was convinced that lightning was caused by this new-fangled thing called electricity. To prove it he flew a kite, on a silk line with a metal key at the end, during a thunderstorm. When he placed his finger near the key a spark jumped from the key to his finger.

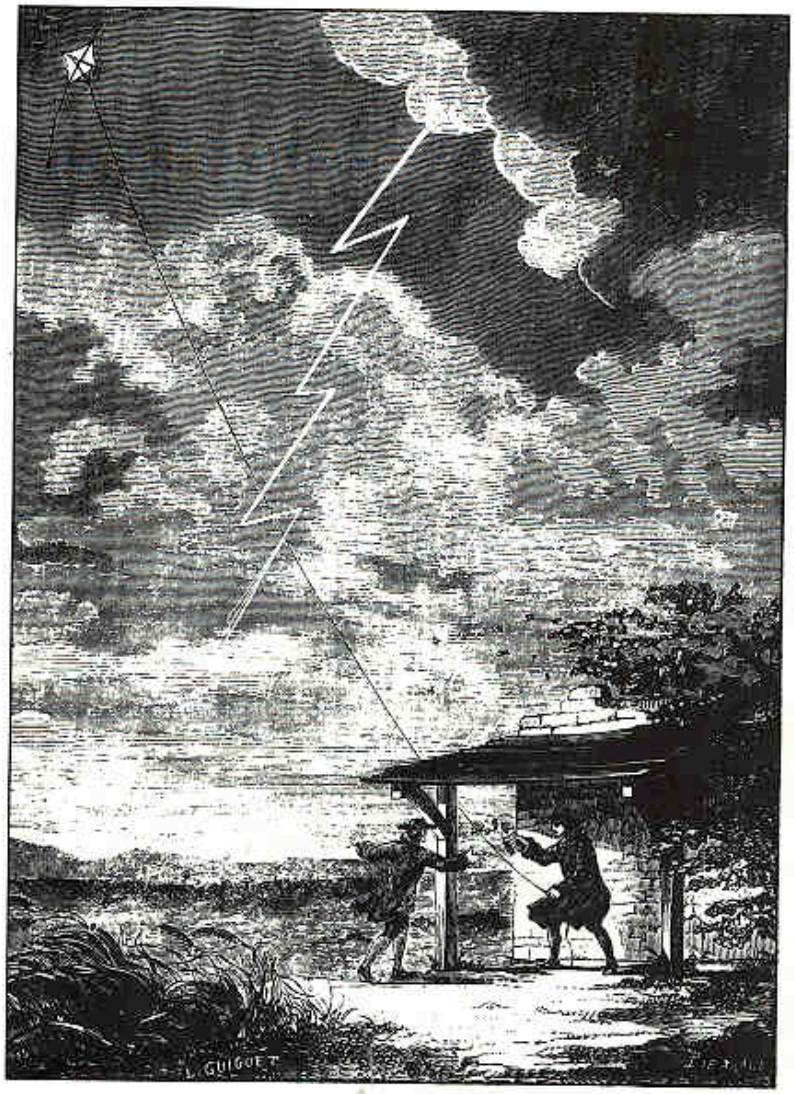
Franklin did not realise how dangerous this experiment was – but fortunately he was not electrocuted and lived on to help set up the American constitution! Incidentally, it was Franklin who invented bifocal spectacles. A man who could turn his hand to anything, it seems.

Of frogs and batteries...

Two gentlemen who are perhaps better known because their names have passed into electrical terminology are Volta and Galvani.

Around 1800 Alessandro Volta's experiments led him to demonstrate the first primitive battery, made from alternate plates of zinc and silver. Volta's batteries were, of course, nothing like present day batteries, but the principle had been established, and Volta's name lives on as one of the most frequently used electrical terms – the volt.

