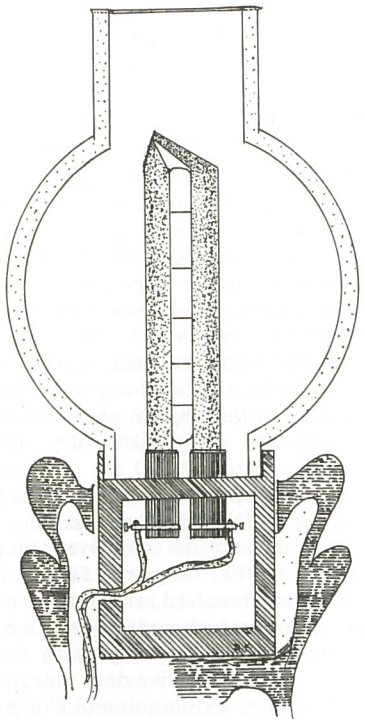

Fig. 2 Jablochkoff's candle (permission Siemens AG)

the arc. As the rods were consumed, the insulating material would vapourise and reveal a fresh supply of carbon. The whole assembly was contained inside a glass globe. There were two main drawbacks to the idea. The first was that it required an alternating current to allow the rods to be consumed equally, and the second was that if they went out, even momentarily, they could not be restruck. As the common practice at the time was for arcs to be wired in series, this meant that it was very much a case of 'One out—all out!' The management also fitted gas to cover contingencies such as these.

A problem incapable of solution

The light of the carbon arc, however white and bright it might be, was more or less useless for domestic use, and its flickering harshness and lack of controllability, did not endear itself to the people of the theatre, (although it was later to be developed into the very fine Stellmar, Sunspot, and Super Trouper follow spots), for general stage lighting purposes. Besides gas lighting was considered a perfectly adequate, albeit dangerous medium, and the still relatively new limelight was thought to be the best and most useful means of placing a spot of light in a particular place on the stage. Davey's experiments with incandescent platinum had impressed a number of people who carried on experimenting in this direction. In 1820 De La Rue had enclosed platinum strips in a piece of evacuated glass tubing, and in 1840, Sir William Grove lit a whole auditorium with feeble incandescent lamps. These consisted of platinum coils covered with inverted tumblers in glass dishes partially filled with water. The first patent for incandescent lamps was in 1841. These were glass globes filled with powdered charcoal. Envelope blackening at an alarming rate rendered them impractical, but experiments continued, and the principle was well and truly established that filament lamps would work if only the problems could be solved. There were some who believed that they could not: As late as 1878 a group of eminent scientists appointed by the British Parliament issued a statement in which they boldly asserted that:

> "The sub-division of the electric light [into a number of smaller units suitable for illuminating homes and workplaces] is a problem that is not capable of a solution by the human brain".

This view was endorsed by their American colleagues.

On each side of the Atlantic a number of men had taken this attitude as a personal challenge. Among them, Thomas Alva Edison in New Jersey and Joseph Wilson Swan in Newcastle on Tyne quite independently set about passing currents through filaments made from a variety of materials. They quickly found that the feeble and ephemeral light produced from the filaments could be brightened and prolonged by enclosing them in a glass bubble from which all the air had been removed. Even so, as the voltage applied to them was increased to more than a nominal amount, the filaments failed. This caused the experimenters to turn quickly away from expensive and precious metals like platinum and iridium, and concentrate their experiments on carbon. This substance of course comes in a tremendous variety of forms, ranging from diamond to soot. The problem was to find a form which could be fashioned into a filament that had sufficient mechanical strength, as well as exhibiting the appropriate electrical characteristics. A variety of substances were carbonised in special kilns including cotton thread, baling-twine, angling line, coconut fibre, violin strings and crocodile leather, as well as the other 7560 other substances listed in Edisons's papers. *'Somewhere in Gods's workshop'* Edison was (apocryphally) heard to cry, *'there is a dense woody growth with fibres almost geometrically parallel . . . from which we can make the filament the world needs'* His prayers were answered when he tried a piece of Bamboo, plucked it is said, from a ladies fan.

In England, J. W. Swan was having some success with cotton thread prepared from coal tar and shaped like a hair pin. The brightness that he was able to obtain was comparable to that produced by a standard gas burner, but unfortunately the life of the lamp could be measured only in minutes. Rightly suspecting that the vacuum in the bulb was not all it should be, he obtained a powerful Sprengel Pump. The use of this improved lamp life to an hour or more. He then hit upon the idea of evacuating the bulb while the filament was hot. This prevented gasses trapped on the surface of the filament boiling off when operated and spoiling the vacuum. This succeeded, and Swan began logging times of forty, one hundred, and eventually six hundred hours.

Edison is said to have read of this in a research paper in August 1879 and immediately improved his own lamps to the point where they became commercially feasible. He also designed, of necessity, all the accessories, the bulb holders, switches, plugs and sockets, consumption meters and generating plant.

Sabotage by the Gas Co.

Edison's genius (99% perspiration, 1% inspiration) extended to public relations and marketing, and his public demonstrations were noted for both originality and splendour. It is said that at one such demonstration, a short-circuit deliberately introduced by one who could only have been an employee of the Gas Company, succeeded only in blowing one of Edison's new and patented fuses, losing only one or two lamps. The whole thing rebounded to Edison's credit. The culprit was ejected, the Gas Company's shares plummeted and the Shares of the Edison Electric Light Company rose from 106 to 3000.

By 1880 Swan had lit his workshop and indeed the whole of the street with electricity, and this attracted a great deal of attention from people in all walks of life, including the theatre. Thus both men succeeded in their principal aim: to produce an elecric lamp that was within the reach of all. Not a lamp for the millionaire, but for the ordinary man. Initially, the two companies were so successful that the price of a light bulb dropped from one pound to less than five shillings. Later there were to be many bitter arguments, patent suits and recriminations as to who was the true inventor. The truth of the matter was that both men simultaneously responded to the needs of the time, taking what was obviously the next logical step. As it happened they were soon to realise that co-operation was better than competition, and eventually amalgamate into the Edison and Swan United Electric Company.

It was to the Swan Company that Richard D'Oyly Carte turned when the concept of electrifying the Savoy was mooted. Having seen 'electric light in lamps' exhibited outside the Paris Opera House some years previously, (carbon arcs in floodlamps) he had been convinced that

> 'electric light in some form is the light of the future in theatres . . . the peculiar steely-blue colour and flicker which are inevitable in all systems of arc light make them unsuitable for use in any but very large buildings'.

He was not, it seems, a particular admirer of gas as a medium, and had strong views on the mutual incompatibility of clear singing voices and fumes from gas burners.

> "The greatest drawback to the enjoyment of theatrical performances are undoubtedly the foul air and heat. As everyone knows, each gas burner consumes as much oxygen as many people. Incandescent lamps consume no oxygen and cause no perceptible heat".

He did, however appreciate the safety factors which were inherent in the use of properly rated and appropriately insulated cables and lighting fittings coupled with safe installation. In the same year that the Savoy was fitted out there was a catastrophic fire at the Viennese Ringtheater, with the loss of 450 lives. The fire broke out as the gas burners in the