

# DRAMA

## BY DAYLIGHT

Brian Roberts introduces the first in a series of three articles which present a pictorial history of lighting for the theatre and stage through the centuries.  
Act I: The First 2000 Years

The house lights dim, the curtain rises to show an illuminated stage, another play begins. This is the modern theatre. But its origins probably go back to the religious rites of the earliest communities and some say derive from the funeral ceremonies of the early Egyptians (c3000 BC). However, it is generally accepted that the first great theatrical age was that of Greece in the 5th century BC.

### Dionysus and Daylighting, 4th century BC (Figure 1)

It was in Greece that plays and festivals in honour of Dionysus (the wine god), were first performed in special buildings or areas set aside for the purpose. The most famous and best preserved of these is the Greek theatre at Epidaurus which was in the open air and relied on daylighting. Starting time was at daybreak and citizens would often sit through as many as five plays.

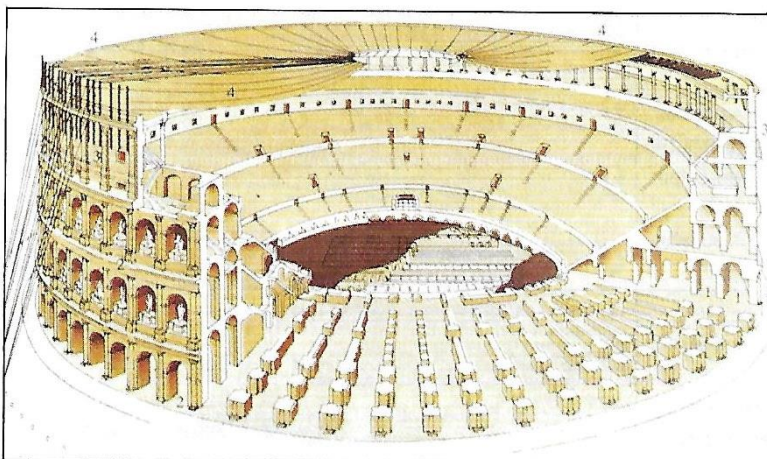


Figure 2: The Colosseum in Rome. Daylighting and glare is controlled by the adjustable roof shades (velarium, 4) (1st century AD)

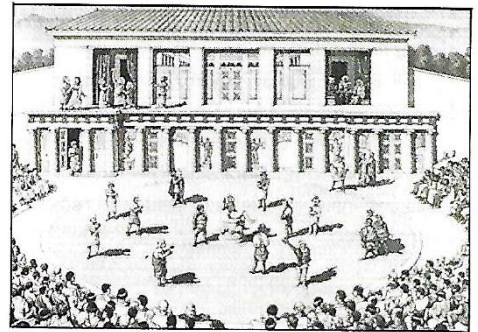


Figure 1: Open-air Greek theatre at Epidaurus (4th century BC)

### Colosseum and Velarium, 1st century AD (Figure 2)

The Romans were responsible for the widespread introduction of the amphitheatre as at Pompeii, Nimes, Arles and in Rome where the Colosseum could easily hold 48000 people. Their size and height posed tremendous architectural problems and the Romans devised ingenious solutions to handle large audiences and provide for their comfort.

At the Colosseum, to control daylighting and provide shade, canvas awnings – the “velarium” – were hitched to masts in the manner of ships’ sails and could be stretched across the top of the arena by a squad of sailors.

The Romans were masters of hydraulics and water engineering and could flood the arena for mock sea battles and aquatic events.

### Awnings at Aspendos, 2nd century AD (Figure 3)

Theatre design was revolutionised by the Romans. They transformed the prepared landscapes of the Greeks, designed to seat large audiences and ensure good acoustics, into works of architecture. Seating areas were provided on vaulted ramps, with passages and stairs behind to provide access. Vitruvius gave detailed descriptions of “several acoustic calculations and contrivances” and “prescriptions as to the size and proportions of the stage and the plan for spectators”.

The stage was roofed over while here also the spectators were protected from the glare and heat of the sun by canvas awnings. On hot days, slaves would sprinkle the audience with showers of perfumed water.

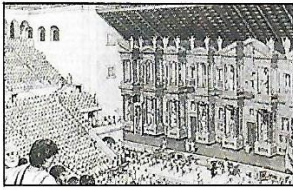


Figure 3: Reconstruction of Roman Theatre at Aspendos (2nd century AD)



Exultet Roll and Candle, 11th century AD (Figure 4)

In the Dark Ages, following the decline and fall of the Roman Empire, it was the Christian Church which adopted a theatrical approach to make its liturgy more vivid. One interesting device was the Exultet Roll, developed in Italy, from which a priest chanted the text, unrolling it over the back of the pulpit as he read his way through it. At intervals in the roll there were pictures illustrating the subject of his Latin words. To be the right way up for the congregation standing below, the pictures had to be upside down in the text. The

Figure 5: Medieval feast and entertainment (15th century)



Figure 4: Exultet Roll (11th century)

picture is from an actual roll in the Vatican and shows lighting provided by the candle on the left. This is one of the earliest known pictures of a candle.

Troubadours and Torches, 15th century (Figure 5)

During the Middle Ages drama was largely confined to religious theatre. This was often taken around the towns and villages by bands of strolling players. The priests made efforts to secure a place for short plays (urging repentance and reform of life) among the entertainments on offer indoors at night in the banquet halls of the nobility. The hall, or refectory, in palace, castle and monastery alike was the common place of assembly for all residents and guests. For here was the food and drink. And here the musician, juggler, jester or player performed. In this case, the scene is illuminated by firelight, by the candlesticks on the tables and by the flaming torches held by the entertainers.

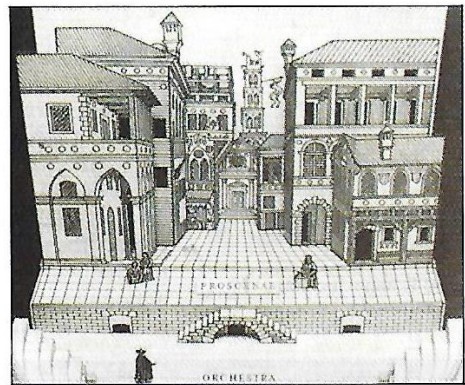


Figure 6: Italian stage ("Comic Scene" by Serlio, 1545)

Renaissance Razzle-Dazzle, 16th century (Figure 6)

Meanwhile, a new style of theatre was appearing in Italy. The Commediell'Arte gave Europe its first fully professional actors in trained companies, while its architects developed the indoor theatre with the proscenium arch, painted scenery and elaborate curtain – typical of later theatre buildings all over the world. In 1513, Girolamo Genga built a set which "had houses made of stucco relief, glowing with jewel-like lights and with alabaster panes in the windows". Later, in 1545, Sebastiano Serlio wrote about theatre architecture and scenic design, describing

how lights (possibly small glass oil lamps) could be made to sparkle in windows. Palladio designed the fully enclosed Teatro Olimpico at Vicenza (1580-84) which had a long narrow stage, backed by an extravagant facade with perspective vistas of city streets. Lighting was a problem. It is recorded that lamps were placed behind rows of red and white wine bottles in an attempt to compensate for the loss of natural light.

