

Stage Lighting

Early history

The classic Greek *theatron* (literally, “a place of seeing”) was built in the open air, usually on a hillside, and placed so that the afternoon sunlight came from behind the audience and flooded the [performing area](#) with [light](#). The larger Roman theatres were also outdoors, but the added luxury of a coloured awning stretched over the spectators softened the glare of the sun. Later, in the Middle Ages, [miracle plays](#) and [mystery plays](#) were primarily performed outdoors on the front steps of the church and the adjoining square, although the first dramatized biblical scenes were performed as part of, or following, mass inside the church. There is no record that these scenes were lighted any differently from the mass itself. In [England](#) the [pageant wagon](#), complete with actors and properties, was drawn through the main street of a town. Until the 16th century, the theatre continued to be mainly an outdoor institution.

Under the patronage of the aristocracy in [Italy](#), private performances, [pageants](#), and tableaux began to be given indoors. [Sebastiano Serlio](#), an Italian architect, gave considerable attention to [theatre design](#), and in a [treatise](#) written in 1545 he discussed theatre construction and the creation of lighting effects. He recommended placing [candles](#) and torches behind flasks filled with amber- and blue-coloured water. [Andrea Palladio](#)'s indoor theatre, also in Italy, used common light sources: torches, pine knots, open-wick lamps, and tallow candles. In England at the end of the 16th century, the [Globe Theatre](#) was used for summer performances of [William Shakespeare's](#) plays, but in winter performances were given in the completely enclosed [Blackfriars Theatre](#). Artificial light, produced mainly by candles, was used in several indoor theatres to light the stage and the auditorium.

In the early 17th century, [Inigo Jones](#) introduced several [innovations](#) in lighting and stagecraft, using [reflectors](#) to intensify the light sources and making use of [colour](#) on stage. The earliest known definite description of stage lighting may be found in *Architectura Civilis* (1628; “Civil Architecture”), by Joseph Furtenbach (also spelled Furtenbach). He describes the use of oil lamps and candles set in a row along the front edge of the stage but out of sight of the audience, and he also mentions vertical rows of lamps behind each wing at the sides of the stage. The common method of lighting the stage and auditorium was by means of tallow candles. As seen in old prints, these candles were mounted in crude hoops or chandeliers, which were hoisted aloft on pulleys to hang in dripping splendour. Gold decorations applied to the interior of the

auditorium caught the many reflections. The inconvenience of the lighting system was that candles were expensive and hard to control. The twisted wicks had to be constantly trimmed during the performance, and this was the duty of the snuff boy. A transformation from light to darkness was effected by the agile skill of the candle snuffers. When [David Garrick](#) used footlights at the [Drury Lane Theatre](#) in 1765, he masked the candles with metal screens. By 1784, when [Richard Brinsley Sheridan](#) managed the Drury Lane, all lights used to illuminate the stage were out of sight, hidden by the now familiar wings and borders.

The floating oil wick [lamp](#) was replaced after 1783 by the [Argand](#) oil lamp, in which the cylindrical wick was enclosed in a [glass](#) chimney to steady the flame and provide a brighter, whiter, and cleaner light source. The chimneyed oil lamp eventually replaced the candle, but it was still hung in clusters above and bracketed to the walls. At the [Haymarket Theatre](#) in London, the oil lamps had chimneys of white and green glass that were controlled by levers, so that raising or lowering the chimneys could effect light changes. Actually, rather than subtly shifting the quality of the light, the chimneys' movement merely made the actors and scenery more or less visible. Stage design and stagecraft had now advanced as far as was technically possible under the limitations of low-intensity stage lighting.

The first major advance in several centuries was the introduction of [gas lighting](#). Near the end of the 18th century, the Scottish engineer [William Murdock](#) developed a practical method to distill gas from coal for illumination. The first successful adaptation of gas lighting for the stage was demonstrated in the [Lyceum Theatre](#), London, in 1803 by a German, Frederick Winsor. The Chestnut Street Opera House in Philadelphia installed a gas lighting system in 1816 and supplied its own gas by installing a gas generator on the premises. (Gas stations and city mains did not come into use before 1850.) The advantages of gas lighting were immediately realized and exploited, despite the initial cost. No new methods of lighting, however, were devised for stage lighting. The conventions remained the same: [footlights](#) (a row of lights across the front of the stage floor), borderlights (a long horizontal row of lights used for the general lighting of the stage from above), and striplights (a row of lights usually mounted in a trough [reflector](#) and placed in the wings to illuminate specific portions of the stage or setting).