A contemporary of Volta's was Luigi Galvani, and who has not heard of the galvanometer? – or used the expression 'he was galvanised into activity'? But some historic figures, like King Alfred and his burnt cakes, are mainly remembered for ridiculous things. So it is with Galvani, who is remembered for his frog's legs. He

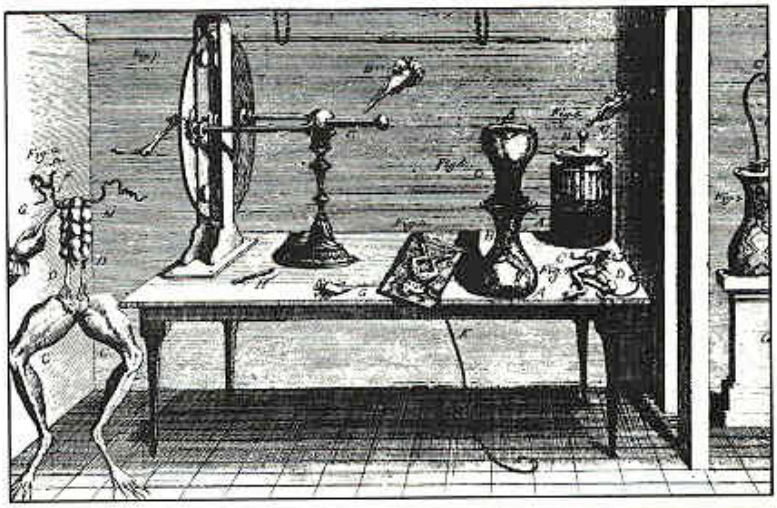


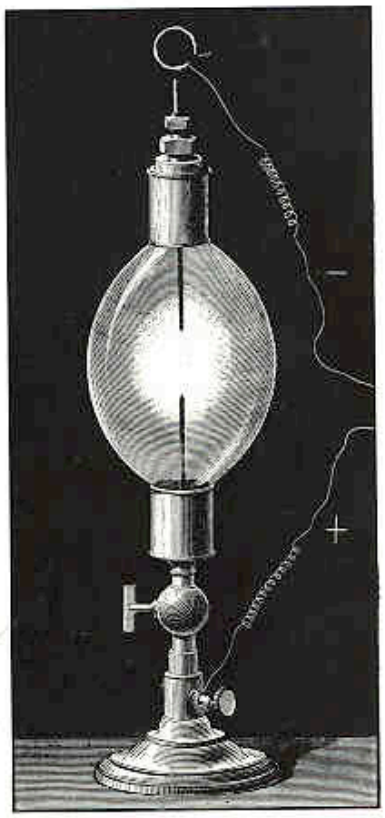
Left *Benjamin Franklin, better known as an 18th Century American politician, risked electrocution when he used a kite during a storm to show that lightning was caused by electricity.*
Below *The first primitive battery (or 'voltaic pile') was demonstrated around 1800 by Alessandro Volta. The volt was named after him.*
Bottom *Impressed with Volta's battery, Napoleon thought that electricity might contain the key to life itself.*

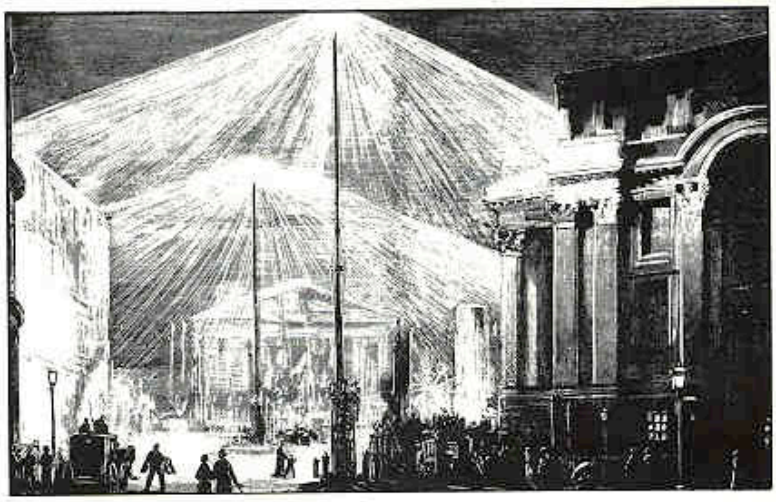
liked eating them and one day hung some out to dry on a metal balcony railing. A storm brewed and he noticed the legs twitching. He concluded that muscles were activated by electrical impulses and called this effect 'galvanism' or 'animal magnetism'. (Pedants please note that the term never did and has not now anything to do with sex attraction.) Galvani is assured of his place in history; perhaps in passing we should spare a thought for the frogs, animals which always seem to play an unwitting part in the march of science as well as gastronomy.