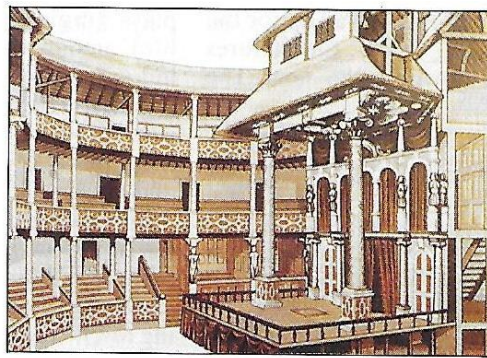
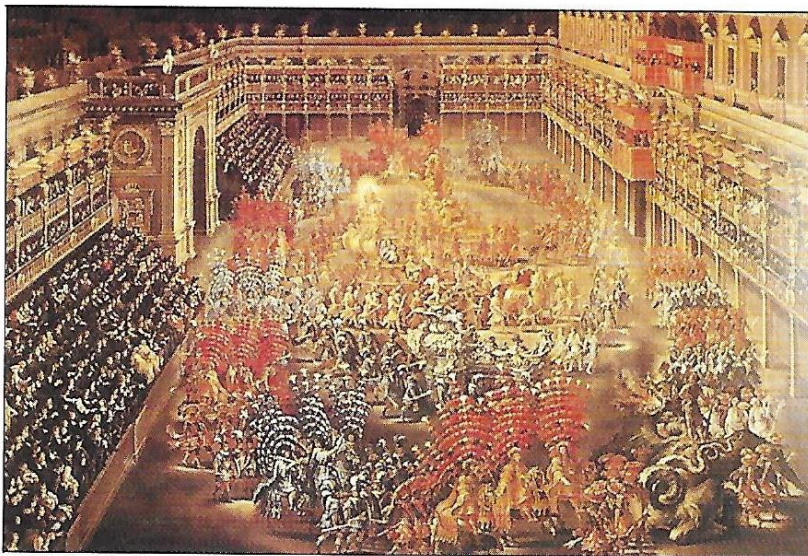


Figure 7: The second Globe theatre (1614)

**Elizabethan Extravaganzas, Late 16th century (Figure 7)**

The first permanent theatre in London was built in 1576 by James Burbage, a carpenter and part-time actor. It was known simply as "The Theatre". Others followed: the Curtain, the Rose, the Swan, the Fortune, the Globe and the Hope. A trumpet-call from the machinery tower announced the opening of a play. A flag was flown during the performance which

Figure 9: Night festivities in Rome (oil painting by Lauro and Gagliardi, 1656)



usually took place in the early afternoon; the stage was thus lit by daylighting from above. There were no footlights.

**Burbage's Blackfriars Theatre, 1597 (Figure 8)**

By the turn of the century many plays were being written for the indoor or private theatres set up in Blackfriars and elsewhere. These were roofed and could be used in bad weather. Lighting was provided by candles. In a reconstruction of the second Blackfriars Theatre (built by James Burbage) the drawing shows lighting over the stage provided by candle chandeliers. It also shows candle foot lights though there is no evidence for their use at this time.

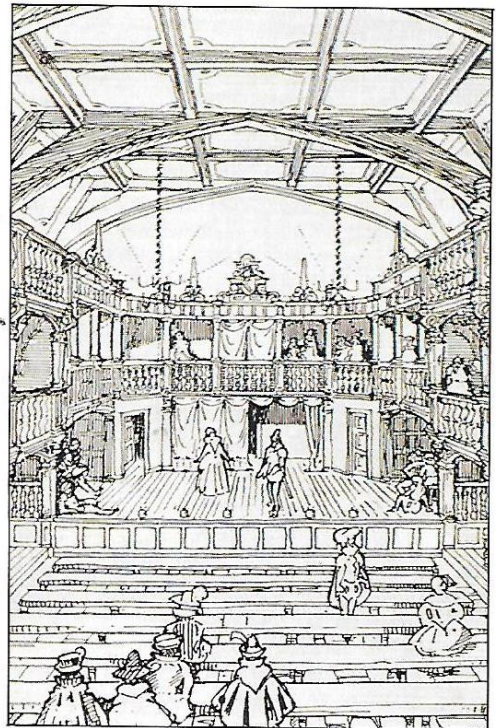


Figure 8: A reconstruction of the second Blackfriars Theatre (1597)

**Rome's Royal Revels, 1656 (Figure 9)**

Queen Christina of Sweden abdicated her throne, embraced Catholicism and took up residence in Rome where, soon after her arrival, this spectacular night-time entertainment was mounted in her honour. It featured a mock battle between Cavaliers and Amazons in the courtyard of the Palazzo Barberini, illuminated by flaming urns on the roofed galleries.

# FOOTLIGHT PARADE

Brian Roberts continues his pictorial history of lighting for the stage. As time goes by, candles are used to illuminate those that "want to be seen" at the theatre and are also suspects in the demise of a venue.

Act II: 1650-1825

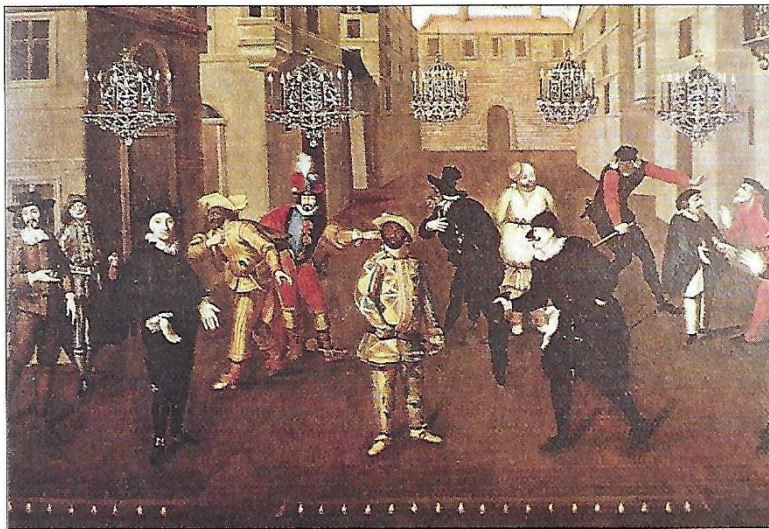


Figure 10: The Comedie Francaise (1670)

## French Farce, 1670 (Figure 10)

This is part of a painting of the Comedie Francaise in a Moliere farce. In the full version there are six candle chandeliers over the stage and a row of 34 candles, acting as footlights, may be counted. A 1673 print of a Moliere play at Versailles shows five elaborate chandelier fittings but no footlights.

A drawing of a German stage around the same period again has chandeliers but no footlights. The first illustration of footlights in use on an English stage is that to be found in the frontispiece to "The Wits; or, Sport upon Sport", by Francis Kirkman, published in 1673.

## Smoking Candles at Drury Lane, 1674 (Figure 11)

This drawing shows the auditorium and the stage lit by candles. The audience came as much to be seen as to see and the "house lights" were not dimmed. Gentlemen of quality were permitted to sit on the stage (which gave them direct access to the actresses' dressing rooms). The smoke from the candle chandeliers over the stage was a nuisance, but considered less so than from oil lamps. Samuel Pepys noted in his

diary that the actresses made quite a show by candlelight. He also complained that the candlelight gave him a headache. Footlights can be seen in the drawing and were now in general use, allegedly to enable the dancers' legs to be fully appreciated. With all these open flames exposed, fire was a major hazard. Oil wicks were often floated on water to reduce the risk – hence the theatrical term "floats" for footlights. (The first Drury Lane was gutted by fire in 1672. Rebuilt and expanded in 1794, the third version was also destroyed by fire in spite of four large "sprinkler tanks" in the roof).



Figure 11: Interior Drury Lane (1674)



Figure 12: Duke's Theatre (c1680)

**Drama at the Dukes, c1680 (Figure 12)**

Between 1642 and 1660 all plays were banned by the Puritan Parliament, but with the Restoration a new theatre was built at Dorset Gardens. The Duke's Theatre, as it was called, had general lighting from great circular fittings which held many candles and were hung above the stage apron. These also illuminated the auditorium and there were probably further candles round the boxes and galleries. There also came into use a new form of footlights, consisting of oil lamps recessed into a trough at the front of the stage.



Figure 14: Vauxhall, detail (by Rowlandson 1785)



Figure 13: Laughing Audience, detail (by Hogarth 1733)

**Laughter in the House, 1733 (Figure 13)**

Hogarth gives a close-up view of a candlelit theatre interior of the period: "the dejected boredom of the orchestra, the delight of the people in the pit, the orange girls flirting with the elderly beaux in the boxes who are totally uninterested in the play. This was something of a convention".

**Night-time Pleasures, 1785 (Figure 14)**

For nearly 200 years the Pleasure Gardens at Vauxhall (1661-1859) provided a source of diverse pleasures for Royalty, the aristocracy, politicians and others. In this picture the entertainment is provided by Mrs Weischell, the singer. Mr Barthelemon is the leader of the orchestra, the conductor Mr Hook. "In this hey-day of the Gardens oil lamps were the only possible illumination other than candles, and each lamp had to be filled and its wick trimmed by hand, after which it had to be replaced on its hook. As many of the lamps were in positions only accessible by ladders, it could have been no easy task to arrange for the lighting of the whole 10 000 at approximately the same moment. Candles were of course provided for the supper tables, and charged for at the rate of two shillings a pair".

