Modelling Light: The transformative role of the model and the miniature studio in the development of lighting design practices in the UK

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Biography

Nick Hunt was a professional lighting designer and technician before starting to teach lighting design at Rose Bruford College, where he is now Head of the School of Design, Management and Technical Arts. His research interests include the performative potential of light, digital scenography and performance, theatre technology history, and the roles and status of theatre-making personnel. He is currently researching the relationship between photography and scenography. Nick is an Associate Editor of the International Journal of Performance Arts and Digital Media and is a co-convenor of the Scenography Working Group of IFTR.

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Abstract

As a plastic, immaterial medium, the use of light on stage is challenging: how to experiment, test, develop and communicate lighting intentions in advance of the performance? How, in other words, to *model* light? And for lighting practitioners, how to acquire, hone and reinvent techniques and a design sensibility? Lit models have been used for these purposes since at least the start of the twentieth century, working at various scales from the traditional 1:24 or 1:25 of the scenic designer's model up to room-sized, quarter-scale model studios. In this article, I trace the crucial role of model-scale lighting and miniature lighting rigs in the development of lighting practice in the UK at key historical moments: in the 1950s when the named role of lighting designer first appeared; in the 1990s when dedicated degree-level lighting design education began and when the model studio concept initiated the practice of pre-visualisation and pre-programming of lighting for the concert stage, before the advent of 3D software visualisation. I argue these developments were vital to the establishment of performance lighting in the UK as an artistic practice in its own right, and propose the model-scale lighting studio has a continuing role for lighting designers' development.

Introduction

The scenographic use of light as a part of performance offers some specific challenges, arising from its nature as a plastic and immaterial medium. These challenges are particularly shaped by two of the dominant tropes of contemporary Western performance: rehearsal, and the presumption of a darkened performance space. Visually, theatre comes 'out of black,' with darkness presumed to be the initial, neutral state to which light is added deliberately and consciously through a process of design and development. Such a process requires rehearsal, yet rehearsal time under performance conditions requires all performance elements to be present and so is limited by cost. From these fundamentals arise a series of questions: who is to be responsible for the creative use of light, and how is their role and responsibility to be defined? What skills and sensibilities do they need, and how are these to be acquired? How are lighting intentions to be formulated, communicated and agreed in advance of the actual performance, given light's immaterial nature? How can light and lighting be *modelled*?

While these questions are now to a large extent settled through established professional and educational practices, this was not always the case. The twentieth century saw enormous change in performance lighting, partly driven by technological developments, with the now-familiar role of the lighting designer emerging in the US, the UK and elsewhere in the middle decades of the century. During the twentieth century, model-scale lighting systems were instrumental in advancing professional lighting design practice and education, and in addressing the kinds of questions I identify above. It is this story – specifically in the UK context – I want to trace here.

Beginnings

Prior to the twentieth century, there are some notable examples of the use of lit models as elements of performance or as artworks in their own right. In the seventeenth century in Germany, Joseph Furttenbach conceived a type of theatre that combined models of architecture and scientific instruments with live performance, lit by controllable oil lamps. In the eighteenth century, Phillippe-Jacques de Loutherbourg's *Eidophusikon* was a miniature theatre presenting the natural world in the form of landscapes and cityscapes, with elaborate lighting effects to present different times of day and types of weather. However, the use of model scale lighting as a way to develop a lighting scheme for use in a later, full-scale performance first becomes established at the start of the twentieth century, following the widespread introduction of electric lighting in theatres (mainly for safety and convenience rather than artistic reasons).

Edward Gordon Craig, developing his ideas for a radically new approach to staging, created large-scale models to test and promote his concept of a scenography of movable screens, which relied heavily on the careful control of light to create the expressive effects he sought. Making his first model theatre in 1907, Craig went on to exhibit to the public a model of his screens in 1911, while developing designs for a production of *Hamlet* for the Moscow Art Theatre the following year. During an extended rehearsal and development process, Craig had built a large-scale model of his designs complete with a replica of the Art Theatre's lighting system, so that the movement of the screens and the lighting could be rehearsed (Brejzek and Wallen, 2018). At around the same time in the USA, Norman Bel Geddes was building a model theatre complete with an electric lighting system, to experiment with new approaches to staging. In 1921 Geddes created designs for an unrealised production of Dante Alighieri's *The Divine Comedy*. Conceived on a vast scale, Geddes created a large model

eight feet square, incorporating dramatic lighting revealed by smoke effects that prefigured Josef Svoboda's scenography of light in the second half of the century.

By the nineteen-twenties and nineteen-thirties in the UK, there was considerable interest in finding out how to exploit the greater control offered by advancing lighting technology. The writings of Adolphe Appia, Edward Gordon Craig and others fostered radical new thinking about the nature of theatre, stage design and the role of light, and gave a conceptual and artistic impetus to experimentation. In this period, the model theatre was promoted as a tool for practitioners to try out ideas in advance of the production. A British Pathé documentary film *Stagecraft* from 1933 shows the use of a model stage as part of the design and planning process, including scale lighting. As the voice-over explains, 'all the paraphernalia of a big theatre stage is here: tabs, curtains, and spot- and flood-lights. These lights are very important, for lighting effects play a very prominent part in the decoration scheme of stage sets today. Colour blending, too, takes a good deal of time, and is a gift, more than an art.' Theatre consultants C. Harold Ridge and F. S. Aldred argued the importance of using model theatres as a tool for experiment and developing design ideas while claiming it as established practice:

> All serious practitioners of the art of the theatre use models to help them in planning a production. It is good practice to have a scale model of the stage with a complete set of the permanent rostrums and scenery. Small finickey models are more trouble than they are worth, and a minimum size, to be of any "workshop" use, should be about 3 ft. square. (Ridge and Aldred 1935, 110)

Ridge and Aldred warn about becoming too fixated on the scale mechanics of the model, however, arguing that model lighting cannot be scaled down: 'all that can be done is to get on the model a general impression of the effect desired […] This is far more valuable than to

attempt to use a miniature batten, with pea lamps run from a battery or transformer […] On a small model the use of dimming effects and miniature spotlights is of no value in arriving at actual requirements' (110-111).

