A Primer for the History of Lighting Design

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A PRIMER FOR THE HISTORY OF STAGE LIGHTING

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The history of stage lighting begins not with invention of electricity, gaslight, or the oil lamp. The use of light in performance began with the very origins of theatre in the ritual acts of tale telling around an open fire, the warmth and brightness of fire naturally drawing people together to create the audience/performer (storyteller) relationship. Although one usually assumes the history of stage lighting to begin with the considered intentional placement of artificial light sources that began during the Renaissance, the orientation of Ancient Greek stages was itself a form of lighting design in that the theatres were situated to exploit the changing sun angle throughout the day-long presentation of a cycle of plays (Penzel 3). Roman theatre practitioners, though less attuned to the role of sun angle on dramatic effect, did make use of artificial light sources, specifically torches, in their theatrical events. As theatrical production became more reliant on artificial light sources, the tug-of-war between art and technology began, continued into the gaslight era, was a source of frustration for theorists such as Adolphe Appia and continues to the beginning of the 21st century as the ability to remotely automate every conceivable attribute of stage lighting provides seemingly boundless flexibility and specificity.

It was during the Renaissance, when theatres moved inside, that the role of stage lighting took on significance as both a means of illumination and for enhancement of dramatic effect. Also during this period, the art of scenic painting reached a level of sophistication that included not only the depiction of the comic, tragic, or pastoral scenes,

but also the articulation of light and shadow within the painted scenes to convey time of day.

Many of the lighting positions still in use to this day were developed in Italy in the 16th and 17th centuries. Artificial light sources, either candles or oil lamps, were used for general illumination, illumination of the rear shutter or background, or for special effects such as stars or hell fire.

Angelo Ingegnieri, in his 1598 treatise *Dramatic Poetry and How to Produce Plays* describes what would now be called a "1st Electric" position for illuminating the action, that is a row of lights behind a header, or "valance," that obstructs the audience's direct view of the light sources but illuminates the stage and scenery (Penzel 9). In 1628 Josef Furttenbach the Elder, a German who visited Italy and chronicled scenic practices there in his *Civil Architecture*, describes the effect, "Behind the proscenium frame and the parapet are placed numerous candles or oil lamps which throw such a splendor on the scene and up into the heavens that they make the scene bright as day." Furttenbach goes on to describe the lighting of the background: "At the back of the stage is another pit 3 feet wide. In this also many oil lamps are concealed to throw their splendid beams on the scene above" (Hewitt 185).

The oil lamps were sometimes in the form of *bozze*, round glass vessels [insert Figure 1] that could be used to contain oil and a wick or, as Sebastiano Serlio describes in his 1545 *Second Book of Architecture*, the bozze can be filled with translucently colored water and

placed in front of a candle or oil lamp with, if needed, a reflector of tinsel or a polished barber's basin. Serlio explains that "each of those *bozze* are placed with the curved part to the opening…The sides of the *bozze* should be flat or convex the better to receive and send out light" (Hewitt 34). This rudimentary combination of source, reflector, and convex glass is the precursor to the optical assembly of the nineteenth century limelight, the plano-convex spotlight and from there contemporary stage lights, especially the development of the ubiquitous ellipsoidal reflector spotlight and the fresnel spotlight.

Natural light was still a major component of stage lighting during the Renaissance. Theatre architects were advised by Furttenbach to place windows so as to provide both light and air (ventilation became an even more serious issue during the gaslight era) and to avoid windows "at the sides of the front of the pit. The walls there left unbroken so that the spectator will not be blinded, but will sit in darkness and have the greater wonder at the daylight falling in at the streets…." (in Hewitt 206).

The hall playhouses in Shakespearean England at this time were also designed to make maximum use of natural light. The Great Hall at Hampton Court, for example, situated along an east-west access, has high windows situated along its north and south wall such that "The predominant effect, characteristic of all Tudor halls, is the soft descending nature of light" (Graves 132).