Even without a chimney, an open gas jet flame was brighter than oil lamps or candles. The additional advantage was control; by varying the control valves from a central point, a smooth increase or decrease of light could be effected, and at variable speeds. For the first time, to add to the realism of the play, the

auditorium lights could be darkened. Elaborate central control systems were devised, with a main regulator, branch mains, secondary regulators, and valves. This growing array of valves and pipes was organized into circuits and displayed on the “gas table”—the forerunner of the modern switchboard. But there were also disadvantages to gas: heat, offensive vapours, and the serious fire hazard of the open flame. Protective codes were soon established that necessitated the use of guards, screens, and glass chimneys. In 1890, after the introduction of electric lighting, the incandescent gas mantle was developed (see [incandescent lamp](#)). Although the mantle greatly improved the quality of light—which was brighter and whiter—the hazards of fire still remained.

Although [Thomas Drummond](#), a British engineer, invented the [limelight](#) in 1816, it did not come into general use until some 30 years later. A limelight produces light by [directing](#) a sharp point of oxyhydrogen flame against a cylindrical block of lime. The tiny area of lime becomes incandescent and emits a brilliant white light that is soft and mellow. As the block of lime is slowly consumed by burning, it has to be slowly and constantly turned by an operator to supply the flame with a fresh surface. Since the brilliant area was very small, the addition of a mirrored reflector was necessary to give accurate control. The intensity of the limelight permitted it to be directed onto the stage from the auditorium. Since it offered control as well as intensity, the limelight was quickly adapted to follow individual performers around the stage. The sharpness produced by the small point source made possible the creation of realistic effects, such as sunlight and moonlight, and moving effects, such as clouds, water, and fire.

Electrification

An advance of great importance was the introduction of the [electric carbon-arc lamp](#), which was exhibited in experimental form in 1808 by [Sir Humphry Davy](#). The [Paris Opéra](#) developed the earliest electric arc effect—to represent a beam of sunlight—as early as 1846. By 1860 the Paris Opéra had also developed a lightning machine, a rainbow projector, and a luminous fountain. Most important, the company made the earliest [spotlight](#), a carbon arc and [reflector](#) housed in a hood, which included a [lens](#) and a shutter.

The next great advance in lighting was the development of the [incandescent](#) electric lamp, in which light is produced by a filament electrically heated to incandescence. The invention of a practical electric lamp by [Thomas Edison](#) in 1879 marked the beginning of the modern era of stage lighting. Gas was quickly discarded; within one year the progressive Paris Opéra introduced the new system. Two years later, at the Electrotechnical

Exposition in Munich, a small theatre was erected that used electric lighting exclusively for both stage and auditorium. The success of the experiment received worldwide acclaim. In London the Savoy Theatre was the first to install the new lights; in Boston the Bijou Theatre followed the new trend in 1882. The following year the Landestheatre in Stuttgart, the Residenztheatre in Munich, and the [Vienna State Opera](#) were among the first completely electrified theatres.

At the turn of the 20th century, incandescent lamps were in almost universal use for stage lighting, but no new methods or techniques of lighting appeared. The conventional footlights, borderlights, and striplights were merely electrified, and the arc light was used for concentrated light sources. Gradually, new improvements provided brighter lamps that were both more durable mechanically and available in larger wattages. Metallic filaments replaced carbon, and in 1911 drawn tungsten [filament lamps](#) appeared. The use of [inert gas](#) in place of a vacuum produced lamps of even higher [efficiency](#) and larger sizes. The introduction of concentrated coil filaments made practical the development of the incandescent spotlight. The refinement of the incandescent spotlight added an exciting new tool for the advancement of stage lighting and the further development of stagecraft. Gradually the arc spotlight was replaced by the new incandescent spotlight, which, in turn, gave way to the [tungsten-halogen lamp](#).

About 1902, in Germany, [Mariano Fortuny](#) developed an elaborate system of soft reflected light using arc lights bounced off coloured silk fabrics. The simulation of natural lighting was remarkable, but the entire mechanism was too bulky and intricate and required the construction of a special theatre. In the course of his experiments, Fortuny evolved a dome-shaped [cyclorama](#), its rear wall surfaced in plaster. Flooded with light, it gave the illusion of [infinite space](#) and was the perfect means of simulating spectacular sky and background effects. Because it was dome-shaped, however, it occupied a large amount of stage space and tended to distort optical projections. In modified form, as a curved, hanging cyclorama, it became an indispensable tool of the new stagecraft. Earlier, [Sir Henry Irving](#) had used transparent coloured lacquers to coat lamps to produce [colour](#) effects, using separate circuits for each colour. Irving was also the first producer to introduce organized light rehearsals in his productions.

[David Belasco](#), with his electrician [Louis Hartman](#), developed a standard of realism in stage lighting that anticipated the [motion picture](#) and went on to dominate the 20th century. In their lighting laboratory, Belasco and Hartman

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developed and refined many new lighting instruments. Individual sources were developed and used to light the [acting](#) areas from above the stage as well as from the auditorium.