It was the widely respected scientist Humphrey Davy who was the first to show that electricity could be used to produce artificial light. Well known later for his miner's safety lamp, Davy demonstrated an electric light as early as 1810. This was an arc lamp; light being produced by an electric arc (or continuous 'spark') passing between two rods of carbon – almost touching – when a high voltage was applied.

Arc lamps came near to joining the mainstream of lighting 150 years ago. But there were problems; the carbon burned away rapidly and needed frequent adjustment, the process was smoky and messy, and there was no electricity supply industry to maintain a constant mains voltage. So these lamps did not develop quickly; though arc lamps can produce very bright light indeed (remember the wartime searchlights?) and were actually used for public lighting in the Place de la Concorde, Paris, in 1830 and somewhat later outside London's Royal Exchange.







Right *Gastronome Luigi Galvani noticed that frogs legs, being prepared for eating, twitched when a thunderstorm was brewing. He realised that muscles were activated by minute electrical impulses. He called the effect 'animal magnetism'.*
Middle Right *Machines and experiments by Galvani investigating 'galvanism'.*
Below *Humphrey Davy was the first man to produce artificial light from electricity, demonstrating this carbon arc lamp as early as 1810.*
Bottom Right *Carbon arc lighting outside the Royal Exchange in 1881.*

Almost from the days of the early experimenters it was comparatively easy to show that electricity could produce light. Franklin's demonstration had established that beyond doubt, for what is brighter than a flash of lightning? But an electric light is useless for most practical purposes unless it burns continuously. Hitherto the experimenters had only been able to demonstrate the 'flash-bang' principle, but proper artificial illumination using electricity needed some form of *continuous* electric current.

Batteries were hardly adequate for continuous domestic or commercial illumination; they had their uses in scientific demonstrations but were absolutely impractical for the development of electricity as a major source of artificial illumination, and the man who made the biggest contribution to the whole science of electrical engineering; who virtually showed how the continuous generation and distribution of controlled current was possible, was Michael Faraday.

Faraday brought law and order to the mass of existing data and research on electricity. In 1831 he established the basic principles of electric dynamos and the first beginnings of the generating industry. We all owe a terrific debt to Faraday.

Naturally, in the latter half of the 19th century many experimenters became aware that electricity, when passed through a filament of some kind, could make it glow.

The problem, of course, was that when burned in air the filament combined with oxygen and after a short but brilliant life ceased to exist. In other words, where oxygen is present the filament burns away in just the same manner that coal does on a fire. Clearly, if a filament could be heated in an atmosphere free of oxygen, or even in a vacuum, a practical incandescent light would be possible.

It also has to be borne in mind that apart from problems of electrical engineering, the creation of a good vacuum in the 1860's and 70's was a major scientific problem in itself. However, it is at this point that we must turn to the hero of our story, Joseph Wilson Swan.