Ridge and Aldred's last point touches on a matter that divides approaches to model-scale performance lighting even now: whether it is better to model the full-size rig lamp-for-lamp, or to see the smaller version not as a literal representation of a larger stage but as a miniature world unto itself, not corresponding directly to any larger space. This is not only a matter of practicality, as Ridge and Aldred suggest – rather, there is a significant conceptual shift from a model theatre with lighting, into which the set designer's model is placed to be lit, to a (typically larger, room-sized) model-scale scenographic space that enables experimentation with light as an autonomous medium. Historically, this shift has paralleled the move from light conceived as a servant to other production elements (actors, scenery, costume) to light having its own agency and role within a performance, as I go on to describe.

Light as an autonomous medium was of particular interest to the theatre technologist, Fred Bentham. Born in London in 1911, Bentham became interested – indeed obsessed – with theatre and lighting, a fascination which was to shape his whole life. While a boy he built a model theatre in a spare room in his family home, adopting an approach contrary to Ridge and Aldred's advice, using torch bulbs lacquered in three colours and white to create coloured light. 'They were assembled in rows, each of four circuits to form footlights or overhead battens […] Connected up on my stage, I started to colour-mix […] From now on, it was up to music and light to tell the tale' (Bentham 1992, 15). It was while developing his model theatre and its shows that Bentham became interested in making performances comprising of light and music, without text or (model) actors. While 'colour music' had previously been proposed in various forms – including in the eighteenth century by Jesuit,

Father Louis Bertrand Castel, and in the early twentieth century by the painter A. Wallace Rimington and composer Alexander Scriabin – Bentham's approach was a distinctive one. As a young man, Bentham started working at The Strand Electric and Engineering Company Limited (later Strand Lighting) and rapidly came to be a leading figure in the development of stage lighting technology in the UK, remaining at Strand until 1973. In the nineteen-thirties, he created a radically innovative lighting control system using technology borrowed from cinema organs and telephone exchanges – two rapidly developing industries at the time. The Light Console was designed as much to perform colour music as to control lighting for stage drama and was 'played' like a musical instrument rather than 'operated' as a machine or control system. Bentham created public performances of colour music at the Strand demonstration theatre in London, developing stage settings to light comprising either black theatre drapes or abstract, three-dimensional geometric shapes painted in a neutral colour. These shapes were designed so that applying coloured light from different directions would create contrasting colours in the shadows and highlights, due to additive mixing. In Bentham's colour music, the usual theatre hierarchy was inverted: light was not in service to the scenery and performers, but the stage setting was in service to light. Bentham often performed to classical music such as Tchaikovsky, while his colleague Paul Weston specialised in jazz – his rhythmic, syncopated pulses of light prefiguring the kind of lighting dynamics that are now an established part of rock concerts.

Bentham's colour music was only ever a minority interest, although his *Kaleidakon* – an internally illuminated tower where the colours could be 'played' on a Light Console – featured at the Ideal Home Exhibition at Earl's Court in 1938, gaining publicity in the national press. Nevertheless, colour music had a significant impact on theatre lighting, because Bentham's Light Console made a radical proposition: that lighting should be rehearsed and performed, rather than designed in advance and reproduced by rote. The

interruption of World War Two and later changes in lighting technology and practices meant that the Light Console was not widely adopted, but for a time there was a debate about how performance lighting should be made – whether it was a matter of *rehearsal* leading to *performance in the moment*, or of *creative design* followed by *rote reproduction.* This debate arose directly from Bentham's model theatre, with its torch-bulb lighting, and his insight that in that model – and later in the Strand demonstration theatre – light could be an abstract, expressive medium in its own right, or at least in combination with another abstract expressive medium, music. (for a more detailed account of Bentham's Light Console and the ideas it represented, as well as my research into the concept of 'lighting artist as performer,' see Hunt 2013a, 2013b, 2015).

The first lighting designers

The role of the lighting designer as we understand it today emerged at different times in different parts of the world. In the UK prior to the nineteen-fifties, creative lighting decisions were made by the director (then generally called the producer) while technical implementation was overseen by the Chief Electrician or Stage Engineer. Michael Northen is widely recognised as the first credited lighting designer in the UK, but began his career as a Stage Manager and Stage Director in London. After serving in the RAF in World War Two, Northen returned to London and started working again as a Stage Director, but found it unsatisfying. He decided to build an accurate-to-scale model theatre, to help theatre designers develop their designs, so avoiding later alterations that Northen knew to be expensive and time-wasting. Northen funded his model with the gratuity (over £300) he received on leaving the RAF. He built it in the top-floor spare room of his family home in Cheyne Row, London, and the model was ambitious from the start:

> I decided that the stage had to be large enough to be adapted to the size of the Opera House and then down to the most intimate theatre. The model was to be completely versatile so that at a moment's notice the stage could be changed to any required shape or size. I used the then recognised scale for all models and drawings of half an inch to a foot […] The actual opening on my model was 60 inches wide and 40 inches high. (Northen 1997, 64-65)

From the beginning, Northen's model theatre incorporated lighting, using equipment made by Robert Stanbury, who taught lighting to theatre design students at the Wimbledon School of Art. Stanbury's equipment was not exactly to scale for Northen's model but was small enough to represent the various spotlights, lighting battens and cyclorama lighting of a real theatre. The model was soon successful in gaining Northen work, both as a technical assistant and as a lighting designer. Sir Francis Rose asked Northen to help him with his designs for a new ballet, *La Peri*, for the Serge Lifar Ballet Company, and Lafir came to see the model set. Northen recounts, 'In the meantime I had roughly lit it, really for my own amusement and to see how effective the miniature lighting was. I was astonished when he asked me to light the London production' (65).