Although David Garrick is often credited for bringing footlights to England in the 18th century, it is clear from this 1672 engraving of the Red Bull Theatre [insert figure 2] that

footlights were used in England one hundred years earlier. Garrick did, however, significantly modernize lighting on the English stage during the 18th century. For example, he removed the overhead rings of candles depicted in the engraving of the Red Bull Theatre and placed lights further upstage.

> On the opening of the Drury Lane play-house for the ensuing winter, the audience was agreeably surprised to see the stage illuminated in a clear and strong manner, without the assistance of the rings hitherto used for that purpose. This is done by the disposition of lights behind the scenes, which cast a reflection forwards, exactly resembling sun-shine, greatly to the advantage of the performers, but more to the spectators, who have no longer the air they breathe tainted by the noxious smoke of between two and three hundred tallow candles, nor their sight obstructed by them and the rings supporting them. The French theatre has long been illuminated without these offensive rings, though not that perfection attained by Mr. Garrick, who, however, is supposed to have taken the hint from it. (*Annual register* 130)

The placement of lights remained essentially the same throughout the 18th century and well into the gaslight era of the 19th century. Forestages were often illuminated by five large chandeliers within the depth of the proscenium arch as depicted in this c.1770 engraving of an Amsterdam stage, candles or oil lamps behind the proscenium arch, and a row of footlights. [figure 3]

Sightlines, however, were further improved with the advent of gas lighting, introduced into the auditoria of London's three major theatres (Covent Garden, Drury Lane, and Lyceum) in 1817. The *Times* of September 8, 1817, described the effect: "All the former chandeliers are removed, and a great central light descends from the centre of the ceiling, but not so far as to intercept the view of the stage even from the one shilling seats" (qtd in Penzel 37-38).

The first use of gas for purposes of illumination is widely attributed to Rev. John Clayton, Dean of Kildare in 1684 (Rees 1). Once it was harnessed for stage use in 1817, gas light significantly changed theatrical production in ways more meaningful and lasting than just improved sightlines. The increase in overall light level, the changes made possible in the distribution of light on stage especially as it relates to direction of light, the ability to control light levels and articulate differing areas of the stage and auditorium, and even the difference in color rendering properties of gas light all had fundamental effects on theatrical performance.

The increased intensity of gas light as compared to candles and oil lamps was less forgiving of the declamatory style of acting popular at the beginning of the nineteenth century (Penzel 54). This intensity was also less forgiving of poor scenic painting and shoddy set construction. When electricity hit the stage in 1881, the further increased brightness exposed scenic flaws in a similar fashion.

The advent of gaslight enabled stage light control to be at one central location, the gas table, or gas plate. From there, some areas of the stage could be made darker, or others lighter, and areas of the auditorium could be darkened as well. Bram Stoker, who served as Sir Henry Irving's lighting assistant at the Lyceum Theatre wrote in *Irving and Stage Lighting* in 1911, "it became an easy matter to throw any special part of the stage into greater prominence – in fact to 'vignette' that part of the stage picture which at the moment was of the larger importance" (qtd in Penzel 61).

Although de Somi had advocated the darkening of the auditorium in the early part of the Renaissance, the central control of the gaslights made complete darkening achievable. At his Bayreuth opera house, Richard Wagner attempted to change the social order of performance by completely darkening the house, thereby transforming the theatre, as Anton Schivelbusch writes, from a social place to a mystical one (Schivelbusch 210). However, the social interaction between audience members and between the audience and the stage continued well into the twentieth century. Schivelbusch, referencing an unpublished dissertation, posits that the dark auditorium did not reach full acceptance until it became the required norm in cinemas in the twentieth century (Schivelbusch 212).