Genius of the lamp

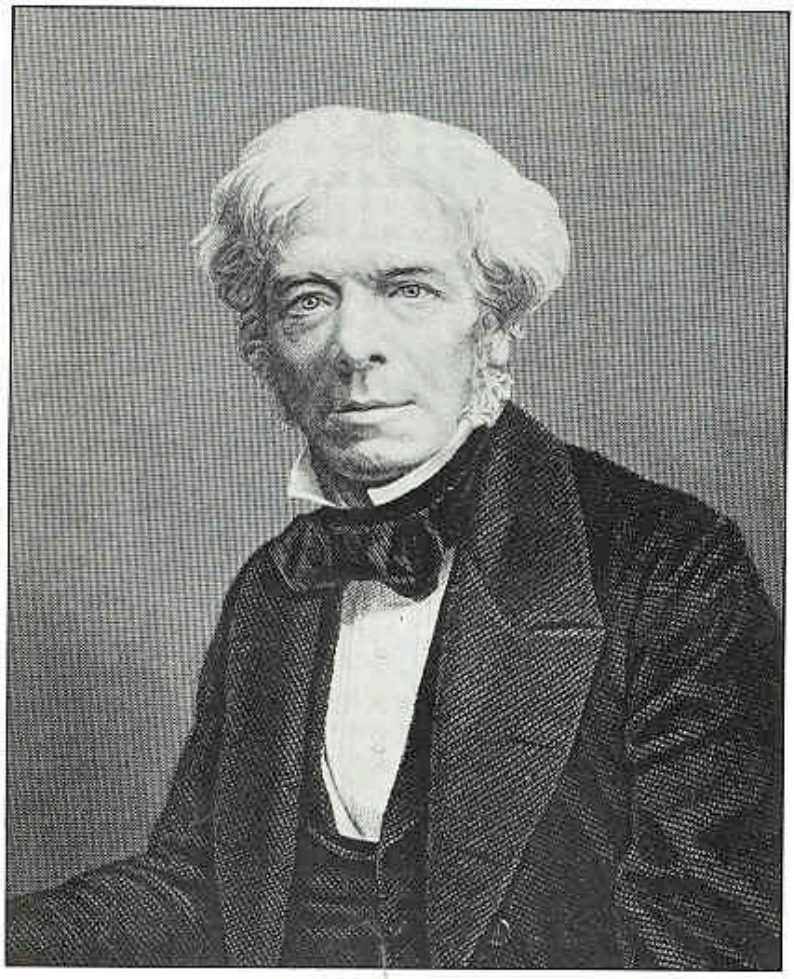
Joseph Wilson Swan was born in Sunderland in 1828 of Scottish descent. He had a fertile mind and though he left school at 13, launched himself into a scientific career by becoming apprenticed to a Sunderland firm of druggists.

In 1846 he joined his friend and future brother-in-law, John Mawson, as a chemist and druggist in Newcastle, later becoming a partner in the firm.

Swan first tried the idea of passing current through a thin filament to make it glow white hot, in the late 1840's but since at that time an efficient vacuum pump was not available, he had to put the idea on one side.

At the time most public interest was centred on carbon arc lighting. But it was clear that if a carbon *filament* lamp could be made it would be cleaner and more convenient. However, Swan's interest in carbon did not end with electric lighting.

Passionately interested in photography, he became widely known as an expert on this subject and succeeded in simplifying the development and washing of photographic plates (then a rather complicated process) by applying



Left *Michael Faraday brought law and order to the confusing mass of existing data and research on electricity in the early nineteenth century. He laid down the theoretical groundwork which made possible the large-scale generation of electricity. This, in turn, was to spread the benefits of lighting to nearly everyone.*