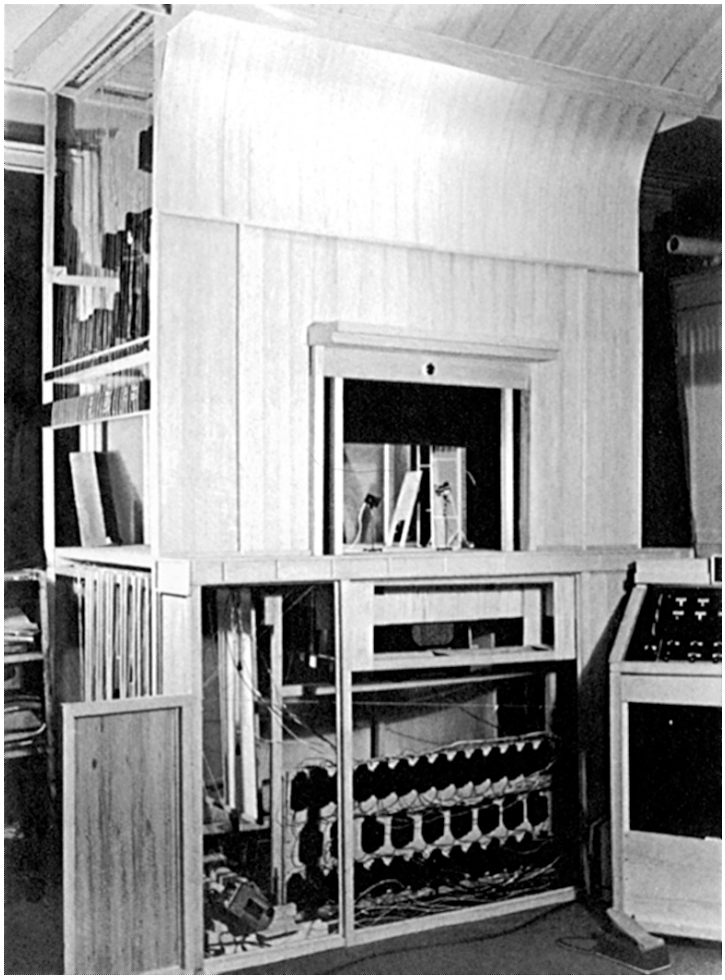

Figure 1. Michael Northen, model stage, Cheyne Row. Photograph by Hummel. (First published in *Northen Lights* [Chichester: Summersdale Publishers, 1997]). Reproduced courtesy of Entertainment Technology Press.

The model was a curiosity in theatre circles, and soon Northen gained further employment as a technical assistant to designers. Through this work, Northen got to know, and became trusted by, set designers and through them directors. In 1949 he was asked by Peter Brook to assist with Brook's designs for the production of *Measure for Measure* he was directing at the Shakespeare Memorial Theatre in Stratford-upon-Avon the following year. In 1950, John Gielgud then asked Northen to light the Stratford production of *King Lear* he was directing and starring in, and in the same year Northen lit *Rosmersholm* in the West End. Northen continued to work as a technical assistant to designers until 1957, but was

increasingly drawn to lighting design as a more creative process, and recognised that the increasing technical complexity of lighting systems meant that designers would be more and more needed in the future. However, at the time the lighting designer did not exist as a distinct professional function. It was by building relationships with first designers and then directors that Northen could establish himself in an unknown and untested role. He was able to demonstrate both the artistic sensibility and technical know-how required for directors to have confidence in him, and his model theatre was critical in making this professional move. Firstly, it served as a meeting place, bringing designers and directors to him; Northen consciously arranged the model to allow space for visitors: 'The model was built between the two windows, which left plenty of room for directors and designers to see the stage comfortably from both sides as well as from the front' (65). Secondly, he was able to demonstrate lighting within the model: the complex miniature lighting system allowed detailed lighting plots to be created and shown, the effect of light on the set designer's painted and detailed model to be established, and technical details of lighting positions, and so on, to be tested. This rigorous preparation gave designers and directors confidence that Northen understood what was needed artistically and knew how to create it technically.

Figure 2. Michael Northen, working at Cheyne Row with Sir John Gielgud. (First published in *Northen Lights* [Chichester: Summersdale Publishers, 1997]). Reproduced courtesy of Entertainment Technology Press.

Michael Northen was not the only early lighting designer for whom a lit model was a vital means to establish a career. Richard Pilbrow was passionate about all aspects of theatre as a boy, involving himself in school and youth theatre productions, and building a series of model theatres – complete with lighting – in which he staged 'elaborate miniature productions [that] took almost every waking hour' (2008, 7). As a teenager, Pilbrow read Edward Gordon Craig's *Art of the Theatre*, and was struck by Craig's conception of the Stage Manager as a 'Master of the Art and Science of the Theatre.' He determined he would become – in the Craigian sense – a Stage Manager, which we would today term a Director.