When the gaslight era began in 1817, the majority of the actual stage illumination came from the footlight position, with additional light from gas wings. The light emitted from the gas wings served primarily to illuminate the painted scenery of the next wing or slider further upstage. [insert figure 4] Despite the availability of color variation made possible by the invention of complex gas installations that could provide up to three different

colors of light from the footlights, many critics decried the unnatural angle of light from the footlight position. Alfred Ainger writes in the *Journal of the Royal Institution of Great Britain*:

> The effect of these lights on the performers is rendered evident by the obviously constrained aversion of their eyes, while the expression of their features is almost destroyed by the reversal of the shadows under which the face is usually and best seen. The figure suffers as much as the face from the inversion; and it becomes peculiarly inappropriate when viewed in conjunction with a scene where the shadows are evidently derived from a superior light [i.e. from above]. (qtd in Rees 23)

In the middle of the nineteenth century, this all changed when overhead gas battens became common. These gas battens provided significant light from over head, not only for the overhead scenic borders, but due to their design, to the playing area below. Figure 5 [insert] shows a cross section and elevation of a gas batten. The asymmetrical reflector design is similar in shape to that found in contemporary T-lamp strips and cyc-floods.

In addition to the gas footlights, gas wing lights and gas battens, nineteenth century stage lighting was characterized by the extensive use of the limelight. Limelight is produced when calcium oxide, commonly called "quick lime" is burned in the presence of a proportionate amount of oxygen and hydrogen gases. A limelight required a skilled operator who would make sure that the proportion of gases was maintained safely. Used on stage from about 1837 until into the twentieth century, the limelight source was used first in open-faced floodlights and then later in more controlled focused instruments.

According to Rees, Charles Kean first put a lens in front of a limelight in 1855 to focus the light into a defined beam for his production of *Henry VIII* at the Princess (Rees 52).

The development of the electric arc lamp followed closely after that of the limelight. However, there was no electrical service to the theatres so electricity was generated by steam engines and then stored in battery cells. The carbon arc sources were used to generate special effects such as sunrises or bright starry halos. Charles Kean was a proponent of the use of the carbon arc source as well as the limelight in early followspot apparati. His use of the carbon arc "gives the figure a prominent appearance, and, by its coldness of color, suddenly changes the tints of the whole scene into an unexpected breadth and warmth of tone" (*Building News* qtd. in Rees 73) foreshadowing the effect of integrating HID-sourced automated lights with quartz incandescent sources one hundred and forty years later. Carbon arc rods could be readily purchased as evidenced by this regular advertisement on the back pages of *Scientific American* [figure 6].

During the gaslight period of 1817-1881, and into the early years of electricity, there was significant exploration of the role of colored light on stage. Sir Henry Irving, with the assistance of Bram Stoker, was one of the great color experimenters of his time. Although dyed fabrics had been used in a rudimentary way to create washes of color from the overhead gas battens and colored glass cylinders were employed on footlights, Irving pioneered the use of colored lacquer on glass filters placed in front of limelight boxes. In 1893, E.S. Cooper applied for a patent for a semaphore-style color changing apparatus for use in front of a limelight burner. [insert figure 7] The first automated color

changing devices developed by George Izenour seventy years later were also of a semaphore design.

Electricity was used to provide exterior lighting for theatres and other public buildings prior to 1881, but in that year a complete installation of electric lights was made at the Savoy Theatre built by Richard D'Oyly Carte to showcase the work of Gilbert and Sullivan. The electric lights in the Savoy were not the maintenance-intensive carbon arc lamps of earlier in the century but instead were of the enclosed carbon filament type invented by Thomas Edison in the U.S. and Joseph Wilson Swan in the U.K.