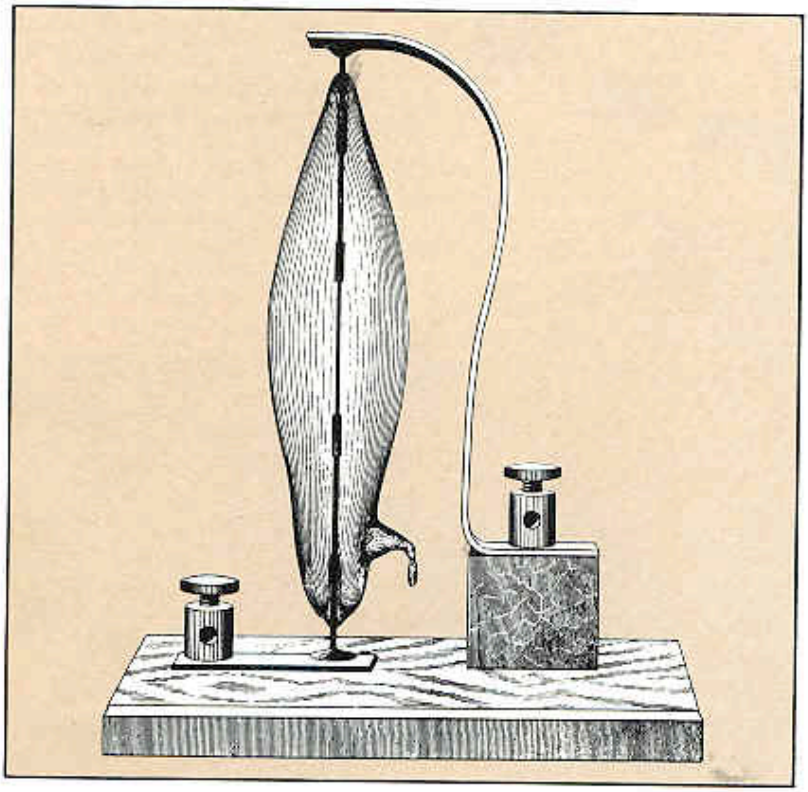
Opposite *Lighting pioneer Joseph Wilson Swan.*

Very truly yours
Joseph W. Swan

a carbon tissue coating to the emulsion, ensuring easier development and greater permanence. The process was commercially successful and many excellent prints survive to this day.

But to return to lighting, the main problem was to achieve a good vacuum, to avoid the filament burning away, and until Sprengel introduced an efficient vacuum pump in the early '70's this seemed impossible.

In 1875 Swan learnt that a Birkenhead bank clerk, Charles Stearn, had been carrying out experiments with high vacuum for Sir William Crooks (to whom we are indebted for the first cathode ray tube, which later developed into the television screens we use today) using the Sprengel pump. He wrote to him, then began to supply filaments to him for mounting in glass bulbs which were then evacuated of air.



By December 1878, Swan, Stearn and a young glass blower, Fred Topham, had produced a number of working light bulbs, one of which Swan showed but did not light at a meeting of the Chemical Society at Newcastle.

In January 1879 he exhibited his incandescent carbon filament lamp at Sunderland and operated it during the lecture. Then, in February, came the famous public lecture to over 700 people in Newcastle, repeated to an audience of 500 at Gateshead in March.

After several thousand years of oil, smoke, gas, candles and– when all else failed – the moon, Joseph Swan had succeeded in turning night into day at the 'click of a switch'.

The secret of Swan's success was to heat the filament to incandescence as the air was pumped from the bulb. This got rid of stray pockets of air in the filament, which had caused rapid blackening in previous experimental lamps.

Swan worked with Stearn to improve the filament and in 1880 introduced a filament of carbon on parchmentised thread which was to become an industry standard for years. Swan, though urged by Stearn to patent the lamp, thought that the broad features were not patentable, and this was why Thomas Edison, who hit on the same technique as Swan in October 1879, was granted the first British patent on a carbon filament vacuum lamp.