The complete drawing includes many famous people: Boswell, Dr Johnson and the Prince of Wales. The original of this cartoon was found in a junk shop in 1945 and bought for £1.

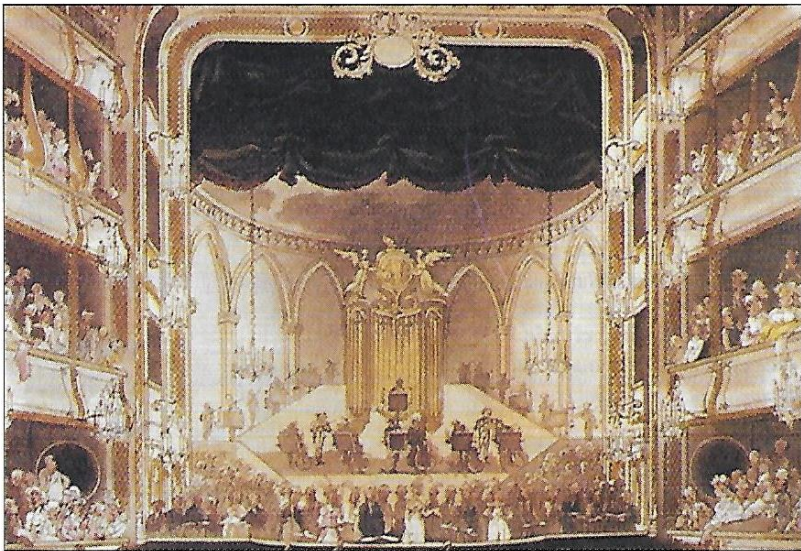


Figure 15: Covent Garden Theatre (by Rowlandson and Pugin 1792)

**Candles at Covent Garden, c1790 (Figure 15)**

The first theatre on this site (illustrated) was established by John Rich in 1732 as the Theatre Royal Covent Garden, under a Charter inherited from his father. The lighting by candles is clearly visible during this performance of an oratorio. Reconstructed in 1792 the theatre was destroyed by fire in 1808 (were the candles to blame?).

Seat prices were raised to pay for the rebuilding and led to the celebrated Old Price Riots when continual nightly disturbances finally forced the management to return to the old seat prices.

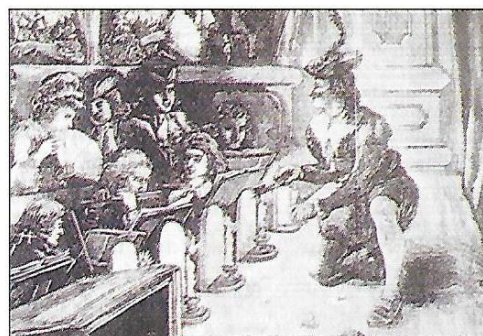


Figure 16: Lighting the footlights (c1800)

**Lighting the Footlights, c1800 (Figure 16)**  
This picture shows a tedious chore still necessary around the turn of the century, possibly at the Theatre Royal, Ipswich.

**Sadler's Wells Aquatic Entertainments, 1809 (Figure 17)**

This theatre dates from the 17th century when it was built by one Thomas Sadler in his pleasure gardens where there were medicinal springs and wells. Rebuilt in 1765, the footlights and auditorium candle chandeliers show the typical theatre illumination in use at this time.

Also to be seen is part of the new "aquatic entertainments" with Neptune and his horses sailing in from the wings in a tank fed from the nearby New River reservoir.

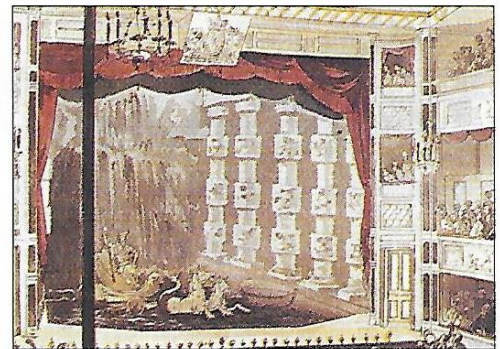


Figure 17: Sadler's Wells Theatre (by Rowlandson and Pugin 1809)

**The Violin Snuffer, c1810 (Figure 18)**

Rowlandson's satirical etching "Comedy in the Country" (and its companion piece "Tragedy in the Town") echo the convention of the boorish audience.

Both feature a candle-lit auditorium but the "Comedy" is particularly interesting, from our point of view, in that it shows a candle being snuffed by one of the violinists.



Figure 18: Comedy in the country (by Rowlandson c1810)

# THE GASLIGHT ERA

Brian Roberts concludes his journey through the history of theatre lighting with a look at how engineers and technicians finally took over centre stage.  
Act III: 1820-1925

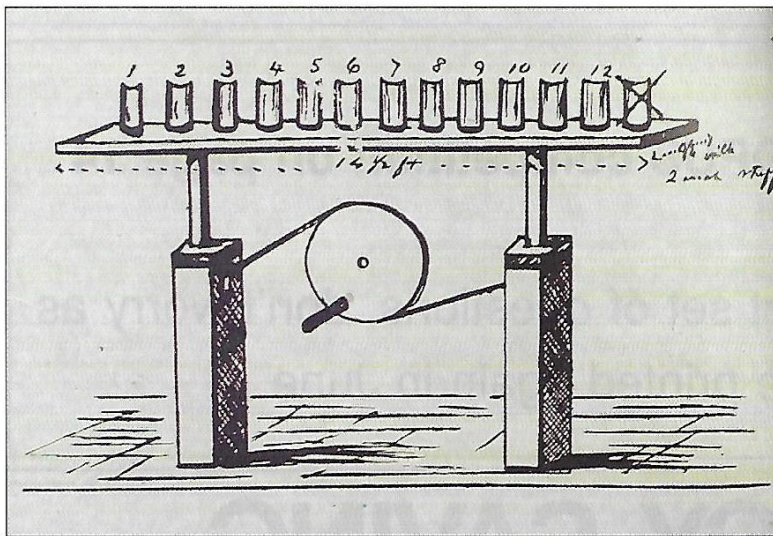


Figure 19: Movable footlights (c1825)

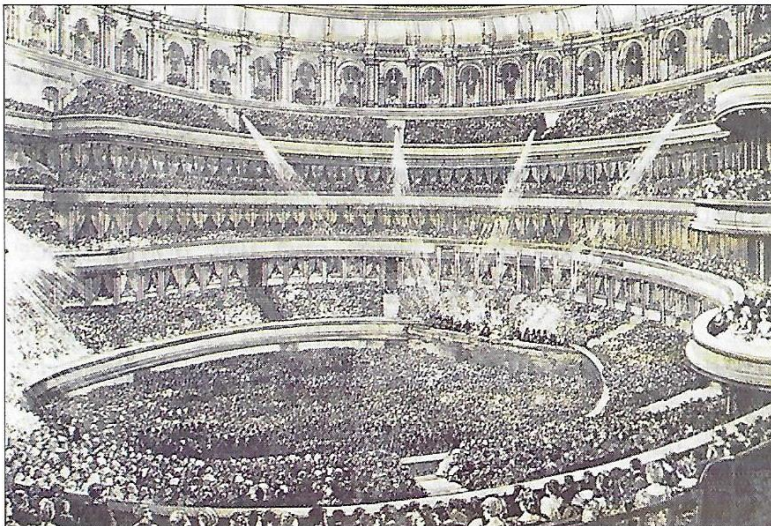


Figure 20: A State concert in the Albert Hall (1873)

According to Glynne Wickham, the first Professor of Drama in Britain: "It can be argued that most of the major changes that overtook the theatre during the nineteenth century owed more to engineers – civil, mechanical and optical – than to actors or dramatists."

He maintained that, "If such a claim is thought to be perverse, it has to be remembered that the candles and oil-lamps, which had provided the sole form of lighting in every theatre until the end of the eighteenth century, were banished first in favour of gas and limelight and then in favour of electricity".