This first complete electric light installation in a public building is well documented. The 1158 electrical fittings included 114 lamps in the auditorium, 220 in the dressing rooms and circulation areas, and 824 lamps for stage light, the vast majority of which were located overhead. These lights were divided into six groups, four of which could be variably controlled in six increments between slight glow and fullest intensity via a resistance dimmer. Figure 8 indicates that six years later, the Paris Opera increased the amount of control three-fold with an 18 dimmer handle arrangement located within earshot of the prompter. [figure 8]

Although Henry Irving used light as a means of advancing his idea that "the purpose of stage art is illusion" (Stoker 15), Adolphe Appia a few short years later espoused a quite different theatrical aesthetic that influenced lighting design throughout the twentieth century. Appia's vision was more expressive than illusionist. In his description of the

staging of *Tristan and Isolde*, he in a sense defines the expressive use of stage design, "The audience must see the world of the protagonists as they themselves see it" (qtd in Simonson 21). In *Music and the Art of the Theatre* he wrote more specifically of lighting, "lighting, apart from its obvious function of simple illumination, is the more expressive [than spatial arrangement]. This is so because it is subject to a minimum of conventions, is unobtrusive, and therefore freely communicates external life in its most expressive form" (Appia 22). Perhaps the most influential of Appia's ideas however, was his rejection of two-dimensional scenery. He felt that the three dimensional human form, lighted three-dimensionally by electric lights, should not appear in front of flatly painted illusionist scenery.

Appia designed very few actual productions, however; his impact was largely theoretical. David Belasco in the U.S., working with lighting engineer Louis Hartmann depicted in Figure 9 along with a metal worker and "midget" on a stand from Hartmann's shop, was one of the first twentieth century directors to make extensive use of the capabilities of electric light (Pilbrow 177) on productions that were sometimes visual extravaganzas. [figure 9] The sunrise and sunset effects he employed in a 1902 production of his play *Madame Butterfly* on which Puccini's opera is based are widely cited for their innovative use of multiple electrical sources colored with silk screens (see History Project). The simple lensed spotlights Hartmann describes in his 1930 *Theatre Lighting: A Manual of the Stage Switchboard* are no longer in theatrical use, but his names for them such as "baby" and "midget" are still heard on film and video sound stages to describe small fresnels.

In the early years of the twentieth century, stage lighting was largely designed, if designed at all, by visionary directors such as Belasco (with Hartmann's assistance) or Max Reinhardt in Germany. Alternatively, set designers such as Donald Oenslager or later Jo Mielziner oversaw the lighting of the stage as well as the design of the setting. More often then not, however, the lighting wasn't "designed" at all. Theodore Fuchs, in his 1929 *Stage Lighting* wrote, "The lighting is left until the dress rehearsal for the stage electrician (who has seen the production for the first time) to work out as best he can. Under this deplorable system, which is the result of economic conditions, good lighting is usually accidental, and in many productions is just as one would expect it to be – utterly inadequate, meaningless, and ugly" (Fuchs, qtd in Owen x).

In the foreword to Hartmanns' *Theatre Lighting*, Belasco writes, "For twenty-eight seasons the programs of my plays have carried this line: "Electrical Effects by Louis Hartmann."….Mr. Hartmann is an expert in lights, shading and coloring, an artist who paints with light-beams and diffused glows instead of pigments and brushes" (v). However, lighting design as the specialization we currently consider it to be emerged largely during the 1930's, in the work of Abe Feder and Jean Rosenthal, and the 1940's with Peggy Clark. Both Abe Feder and Jean Rosenthal (first as a stage manager) established their theatre careers with the Federal Theatre Project while Peggy Clark worked early in her career as a technical assistant to set designers, often serving, de facto, as the lighting designer.