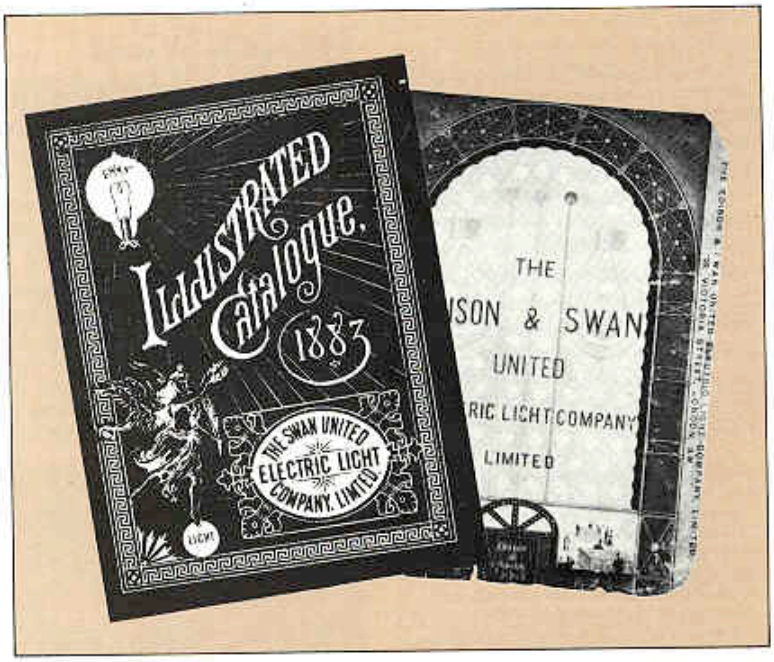
Nevertheless, the future of Swan's lamp was assured. By 1881, the newly formed Swan Electric Lamp Company was producing lamps in commercial quantities at a new factory in Benwell, Newcastle.

Many firsts then followed; the first shop lighting – Swan's

Top Left *This original Swan lamp is the type which so impressed the Newcastle Literary and Philosophical Society. The lamp has a carbon filament and an individually blown glass bulb.*
Bottom Left *Staff at the Benwell factory, near Newcastle, where the world's first commercial production of filament lamps took place. Swan opened the factory in 1881 after forming the Swan Electric Lamp Company.*

chemist's shop at Newcastle – the first ship, the 'City of Richmond'; the first private residence to be electrically lit, the home of Sir William Armstrong at Cragside, Northumberland; followed by the lighting of the House of Commons, a special train and the d'Oyley Carte-managed Savoy Theatre in London.

In 1883, Swan joined forces with Edison to form the Edison and Swan United Electric Light Company. Their joint names lived on as Thorn Lighting's Ediswan brand until quite recently. Now the brand is not used in Britain but it is remembered.



Right *Early Swan and Edison/Swan catalogues. The 'Ediswan' brand name resulted from the decision of the two inventors to co-operate.*
Below *A Newcastle street lit by Swan lamps.*

Postscript

Nowadays light bulbs are so commonplace that hardly anyone gives them a second thought – until they fail. But they *are* precision instruments – and should be treated accordingly.

For instance, although the filaments are as robust as the lightmakers can make them, the lamps should not be subjected to undue shock, stress or vibration.

It is not generally realised, either, that all lamps are designed to be burned in a given position; cap up, cap down (as with decorative candle lamps) and in some cases, horizontal e.g. incandescent striplights – *not* to be confused with fluorescent lamps. Use the lamp incorrectly and the probable result will be early failure.

The commonest mistake is to burn a light bulb in too small a fitting or shade. Remembering the temperatures quoted earlier, this can easily result in overheating and early failure. Again the mains voltage should be constant and match the rating of the lamp. Too high a voltage can wreak havoc with a filament though you will get a very bright light from it.

By far the commonest myth about light bulbs – one that would have amused Joseph Swan – is that somehow manufacturers could, if they wished, make bulbs last almost for ever.

If only this were true! But the standards of quality now demanded of light bulbs have reached their zenith. Life can only be extended by greatly lowering the efficiency of the lamp; and the ratio between life and brightness is the one big enigma facing all lamp engineers. With something like a flashbulb, lasting only a few milliseconds, the answer is obvious; brilliance is everything.

At one time Swan would have given a fortune if he could have been shown how to make an electric lamp give well over 1000 lumens of light and last 2000 hours.

It is well to remember, one hundred years after his first faltering triumph, how the monumental service he performed for mankind is now so widely taken for granted, that piles of light bulbs appear in grocery shops along with the bread and butter, sell for half the price of a packet of cigarettes, and certainly cost the average household less than it does to feed the cat for a week.

We, in Thorn, pay tribute to this outstanding man and extend our good wishes to his home town, Newcastle.

If ever a man deserved to have his name up in lights, it is **Sir Joseph Swan.**