## Dimming the Footlights, c1825 (Figure 19)

Before the gas or electric light, ingenious devices were invented which made it possible to lighten or darken the stage: "Although each candle or lamp could be masked or snuffed out, this was obviously a slow and laborious process, but when numbers of lights were mounted together the whole fitting could be raised or lowered through a slot in the stage, or when mounted vertically behind each wing, they could be turned away or shuttered in a single movement.

It was not easy to darken the auditorium, although this was partially achieved in some instances by withdrawing the candelabra or chandeliers through the ceiling, as done at the Comedie Francaise and La Scala".

## In the Limelight, 1873 (Figure 20)

The building of the Albert Hall commenced in 1867. It was a huge red circular building with a dome of glass and iron. This picture shows the lime or calcium light in use.

Two cylinders of compressed gas (one of hydrogen and one of oxygen) were directed against a column of lime, which was then heated to produce a great incandescence. Developed by Drummond in 1816 it produced a brilliant white light "of a quality so excellent for stage purposes that...we tend to associate it with the theatre and nothing else".

In *The Stage* magazine of 1883 it was reported "Limelight appears to be likely to hold its own in theatres with more favourable results against electric light than coal-gas".

Figure 21: Performance of Das Rheingold at Bayreuth (1876)



Figure 22: Aux Ambassadeurs, detail (Degas c1876)

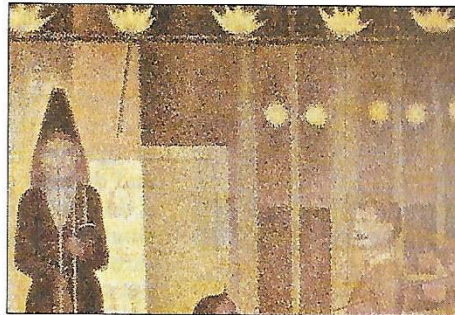


Figure 23: La Parade de Cirque, detail (Seurat 1887/8)

#### Rhine Maidens, 1876 (Figure 21)

This print shows, from backstage, a production of *Das Rheingold* at Bayreuth. Over the scenery is a gas batten encircled by a wire gauze screen (in some theatres coloured lighting effects were achieved by pulling coloured silks around the outside of the screen by a cord and pulley system). There is also a spotlight. Another painting from the audience side shows the floating maidens and the high rock – a Wagnerian fantasy.

#### Cafe-Concert, 1876 (Figure 22)

Degas is famous for his views of the ballet and the orchestra. In several pictures the lighting effects and styles are brilliantly observed. This particular illustration is of an open-air concert on a warm summer evening at the relatively smart and expensive Cafe aux Ambassadeurs on the Champs-Elysees, where up to 1200 people attended the performances. The lighting is by globular gas lamps suspended in the trees.

#### Gas-Jets at the Circus, 1887 (Figure 23)

The painter Seurat was interested in another form of theatre – the circus. This detail from his *Circus Parade* shows an overhead gaslight batten, possibly with batwing or fishtail burners, though at this date the flame shape could be the badly adjusted flame of a union-jet type of burner. There are also gas lamps on the far wall.

Figure 24: Lighting console at the Paris Opera (1893)

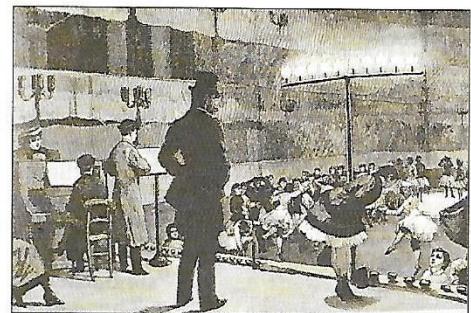
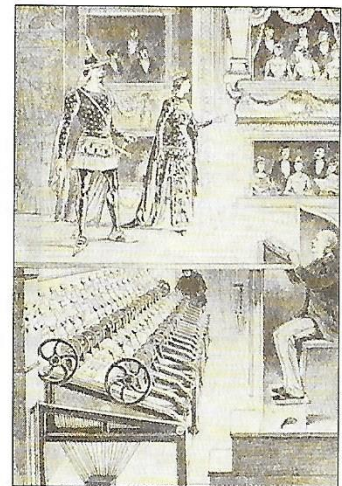


Figure 25: The Rehearsal (c1900)

#### L'Opera Console, 1893 (Figure 24)

“The Paris Opera possessed 10 gas meters, fed by six service pipes, off which six meters fed into 1000 burners each, and four into 800”. The gas had to be regulated before it reached the various lights and this was carried out at the gas table (the *jeu d'orgue*) by a series of taps and stopcocks. This gas table, or console, at the Opera was over 10 m long and sat in front of and below the stage apron where the light man could see the effect of each cue clearly.

#### Victorian Gaslight, c1900 (Figure 25)

The rehearsal is taking place in a theatre with a 10-jet temporary gas batten on the front edge of the stage. There is also a row of footlights, which look like oil-wick “floats”. On the front of the circle boxes is what appears to be the permanent gas house-lights, while at the left, behind the musicians, are some unlit gas (or oil?) lamps on stands.



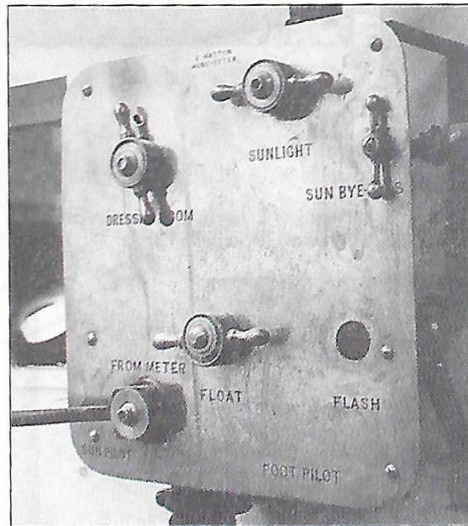


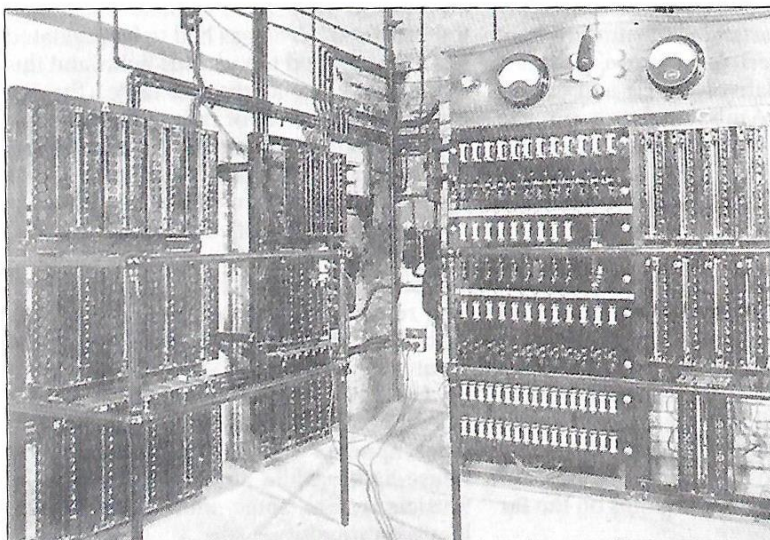
Figure 26: Gas Distributor at Buxton Opera House (1903)

#### Buxton Gas, 1903 (Figure 26)

Buxton Opera House was designed by the famous theatre architect Frank Matcham. Though wired for electric lighting it had a gas lighting system working in parallel. Gas footlights were retained in the building for atmosphere and the auditorium had a large ceiling-mounted combined gas light and ventilator known as a "sunburner".

The gas Distributor (illustrated) has controls labelled From Meter, Sun Pilot, Foot Pilot, Float (footlights), Flash, Sun-

Figure 27: Cambridge Festival Theatre Switchboard (c1925)



light (sunburner), Sun Bye-pass and Dressing Room.

"The Float was on the most sophisticated triple system: pilot, flash and main supply. The pilot lit the flash, the flash the whole of the footlights, a system first patented in 1883 at the Alhambra. This three tier system provided safe and gentle ignition that was not possible with the inevitably explosive leap from single pilot to full length footlights".