Pilbrow went to study stage management at the Central School of Speech and Drama, and on finishing in 1956 took a job as Deputy Stage Manager at Her Majesty's Theatre, London. Two things then happened that set Pilbrow on a path to becoming a lighting designer. Firstly, he read *Theatrical Lighting Practice* by Joel Rubin and Lee Watson, which introduced him to the idea – in the US context – of the established profession of the lighting designer. In the UK, only Michael Northen and Joe Davis had begun to be recognised (and credited) in the role. Secondly, Pilbrow met Michael Northen and saw his model with its lighting equipment by Robert Stanbury, which was revelatory for Pilbrow:

> In a bedroom was a complete model stage with rows of miniature spotlights. [Northen] told me that he could show producers what their lighting would look like on the real stage. My prime possessions for years had been a series of model stages […] but I'd never been able to work out how to do adequate lighting to scale. This was a breakthrough […] Lighting had been my hobby since my early teens. Now I saw that it could be a real profession! Lighting design could be my future! (Pilbrow 2008, 18)

Pilbrow recognised that, following the example set by Northen, he needed to rebuild his model theatre as a professional tool. He did this initially in the band room of Her Majesty's Theatre, but soon afterwards Pilbrow started his company Theatre Projects and moved the model to his rented premises in Whitcomb Street, London.

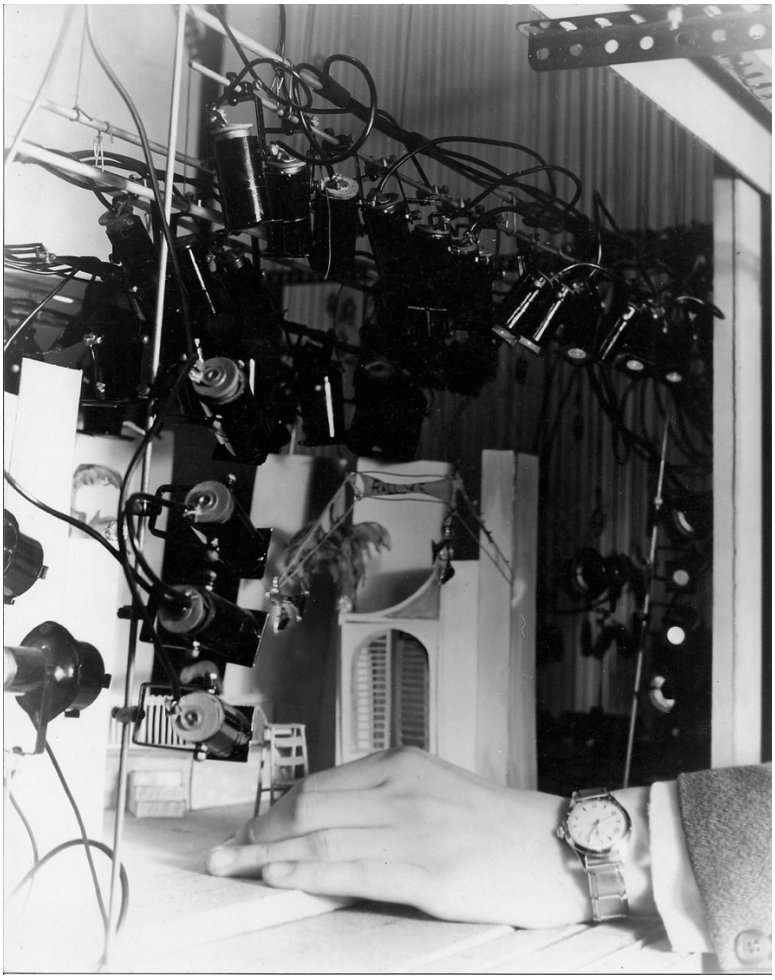

Figure 3. Richard Pilbrow's model theatre. Reproduced courtesy of Richard Pilbrow.

In 1958, Pilbrow lit *Lady at The Wheel* at the Lyric Theatre, Hammersmith, directed by Wendy Toye, with sets designed by Richard Negri and costumes by Motley. Negri brought his set model to Whitcomb Street, and Pilbrow lit the show scene by scene. He went on to light a season of five shows for the new 59 Theatre Company, also at the Lyric Theatre, Hammersmith, and again Pilbrow pre-lit the entire season on his model. The designer's set model was largely complete when it was lit in Pilbrow's model theatre, including paint finishes, which allowed experimentation with coloured light, using small pieces of the actual colour filters that would be used at full size, allowing colour effects to be gauged accurately. According to Pilbrow, Negri was particularly interested in backlighting backcloths and experimented with various materials such as tracing paper and vellum. For an Old Vic

production of *Richard II* in 1960, Pilbrow 'lit the whole show scene by scene on the model and it looked fabulous. The real show looked exactly like the work we had done on the model' (Pilbrow cited in Jones 1999, 19-20). Stanbury's miniature lights were essential to the success of the model lighting system; according to Pilbrow 'you could be terribly accurate […] The fixtures focused and had a beam. You could create the acting areas on the model and show patterns and beam projections' (19). As with Michael Northen, Pilbrow's model was critical to his establishing himself in the largely unknown role of the lighting designer. As directors and producers came to understand the value of having a lighting designer, the need for the model reduced, and it fell into disuse. Setting up the lighting for each show became too time-consuming, and the model was lost in later office moves as Theatre Projects grew.