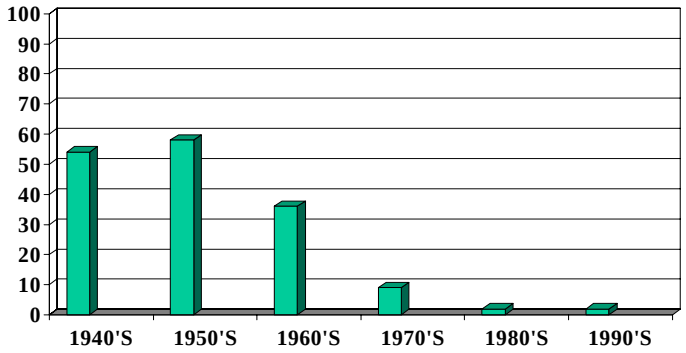
Rosenthal credits lighting educator Stanley McCandless, however, as being "the grandfather of us all" (Rosenthal 16). McCandless was trained as an architect but was brought to Yale to teach theatrical lighting. In his *Syllabus of Stage Lighting* and *A Method of Lighting the Stage* published a few years later, he codified a method for illuminating the stage. His method consisted of manipulating four properties of light (intensity, color, distribution, and control) to achieve four functions of light (visibility, form, naturalism, and mood). His method led primarily to uniform and consistent visibility on a stage broken down into "acting areas" lighted from a 45 degree angle above and to either side of the actor, an angle of light espoused much earlier by others. Yet, because no one before had organized stage lighting in such a coherent way, his method influenced designers throughout the remainder of the twentieth century. McCandless' method was not without its limitations, however. Jean Rosenthal notes, "the stumbling block for McCandless was that much as he loved light he did not know how to apply it dramatically" (Rosenthal 16).

In addition to his influence as an educator, McCandless worked for Century Lighting during the development of the ellipsoidal reflector spotlight, or ERS, which became the most prevalent stage lighting unit in the second half of the twentieth century. McCandless developed an early ellipsoidal reflector fixture that was then further developed by Joe Levy, who, along with his Century lighting partner Ed Kook, is credited with inventing the ellipsoidal reflector spotlight (ERS) called the Lekolite or "Leko" (for **Le**wis and **Ko**ok) patented in 1933 ("History Project"). It is worth noting that Century's primary U.S. rival, Kliegl Brothers, patented its own ERS at around the

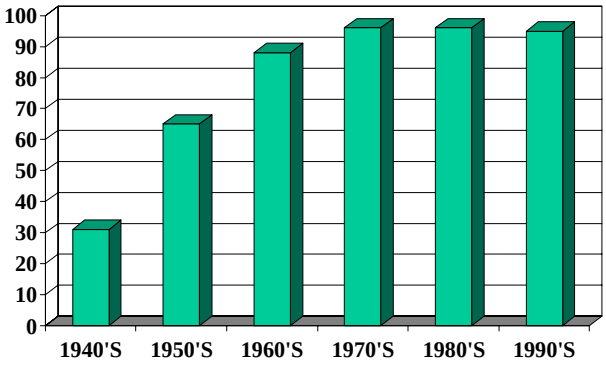
same time. Until 1992 when Electronic Theatre Controls introduced a significantly more efficient ERS, the "Source 4," the trade name Leko was used to mean any ERS much as Kleenex or XEROX are used to describe tissues or photocopiers.

Lighting design matured as an art form during the middle part of the twentieth century, receiving more and more recognition as such in the commercial theatre and elsewhere. Throughout this period, the credit "set and lighting by" was seen less and less frequently and the individual "lighting design credit" became the norm on Broadway, as these two tables (from Essig "Shoulders") indicate:

PERCENTAGE of BROADWAY PRODUCTIONS WITH COMBINED SET/LD CREDIT



PERCENTAGE OF PRODUCTIONS WITH LIGHTING DESIGN CREDIT



In 1962, United Scenic Artists, the union of professional theatrical designers, recognized the equality of the lighting designer with the other design disciplines by granting lighting designers their own membership category.

Lighting design and its history has always been influenced – some would say driven – by technical developments, especially as they relate to control systems. As noted earlier, crude resistance dimmers were used at the Savoy Theatre as early as 1881 and as late as 1979 resistance dimmers were still in use on Broadway on the musical *Dancin'*, although these were of somewhat greater sophistication and quantity. As long as dimmers were mechanical and of large capacity, lighting control was limited to broad swaths or "washes" of light with a few isolated specials more specifically controlled through auxiliary plates or preset boards (sub-boards of the larger resistance dimmers). Hartmann, as early as the 1920,'s even provided local control of individual lights with "field rheostats" (Hartmann 65).