#### Electric Festival, c1925 (Figure 27)

This photograph is of a special board installed at the Festival Theatre in Cambridge by Reandco. The switch panel and dimmer panels are separate and there is no mechanical interlocking. There are 33 single-pole knife switches and fuses in three rows, and also a single-pole black-out switch.

The negative fuses are grouped at the bottom of the board. On the right of the panel is a bank of sliding contact dimmers controlling the front-of-house lights and decorative illumination. On the left is a panel of cyclorama lighting controls and next to it the resistances for the batten, spots and stage dips.

Today's stunning lighting effects are another story for here the curtain falls and the house lights come on. Our tale has ended.

EurIng Brian Roberts CEng FCIBSE MASHRAE MIP MASPE is Technical Director of Colt HH Airpower Ltd and Chairman of the CIBSE Heritage Group.

Photography by Zoe Roberts

Picture sources:

Figures 1,3,6,16,19 Leacroft, Theatre & Playhouse (Methuen 1984): Figure 2 World Atlas of Architecture (Mitchell-Beazley 1984): Figures 4,18,21 Gascoigne, World Theatre (Ebury 1968): Figure 5 Holme, Princely Feasts & Festivals (Thames & Hudson 1988): Figure 7 The Entertainers (Pitman 1980): Figure 8 Hartnoll, The Theatre (T&H 1968): Figures 9,24 Wickham, A History of the Theatre (Phaidon 1985): Figure 10 Harwood, All the World's a Stage (Methuen 1984): Figure 11 Leacroft, The Development of the English Playhouse (Methuen 1988): Figure 12 Cleaver, The Theatre through the Ages (Harrap 1946): Figures 13,14 George, Hogarth to Cruikshank (Viking 1987): Figures 15,17 St Aubyn, Ackermanns Illustrated London (Wordsworth 1985): Figure 20 Hibbert, London (Penguin 1980): Figure 22-Bade, Degas (Studio 1991): Figure 23 Russell, Seurat (T&H 1965): Figure 25 Mander/Mitchenson Collection: Figure 26 Buxton Opera House brochure (1990): Figure 27 Ridge, Stage Lighting (Heffer 1928)

# ELECTRICITY AND LIGHTING IN ART



Fig 2: The effects of candlelight, Paris (c1630). By Abraham Bosse from *Marriage a la ville* (Bibliothèque Nationale, Paris).

Much can be learned about early forms of lighting and about the first experiments and uses of electricity by looking back at the paintings, drawings, engravings and prints of the period. Often the main subject or topic of the picture is nothing to do with lighting or electricity and one has to focus on the background or detail to uncover the information. At other times, pictures may be found in technical publications or popular magazines of the day which specifically illustrate an important engineering event or a new piece of apparatus.

While the lamp is known to be a product of the early Stone Age, the American author, Thwing, in his book *Flickering flames: a history of domestic lighting* (1958), states that the oldest picture of a candle is probably that shown in a seventh century miniature in the Bibliothèque Nationale in Paris. Other candles are shown in the *Exultet Roll*, painted in the 11th century. Another picture of this period, depicting the act of ordination to the priesthood, shows a short taper on a tall ceremonial candlestick when, to the Church, the word *candela* (now the SI unit of luminous intensity) meant a lamp. But we begin with the 16th century.

*16th century: Luminary of glasse (fig 1)*  
It was realised as long ago as the 16th century that certain tasks demanded a higher level of illumination than commonly obtained from a simple candle or candles. Certainly, the use of water

## FLICKERING FLAMES

Brian Roberts, in the first of three articles, traces the history of lighting and electricity through the paintings, engravings and prints of bygone days. Part one: up to 1800.



Fig 1: A scholar reading by candle and water lens (16th century). Contemporary woodcut.

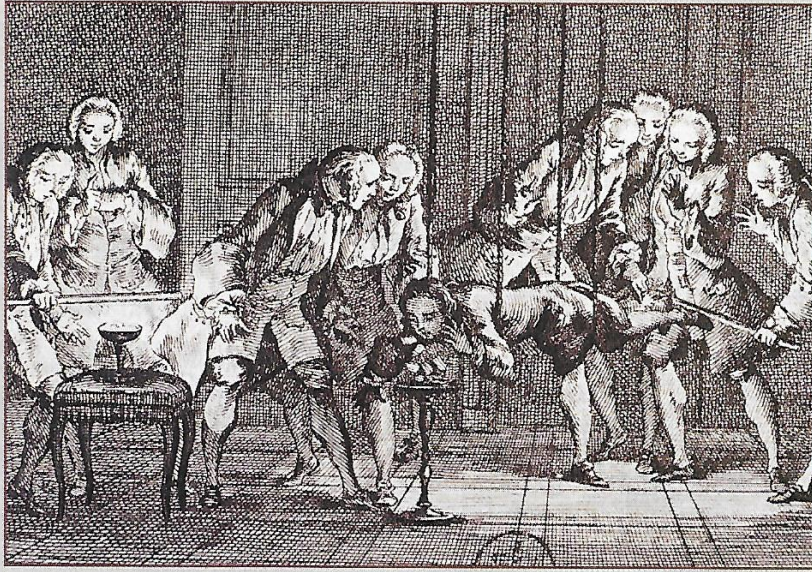


Fig 4: An experiment with electricity (c1739). Engraving by Charles-Nicolas Cochin Fils.



Fig 3: A platform stage with footlights (1673). Frontispiece to Francis Kirkman's *The Wits; or, Sport upon Sport*.



HUBERT-FRANÇOIS GRAVELOT. *Electricity*

Fig 5: Electricity (c1750). Engraving by Hubert-François Gravelot.

lenses or refractors dates from this time, when they were used by lacemakers, cobblers, and scholars to aid reading. As shown, a spherical flask filled with water, placed in front of the candle flame, acted as a condenser lens, producing a small area of relatively bright illumination (described as a new devised luminary of glasse).

1630: *Paris wedding night* (fig 2)

This shows a rich house where the newlyweds and their guests are in the bedchamber, which is illuminated by a candle in the sconce on the wall (right), with its brass reflector plate, and by a candlestick (left) on the dressing table. The couple are trying to get their guests to go home so that they can be alone.

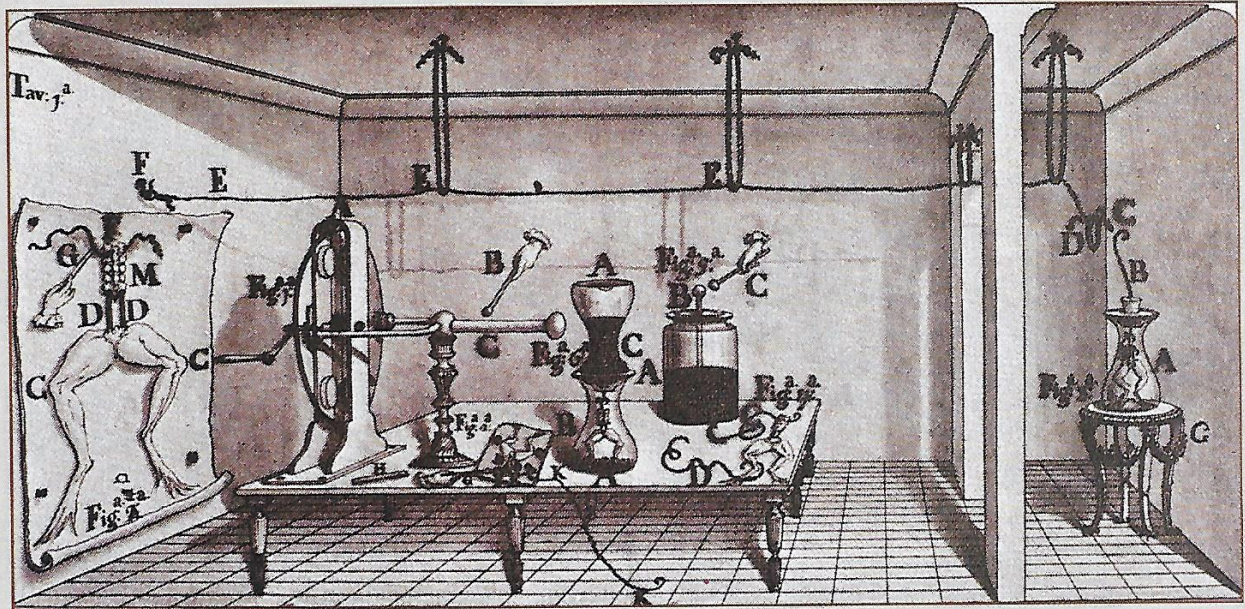
1673: *Footlights* (3)

The first permanent theatre in London was built by a carpenter, James Burbage, in 1576 and was known simply as *The Theatre*. Other Elizabethan theatres followed: *The Curtain*, *The Rose*, *The Swan* and *The Globe*. This illustration shows a platform-stage with footlights, found for the first time on an English stage. There are also overhead chandeliers. Theatres of this time were always burning down, probably because of carelessness with the candle lighting.