While his model was relatively short-lived, it carries a significance beyond helping Pilbrow start his career. Pilbrow and Northen's models both proposed the lighting designer *as a designer*, comparable with the other, longer established design roles of set designer and costume designer. Inherent in the conception of 'designer' is the making of creative decisions in advance of the performance, contributing to the artistry of the production, not only responding to it or facilitating the ideas of others. The model is a focus for this process, a place of experimentation, testing, sharing and collaborative decision-making. While the professional practice has largely moved away from lighting models, and established lighting designers have working relationships with directors and others based on experience and trust, early-career designers still face the challenge of how to communicate their ideas and build the confidence of their collaborators when working in an immaterial medium. Today, scenic designers have models, costume designers have drawings, and sound and video designers can create and play digital media to develop and share their ideas as part of a collaborative creative process; only lighting designers have no ready, professionally established equivalent

means. I would argue that the role of both lighting designers and light on stage is significantly and detrimentally shaped by this difference in process. Until the lighting process begins in the theatre space itself, light remains a matter for individual imaginations and communication via oblique verbal descriptions and perhaps visual references and sketches; light's immateriality becomes doubly immaterial. The sharing of affective experience – light's heat and glow – as part of an experimental and collaborative process was briefly enabled by the lighting designer's model, and it's falling away just as the professional role was starting to become established was a significant loss that has never been entirely recovered from.

Larger scales: the commercial studio

Pilbrow's model was not without a traceable legacy. Steve Kemp joined Pilbrow's company, Theatre Projects, as a lighting design assistant in 1970 (Williams 1991, 37). By the time Kemp started at Theatre Projects, Pilbrow's model was no longer in use, but it seems very likely Kemp would have known about it. Kemp moved to the Netherlands in 1983 and set up his own design and consultancy office in 1986, where he created a model theatre on a much larger, 1:4 scale. Although Kemp died in 1991, his model continues as the Steve Kemp Theatre, part of the Instituut Lichtontwerpen (Institute of Lighting Design). Kemp's large-scale model is significant here in two ways: firstly, as I show below, it helped influence an important development in lighting design education; and secondly, it pre-figured a remarkable innovation not from the world of theatre but from concert lighting.

By the late nineteen-eighties, pop and rock concert touring was big business, with major acts on international arena and stadium tours taking very large staging, lighting and sound set-ups from venue to venue. With productions growing in scale, and so in technical

and logistical complexity, production rehearsals came to be a significant cost for producers, resulting in pressure to minimise the time spent, while maximising the quality and impact of lighting as part of the show. It was during the preparations for the Rolling Stones' *Steel Wheels* tour in 1989 that the lighting designer Patrick Woodroffe and his associate Steve Nolan began to imagine a model-scale facility for rock concert lighting (personal correspondence and telephone interview, October 2017). According to Woodroffe, 'we wanted to find a way to "see" lighting in some sort of virtual sense without having to build the whole thing in real scale.' Woodroffe and Nolan were inspired in part by a relatively new type of small light, the PAR16 – popularly known as a 'birdie' – which was a product of the booming trade show industry in the nineteen-eighties (Halliday 2008).

In 1991 Woodroffe and Nolan opened the 4:1 Studio, named after its scale size, itself determined by the birdie being modelled on but approximately a quarter the size of a standard parcan – the quintessential rock and roll light source of the time. The studio was a commercial operation, available for hire by lighting designers and tour production companies wanting to rehearse at model scale, with an emphasis on the time-consuming process of programming the lighting. Located under a railway arch in Battersea, south-west London, the studio was on a larger scale than any of the models I have described so far. A scaffolding structure provided suspension points for lighting and scenic elements. 24 feet was a typical 'trim height' for the front and rear lighting trusses on concerts, which corresponded to 6 feet in the model. Upwards of three hundred birdies allowed large rigs to be assembled, and other types of miniature concert lighting equipment included 'molefay' eight-lights (using the smaller MR11 lamp) and working colour scrollers to mimic the scrolling colour changers that were in widespread use at the time. Control was provided by a full-size lighting console, the Celco Gold, which was then the market-leading console for concert touring. The Celco Gold had a then-novel removable memory card on which the data for the show plot could be

stored. Lighting designers could programme their show, working to recordings of the music and building in detail the lighting states and cue sequences, and then take away a data file with the lighting programming on it to refine and finalise during full-size rehearsals. The 4:1 Studio thus enabled a remarkable advance concerning model-scale lighting: the model could be used not merely to 'model' light as a kind of demonstration or maquette, but to rehearse the lighting for later deployment as part of the actual show.

Figure 4. The 4:1 Studio in Cologne, set up as a demonstration of a typical corporate event, with wooden mannequins to represent people. Reproduced courtesy of Wilfried Schiefer.

The 4:1 Studio had model drum kits, backline equipment, and 18-inch-tall wooden mannequins in costume to represent the band members. The scenery companies building the full-size staging also provided a model scale version for use in the Studio, and stage fog machines thickened the atmosphere to reveal the beams of light. Rock concert lighting relies on abstract images constructed from the physical lighting rig itself, with repeating patterns of light sources in view arranged on geometric truss structures, together with beams of coloured

light revealed by artificial haze. Lighting design for the concert stage is often as much about creating these dynamic, expressive abstractions as it is about lighting the performers or scenic elements, and the 4:1 Studio made it possible to model such lighting. Where designers such as Norman Bel Geddes and Josef Svoboda who wished to explore light and atmospheric effects had to either build one-off models or experiment at full scale during extended stage rehearsals, the 4:1 Studio promoted experimentation and model-scale rehearsal as a routine part of concert production. Nolan also emphasises the Studio's ability to promote collaborative working and a team ethos. The model stage attracted industry professionals to just 'drop by' to help out and see what was going on, and the band, management and crew of a tour would develop a sense of shared purpose, by seeing and discussing the show presented in a highly engaging way. As Northen and Pilbrow had found, the model develops collaboration and shared understanding, helping to overcome the challenge of working with light's inherent immateriality.