With the advent of electronic dimming, lights could be controlled with greater specificity, allowing the stage mosaic to be composed with finer resolution. The thyratron tube dimmer, developed by George Izenour at Yale, was controlled by a mechanical remote control console, which could be installed in a location from which the operator could actually see the stage. Frederick Bentham, meanwhile, was working in England on "The Light Console," another early remote system.

Because, in part, the transition from DC power to AC power would require a tremendous capital investment on the part of theatre owners, Broadway was one of the last bastions of the mechanically controlled resistance dimmers that had been used since the earliest days of electric lighting. A computer control console driving electronic dimmers famously made its Broadway debut on *A Chorus Line* when it moved from the Public Theatre to Broadway in 1976. In an interview published shortly after that production opened, lighting designer Tharon Musser summarized the positive impact of the then cutting-edge technology:

> …its exciting that the computer age is allowing us to realize the kind of movement in light and the flexibility we want to achieve. In the beginning we did well just to provide visibility. Now we're beginning to be able to choose the kind of visibility we feel is right for a production. We can make light move in ways we never could before. And we haven't even begun to tap what computers can do. We can get a consistency of show we were never capable of before." (Musser 18)

The increasing availability of computer consoles created a focus on the technology of lighting – and away from the art of lighting – that designers like Musser had been working to remediate throughout their careers. Peggy Clark offered this reminder, just a few months after the Musser interview: "True, these fine sophisticated modern control boards can remember cues and duplicate them. But they can't plan, select, hang, color or focus the equipment for a show (THANK GOODNESS!) to make a composition, create a mood or time of day, or invent a concept for the lighting of a show…." (Clark).

Lighting designers of the generations following Clark, including Jules Fisher, Ken Billington, and later Natasha Katz and others, effectively integrated not only computer consoles but also automated lighting, the next important technological development, into their designs. Experiments in remotely controlled color changing date back to the nineteenth century, but it is widely accepted that the first commercially viable automated light was developed by Show-Co, a Dallas-based production company, for the rock band Genesis in 1980. Genesis wanted a color-changing moving PAR head for their 1980 tour and from that request the Vari-Lite was developed. Although the very first Vari-Lites would be considered crude when compared to the automated equipment available today, at the time, the ability to have an entire bank of lights move in unison while changing color was quite extraordinary (Essig *Speed* 50).

Automated lights were used primarily in rock concerts, industrial shows and Vegas extravaganzas until the late 1980's when the standardization of control console protocols made it possible for a modest number of automated lights to be integrated with fixed-

focus lights in musical or dramatic productions. This standard was a digital multiplexed serial protocol, developed originally by the United States Institute of Theatre Technology (USITT), called DMX512. It provided a standard way for a control console manufactured by any manufacturer that adopted the protocol to communicate with not only any dimmers, but also automated lighting attributes. In recent years, as automated light manufacturers increased the number of controllable attributes, and lighting designers increased the number of automated lights used in productions, it was no longer practicable for the automated and conventional lights to be run from the same console. It is not uncommon for a large production today to have three consoles driving three different areas of the lighting rig: one console for conventional fixtures, a dedicated moving light console for the automated lights, and a third computer driving projections, media and effects.

In our present day, the increased use and integration of media with live performance is starting to have an effect on lighting design technology and practice as manufacturers and developers work toward the seamless integration of digital projection with automated lighting fixtures and controllers. As lighting design moves into the future, it is likely to become an even more multi-disciplinary field, continuing the intellectual and artistic practice of design conceptualization using emerging technologies such as wireless remote control of multiple automated lights, and the integration of multimedia elements with the stage lighting.