1739: *Electrical experiments* (fig 4)

This French engraving shows what appears to be an experiment with static electricity. One poor unfortunate is suspended by ropes from the ceiling to insulate him from the floor. His colleagues are touching him with charged rods and little scraps of paper are being attracted to the face of the hanging body from the table below his chin. The character on

# ELECTRICITY AND LIGHTING IN ART



the extreme left appears to be charging a rod, but by what means?

1750: *Electricity* (fig 5)

The man on the right of the picture is hand-cranking a piece of electrical apparatus, apparently to deliver an electrical shock to the unsuspecting maiden stood on an (insulating?) tub. Judging from the text, the machine may have been used to check on the virtue of young beauties by looking into their eyes through the magic of electricity. But the artist was once known to have asked a collector how far should one go with ones jesting?

1781: *Supper, the French way* (fig 6)

Four young people are dining in a small private bed chamber. The room is lit by two three-branch candle holders on the wall, while the central illumination is provided, not by a chandelier, but by a decorative lantern containing several candles. It has a disc above to protect the cord and tassel from heat. Presumably it can be raised and lowered to make it easy to service the candles.

1790: *Frog's legs* (fig 7)

Galvani's electrical experiments with frog's legs are shown here in a contemporary illustration. Little hands, B & C, wearing neat cuffs and hanging in the air on their own, demonstrate how a metal bar was charged by being held against an electric machine. The bar was then brought into contact with the frog's legs, which had been arranged in various ways.

Above Fig 7: Galvani's experiments with frog's legs (c1790). Contemporary illustration.

Below Fig 6: A private supper, Paris (1781). Engraving after a drawing by J M Moreau from *Le Monument de Costume* (Victoria & Albert Museum).



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## BURNING THE MIDNIGHT OIL

Brian Roberts continues his journey through the evolution of lighting and electricity via the canvass and film plates of the times. Part two: 1800-1870.



Fig 8: An evening at cards, Paris (c1805). By Jean-Francois Bosio (Bibliotheque Nationale, Paris).



Fig 10: Billiards (c1815). By W H Pyne, engraved by G Hunt (British Museum).

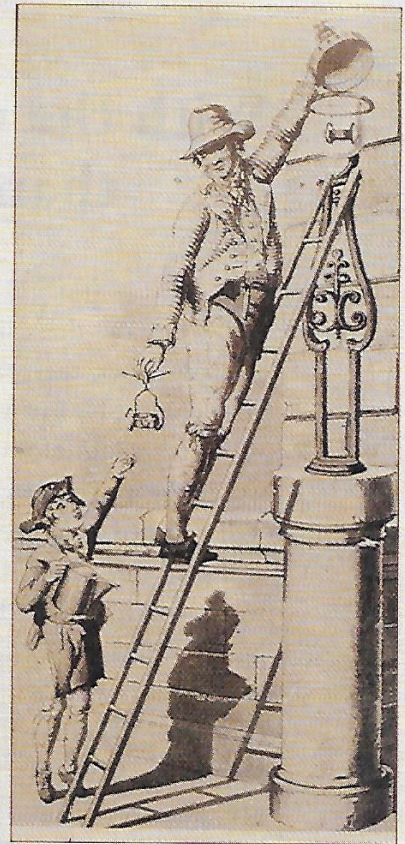


Fig 9: A Regency lamplighter at work (1808). Aquatint by W H Pyne from *Costume of Great Britain*.

It has been said that until 1782, with the introduction of the Argand lamp, there was practically no improvement in lighting from the earliest times. Its tubular wick, which allowed air to be drawn up into the middle of the flame to assist more rapid and complete combustion, was a significant advance. In 1784 Argand added the glass chimney; this permitted a higher flame temperature without smoking. The 19th century saw the introduction and development of a whole range of oil lamps.

The early 1800s also saw the introduction of gas lighting, including its adoption for street lighting, and the formation of numerous gas-light, heat and coke companies for its production and distribution.

### 1805: Cards, and other games? (fig 8)

On either side of the chimney glass (left) is an Argand lamp; below are two ordinary candlesticks, while on the table (right) is a shaded twin-branch candlestick. Maintaining Argand lamps was difficult and dirty since the viscous oil tended to block the feed, especially when the pressure decreased as the reservoir emptied. The spring-operated mechanism introduced in the Carcel lamp in 1798 was devised to overcome this difficulty.

### 1808: The old lamplighter (fig 9)

Until 1738 London by night was almost as dark as in medieval times. But night

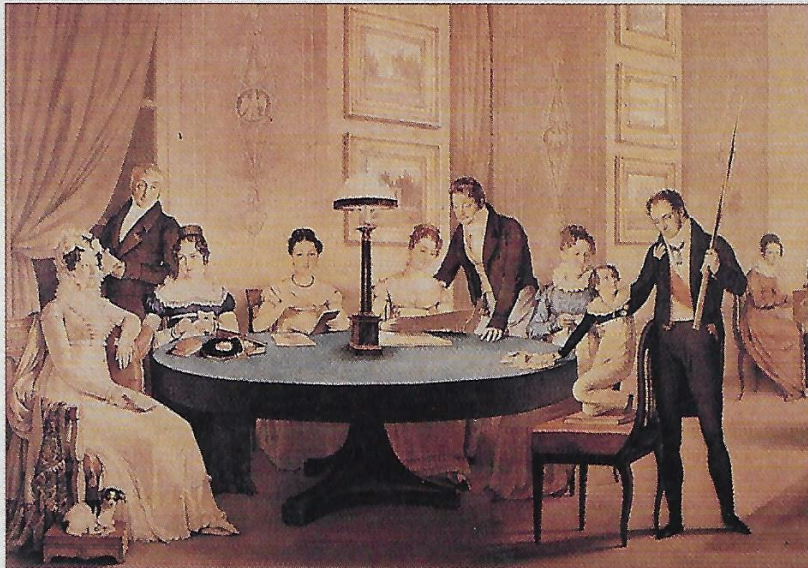


Fig 11: An evening round the table, Vienna (1819). By Louis Dupre (Galerie Carroll, Munich).



Fig 12: Regent Circus (1822). Aquatint by T H Shepherd (British Museum).

crime and suspicion of debauchery in the dark led to the erection of some 15000 street lamps which were set burning from each sunset to sunrise. These oil lamps, as shown in the picture, consisted of cotton twist floating in a tin of crude oil, tended by lamplighters and their assistants.

*1815: Billiards (fig 10)*

Billiards was an outdoor sport, played on the ground, until the 15th century. By the Elizabethan era there were many public tables in London. Although indoor sports are not well documented in paintings, the game of billiards (and later snooker) is an exception, and many pictures clearly show the lighting over the tables, candles, oil-lamps, gaslights, through to electric. In this print, the Regency dandies are wearing top hats and illumination of the table is by candle-light.

*1819: Viennese evening (fig 11)*

The new Astral lamp produces a relatively strong light. It casts little shadow because its oil reservoir is annular and supports the glass shade. This made it possible for several people to sit round it and read or sew. (The man with the red sash is King Jerome of Wurttemberg, the younger brother of Napoleon.)

*1822: Streetlights (fig 12)*

By now gas lighting in the streets was becoming quite common in the West End of London. This view, with rows of elegant lamp-standards, shows Regent Circus (now Piccadilly Circus) looking south towards Lower Regent Street.