The 4:1 Studio was short-lived, at least in its London location; after a few years, Woodroffe and Nolan took the decision to sell it. The growing use of automated ('moving') lights was a problem for the studio as there was no way to model these to scale. Also, in 1994 a newly-formed company CAST Software introduced WYSIWYG, a computer programme that provided a virtual lighting environment. It was possible to build a venue, staging and lighting rig in 3D, and then connect an actual lighting control console to programme the lighting. While the wire-frame rendering in the early versions was crude, it signalled an entirely new, more flexible approach to pre-programming, although one that is arguably less collaborative and engaging, especially for artists, managers and clients. The 4:1 Studio reopened in 1995 in Hürth, near Cologne, under the ownership of Wilfried Schiefer, where it was used to rehearse a diverse range of live entertainment and corporate productions and concert tours for German bands, as well as for education and research through a collaboration

with Beuth University of Applied Sciences, Berlin. After ten years of operation, the improvements in computer visualisation software such as WYSIWYG reduced demand for the 4:1 Studio, and it was donated to the Siemens Media Academy in Berlin, where it is used today for education and training of technicians in the German live entertainment industry.

Education: the lighting laboratory

The model-scale lighting instruments Robert Stanton made for Northen, Pilbrow and others were also used for a model theatre at the Wimbledon School of Art, where Stanton was teaching lighting at the time. Stanton's approach, as with all the models we have considered so far, was to create scale lighting instruments, as a way to reproduce, in model form and in advance, the actual lighting rig to be used for a production. The stage designer and academic Christopher Baugh saw the Wimbledon model in the nineteen-seventies but later rejected this approach. Baugh spent the academic year 1982-3 teaching scenography at Humboldt State University, California, where he found another, little-used, model lighting system. He made some use of this, and on his return to teaching at Goldsmiths (University of London) and at the London Contemporary Dance School he started using a light box as a structured part of the curriculum. Rather than seeing the model as a one-to-one correspondence to the full-sized production, Baugh developed a very different way of working at model scale, asking his students to create 'scenic space,' working rapidly and using found materials from the design studio and scenic workshop. According to Baugh, 'the learning outcomes were about transformation, scale and atmospheres of space. For this, of course, light becomes the energizing material that brings life into a space and makes it "scenic." We had some remarkable projects of great theatrical potential made from utter rubbish' (email correspondence, September 2017).

The improvisatory approach applied to the lighting as much as the scenic modelling. In a small blacked-out room at Goldsmiths, simple lighting was achieved with 'torches […] held in place with clamps and retort stands from the chemistry lab.' Later, Baugh made a platform, 80cm square and 150cm high, as an open model stage, and hung a grid above it made from a stainless steel device intended for suspending kitchen equipment. The set-up was used for teaching, student projects and scenic model presentations, and while a few birdies were introduced, the lighting continued to be low-tech but highly flexible, with no intention of replicating full-size instruments in miniature. Just as found materials drove the scenic work, so found sources characterized the approach to light: Baugh discovered at a medical supply shop disposable examination torches that provided tight spotlights in different beam sizes.

Baugh is clear in his rejection of the exact scale approach to model lighting, aiming instead to create 'the broad brush atmosphere and effect of light in a space. But we never under-estimated the really sophisticated effects that could be achieved with simple means.' The use of found materials enabled integration of all the scenographic elements, including light:

> making scenic space from rubbish was absolutely central for me and my scale (and simplicity) of presentation box allowed me to focus upon scenography, and to ignore distinctions between lights, space and scenic material.

Baugh's pioneering 'broad brush' approach that moved away from a one-to-one correlation between model-scale and full-size lighting instruments has subsequently become the dominant method of lighting education in the UK. The lit model box, working to the designers' model scale of 1:24, and the full-size lighting laboratory (a studio theatre designed for training, not performance, equipped with standard stage lighting instruments, not miniatures) were established in the US as part of degree-level theatre education at least as

early as the nineteen-eighties. In the UK, however, professional training – as opposed to degree-level education – was mostly located in drama schools, not universities, and drama schools conceptually located lighting within technical theatre rather than seeing it as a design discipline. As a result, lighting was constructed as a professional field requiring training in technical skills and procedures, rather than the development of the sensibility and creative processes of the scenographer.

Largely independently, the first half of the nineteen-nineties in the UK saw several academics working at different educational establishments develop model lighting facilities. Scott Palmer at Bretton Hall College (later absorbed into the University of Leeds) and Ian Evans at the Welsh College of Music and Drama created simple systems to light designers' models with birdies and torches, gradually developing more complex set-ups. Once established, these rigs came to be used for teaching exercises such as creating a lighting scenario for a scene for a play, as well as showing models and showing lighting ideas to other members of the production team (email correspondence and telephone interviews, September 2017).

Nigel Morgan was also active in lighting design education from the early nineteen-nineties, and his work brings together many of the themes I have already identified. As a child, Morgan had a general interest in modelling, and after going to a rock concert as a teenager he built a model concert stage lighting rig, 'using torch bulbs and powered by model railway switching and controllers to allow groups, dimming and chases. Playing the band's songs on cassette, [he] tried to recreate some of the concert lighting at home' (personal correspondence, October 2017). Morgan subsequently developed a career as a lighting designer, and later started teaching on a one-year postgraduate certificate in lighting at the Central School of Speech and Drama in 1990. Here, he found himself with only a small room

to teach in and set up a simple six-light bar of Pattern 123s (a basic and out-dated type of light with limited beam control). At a trade show, Morgan saw a miniature profile light which used the same type of lamp as the birdie, but with much more sophisticated optics, capable of accurate beam control and pattern projection. He replaced the Pattern 123s with this profile type and developed teaching exercises for the postgraduate lighting students,

> where they lit the key scenes from a play on the model box before committing to the lighting plan. This was a very successful venture and it occurred to me that this could be a new way forward into teaching lighting design that was not dependent on lighting college plays but taught the rudiments of lighting in its own right.

Critical to Morgan's vision was his experience of lighting in a retail display environment, including shop windows, where he 'gained much insight into how smaller fixtures could create lighting drama away from the physical constraints of the theatre stage.' He saw that a small-scale lighting environment could act as a place for experimentation and learning about light, not merely as a miniature simulacrum for a lighting scheme to be realised later at full size.

1994 saw the introduction of the first single-honours degree in Lighting Design in the UK, and indeed Europe, at Rose Bruford College; Morgan was instrumental in its creation and was its first Programme Leader. Here, he set up what became known as a lighting laboratory – not to the American pattern, but working at model scale, building on his work at CSSD. Morgan's lighting laboratory concept was fundamental to the pedagogy of the BA (Hons) Lighting Design programme at Rose Bruford College from its inception; the following account draws on both Morgan's reflections (personal correspondence and telephone interview, October 2017) and my own experience teaching on and later leading the programme between 1996 and 2007.

Morgan was familiar with scale models such as Northen's and Pilbrow's, and the larger format set-ups such as the 4:1 Studio and Steve Kemp's, but rejected their approach, seeing them as 'glorified displays rather than creative tools – perhaps reflective of the times they were conceived.' With limited resources available from the College, but the freedom to develop a new pedagogy, Morgan set up the first lighting laboratory from improvised materials (today the College has four, so central are they to the teaching of lighting design and technology). It comprised a blacked-out classroom with a scaffolding structure, forming a lighting rig approximately three metres square and with a grid height of 2.4 metres for easy access. A couple of ordinary tables covered in black material served as the stage. Standard portable dimmers and a small lighting desk provided control to the lighting instruments via individual transformers, similar to the systems created by Palmer and Evans. Over time, new types of miniature profile brought more flexible light sources, supplemented by the ubiquitous birdies and some small floods intended for outdoor domestic use. The remote-controlled mirror units from Clay Paky Goldenscans – a technology originally developed for the club and disco market – brought moving light capability, and were christened 'Morganscans' by students. Together with mini stage fog machines, cheap laser-pens and small motors to power moving scenic elements, they introduced the aesthetics of the product launch and rock concert.