*1828: Evening in Russia (fig 13)*

In the salon of a Countess is a curious stand with twin Argand oil-burning lamps. On the oval table stands a new Astral or

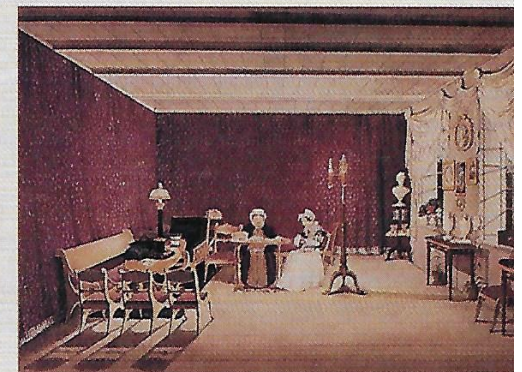
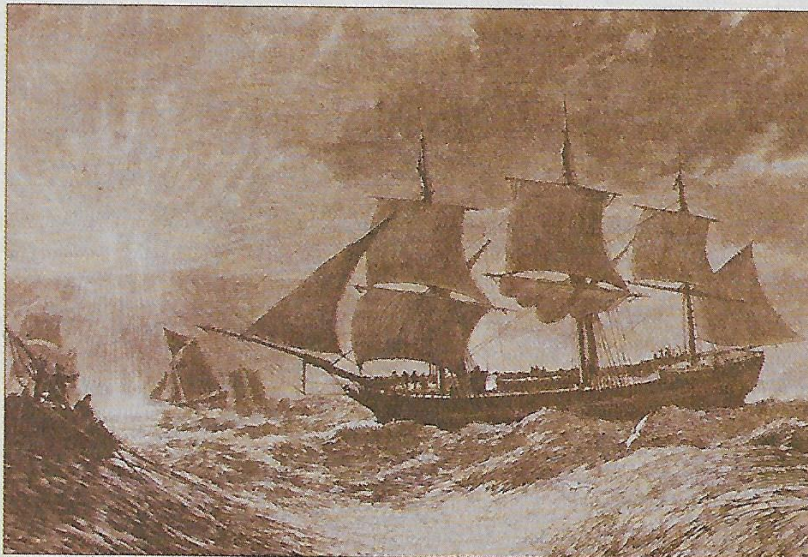


Fig 13: A salon in the Ukraine, Aleksandria (1828) (Jagiellonian University, Cracow).

## LAYING DOWN THE CHANGES

In his third and final article *Brian Roberts* describes the transition from gas lamps to light bulbs and the new consumer age. Part three: from 1870 onwards.



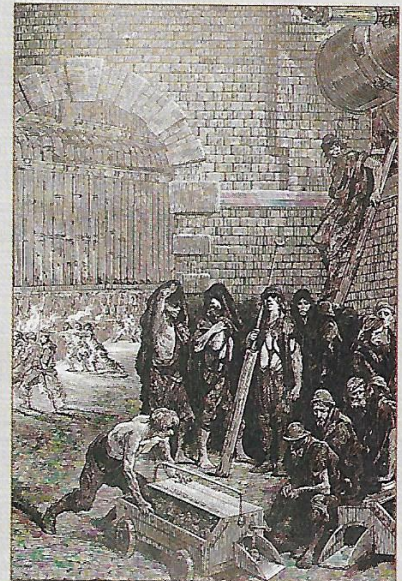
**Fig 16:** The electric light at the South Foreland lighthouse: provided by a steam-driven magneto-electric generator (3 February 1872). From *The Graphic*.

From the middle of the century, numerous trials with arc lamps were carried out, but the wide scale introduction of electric lighting had to wait for the practical development of the filament lamp around 1880. This in turn led to the growth of the electricity supply industry for both lighting and power.

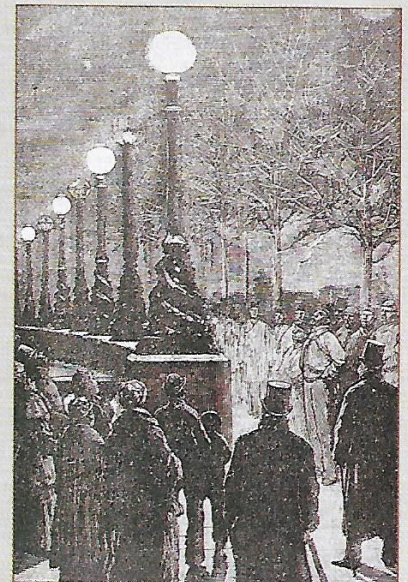
**1872: Trip around the lighthouse (fig 16)**  
Lighthouses, with their requirement for very powerful lights, provided the best application for arc lighting. Drawing on the earlier work of Professor Nollett, it was Professor Frederick Hale Holmes who pioneered their development. He conducted experiments at Blackwall and at South Foreland (illustrated) from 1857 onwards, at Dungeness in 1862, and at Souter Point, near Sunderland from 1870; the latter installation remaining in service until 1900. The light output achieved was around 1520 cp.

**1872: In the gasworks (fig 17)**  
Gas lighting was a 19th century phenomenon. Its use for street lighting started in the 1800s, but decline was under way by the 1890s with the advent of the electric light. Over this period, The Gas Light and Coke Company dominated London. As the picture shows, the working conditions in its gasworks were grim. Employees were exploited. They worked a 12 hour day and a seven day week. Strikes were met with instant dismissal and punctual and steady attendance during Christmas week was required.

**1878: Russian candles (fig 18)**  
It was P Jablochhoff, a Russian officer working in Paris, who invented the electric candle which bears his name. It comprised two carbon rods placed side by side and an arc formed between them, preferably using an ac supply to prevent unequal consumption of the carbons. The picture shows the Victoria Embankment in London, along the river wall between



**Fig 17:** The South Lambeth Gasworks at Nine Elms (1872). Engraving by Gustave Dore.



**Fig 18:** Jablochhoff candles used to illuminate the Victoria Embankment (1878). Wood engraving from *The Graphic* (4 January 1879).

Waterloo and Westminster Bridges. A total of 20 Jablochhoff candles were supplied by a Gramme dynamo and exciter, powered by a steam engine. It appears from the picture that only alternate lamps were fitted with Jablochhoff candles, no doubt so that comparison could be made with the existing gas lighting.

1882: Power-house in New York (fig 19)  
The break through in electric lighting came with Edison's introduction of the-

first practicable light bulb. However, his greater contribution was probably the creation of a whole system for electric lighting. This consisted of a steam-engine driven electric generator with cables and conductor joints (see fig 20), as well as other devices necessary for transmitting the current to the consumer: domestic wiring, electricity meters, fuses, switches and screw holders for his light bulb (things that earlier had not existed, mostly de-

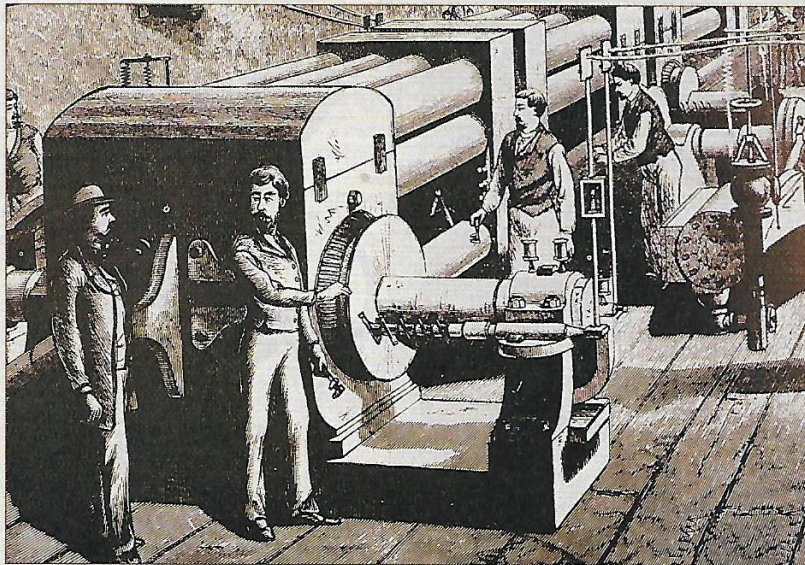


Fig 19: The dynamo room of Edison's electric lighting station, New York (1882). From La Nature.

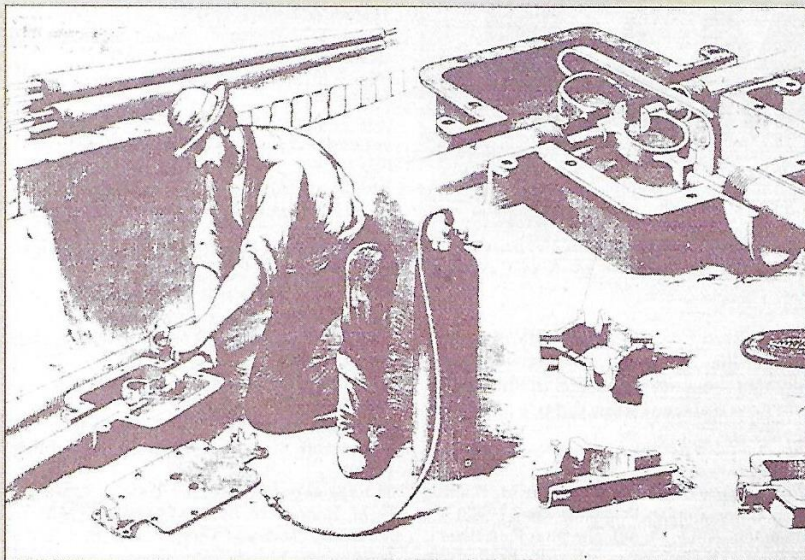


Fig 20: Cable laying in the streets (c1882). Contemporary illustration.

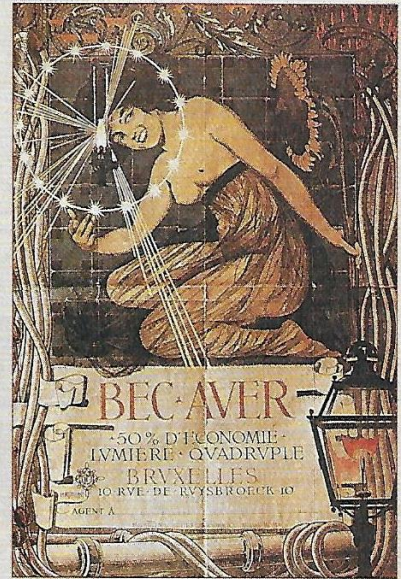


Fig 21: Bec-Auer gas mantles (1895). Poster by G M Mataloni.

vised and tested by Edison himself). The illustration is of his Pearl Street powerhouse, with its three Jumbo generators each of 125 horsepower, together feeding 5000 lamps in 225 houses.

1882: Cable laying in New York (fig 20)

It took two years to lay the 22.5 km of electric cable needed for Edison's power station, a section of which is shown (top right) with a conductor junction box (top centre). The cables consisted of double copper wires, insulated with impregnated hemp string and enclosed in iron tubes. This was a direct current system, soon to be superseded in high voltage networks by alternating current.

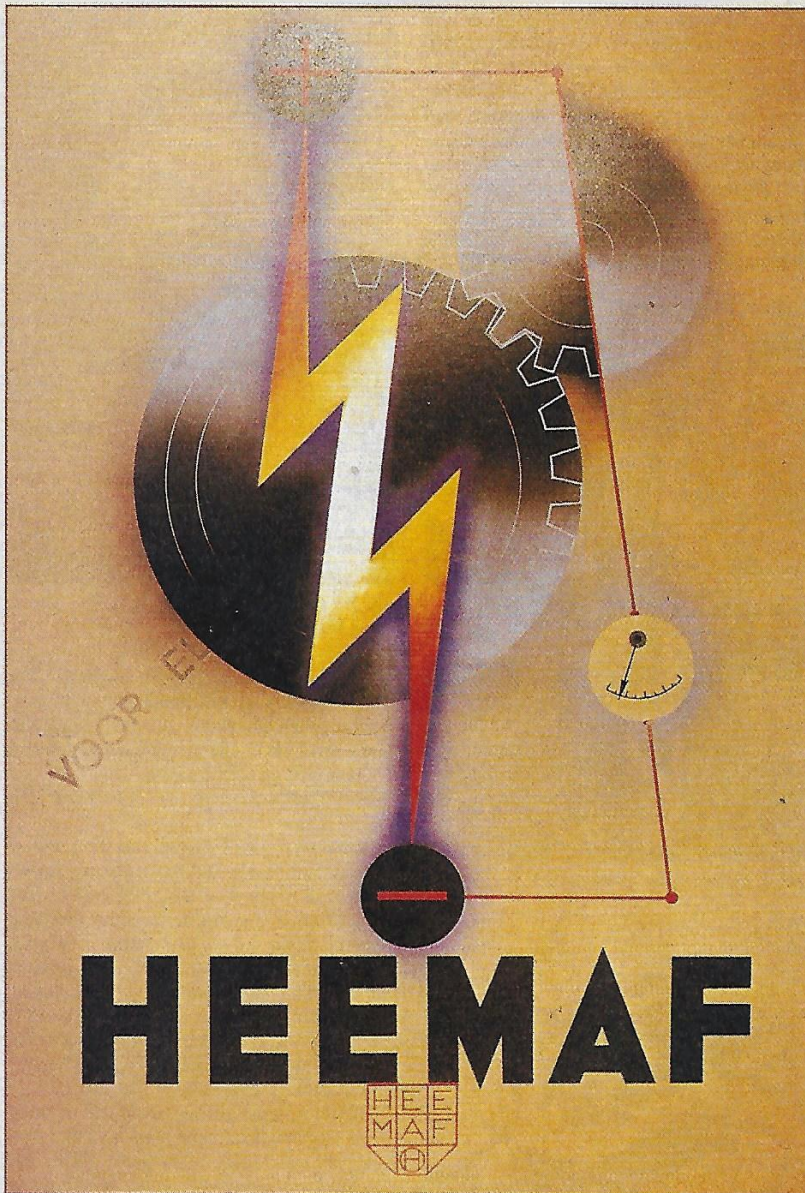
1895: Beauty by gaslight (fig 21)

Originally, gas lighting made use of luminous flames. The next step was the first gas mantles, sold in Paris in 1849, but having only a short life. It was an Austrian, Carl Auer, who produced a long-lasting mantle with a high light output, which he patented in 1893. These were widely adopted in Europe. The origin of this particular topless advertising poster is not clear; it appears to be of Italian origin but features an address in Brussels.

1930: For electricity (fig 22)

According to the art critics, this poster (which is for a Dutch electrical company) has specific electro-mechanical elements without an identifiable machine; the lightning bolt represents a spark jumping be-





**Fig 22:** Heemaf (1930). Poster for a Dutch electrical company Gouache by A M Cassandre (Stedelijk Museum, Amsterdam).

tween positive and negative poles, the response being measured by a parody of an electrometer. What engineer can quarrel with that? The letters voor el make the point that the company, Heemaf, is for electricity.

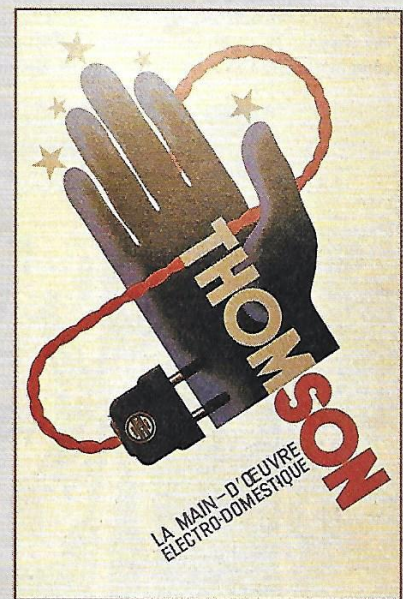
*1931: An electric hand? (fig 23)*

This poster (presumably) represents the hand of the consumer ready to embrace the advantages of domestic electricity, available by means of the two-pin plug

and twisted flex: no doubt very appropriate to the 1930s as new consumer appliances became available in the home, and how different from today's advertisements!

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Pictures were photographed by Zoe Roberts. B M Roberts FCIBSE MASHRAE MIP RP MASPE is Technical Director of H H Airpower Engineering Ltd and Chairman of the CIBSE Heritage Group