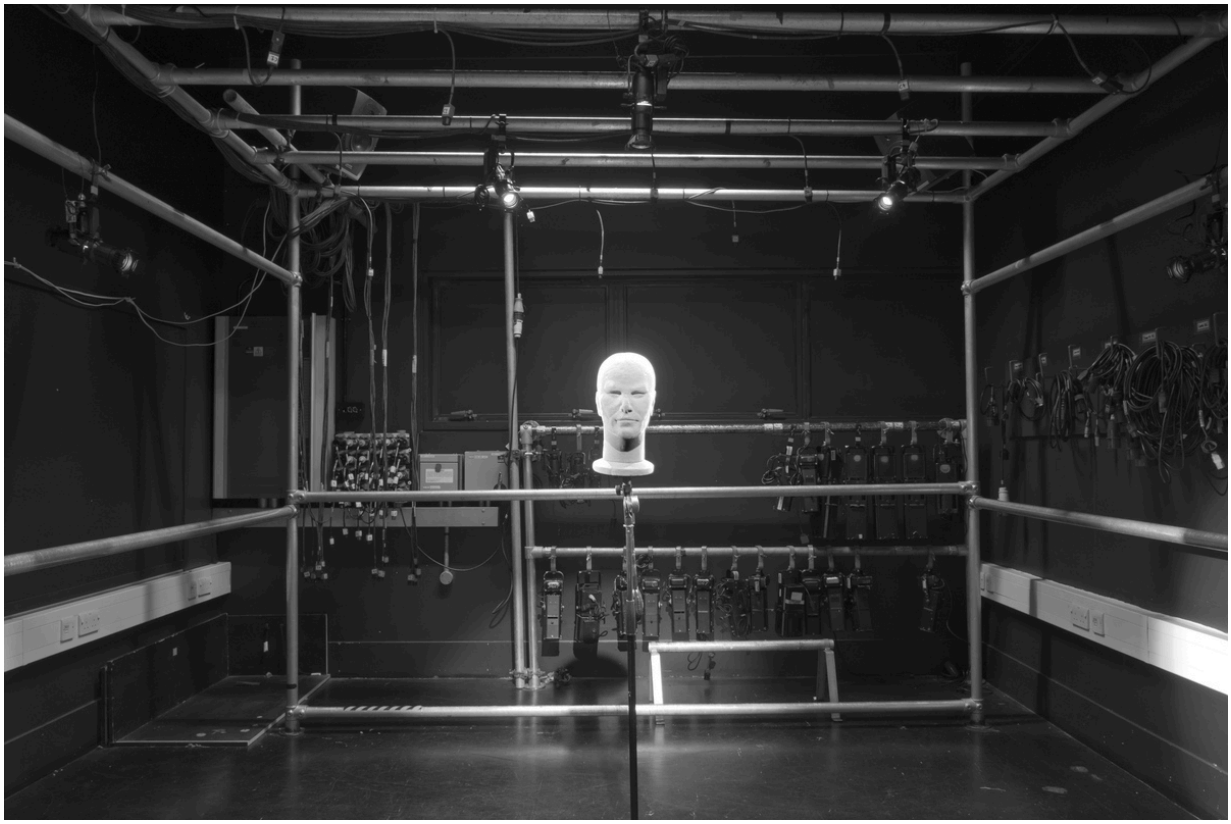

Figure 5. A lighting laboratory at Rose Bruford College, set up for a lighting exercise using a life-size model of a head. Photograph by the author.

Morgan wanted to develop a curriculum and a pedagogy that moved beyond teaching a method for lighting plays. Drawing on his musical background, he felt that there must be a 'method' for learning to light, just as there is for learning an instrument: a series of exercises that began with the fundamentals and built up to more complex techniques, independent of any particular production and free from production constraints and pressures:

> a set of exercises could be established that helped a beginner understand each parameter, practice its implementation, and get an understanding of how the variables come together, all away from the pressure of the fit up and technical rehearsals – and perhaps most importantly away from the need to service the ideas of a director and a stage designer.

As the lighting laboratory shifted the focus away from serving the ideas of others, it moved toward working with light as an autonomous artistic medium. Rather than lighting the set designer's model, lab projects used artist's mannequins and found materials or simple card or wooden blocks and surfaces – a conscious return to the expressive, architectonic scenographies of Appia and Craig, and adopting (unknown to Morgan and myself) Baugh's approach from a decade before. Students could experiment with coloured, textured and directed light interacting with the textures and colours of objects and surfaces, to discover the fundamentals of light as an expressive medium. Alex Murphy, a student on the BA (Hons) Lighting Design programme 1997-2000 and now a lighting designer for concerts, notes the important role of the lighting lab in providing a place to fail:

> I never ever have time to experiment like we did then, more importantly I never have the chance to be able to fail like I did many times in that lab. I'm currently in the process of booking the O2 Arena for the day to build a video wall and try out lights to shine through it. I suppose the practice of using a lighting lab hasn't left me. It just got bigger. (personal correspondence, November 2017)

In a time before lighting instruments with continuously variable colour were readily available, the lab offered, in particular, an unrivalled opportunity to experiment with colour. The colour filter manufacturers freely supplied swatch books that could be cut up to provide a stock of all the available colours, at a size suitable for the miniature lights. Having a stock of all the colours from all the manufacturers would be prohibitively expensive in all but the largest and best-funded full-size theatres, but in the lab it was a matter of moments to try any colour in any range. Students were free from the constraints of budgets and what was in stock, or the influence of fashion or colour names and numbers. Colour choice was democratised, and students often became very adventurous with their choices in the lab – far more so that in their full-size practice.

As I taught alongside Morgan for several years in the late nineteen-nineties, we developed a progressive series of exercises and projects of increasing complexity and sophistication. We encouraged students to see these as performances in themselves – autonomous works – not merely mock-ups of some imaginary, never-to-be-realised performance 'elsewhere.' Typically of three to five minutes duration, and working within a stage space of around one metre cubed, the brief would be to create a *son et lumière* performance in response to a piece of music, a short narrative description, a dramatic scene or an entire play. Students would sometimes be given and sometimes create whatever scenic elements and soundscape were required. The best work was beautifully produced, highly theatrical, and occasionally genuinely moving. Jytte Basler, a student on the BA (Hons) Lighting Design programme 1999-2002 and now an architectural lighting designer, emphasises the importance of narrative:

> Most of all I really enjoyed exploring – and getting to know and maybe understanding – the idea that LIGHTING can carry a narrative […] for me that was the main outcome/understanding I got from those projects: lighting carrying a story, adding a layer of interpretation, giving meaning, adding poetry. I know that that approach heavily influenced me in my career, (even) in architecture. (personal correspondence, November 2017)

The model-scale lighting laboratory concept brings together the fundamentals of the expressive use of light in performance: the exploration of how light together with space and time and physical materials can create narratives and worlds. In the mid nineteen-nineties, the lab was the key to turning a technical training into a lighting design education in the UK.

Conclusion

We can trace a more-or-less continuous history of miniature and model-scale lighting systems for professional and educational use from at least as early as the nineteen-thirties until the present (including examples I have not had space to describe here). In this history, certain themes emerge: Bentham, Pilbrow and Morgan all had childhood model theatres; technological developments borrowed from other applications enable innovation (torch bulbs, the MR16 lamp, miniature profile lights intended for museum and retail display, re-purposed medical and scientific equipment); influences from new fields of lighting practice (the emergence of concert lighting and lighting for trade shows, the convergence of retail lighting and theatre).

Today, the model-scale lighting laboratory concept is well-established in lighting design education in the UK, as is its full-scale equivalent in the US. At least two small manufacturers in the US produce commercial-scale model lighting systems (Yeager Labs and Charles Kirby Designs), again mainly for educational use, and in small numbers. In the professional field, however, pre-visualisation is dominated by virtual software-based systems such as WYSIWYG, which integrate visualisation, pre-programming on the lighting console, rig plans, equipment inventory, power and weight loads, transport logistics, and other aspects of the technical planning process, bringing great benefits to the *management* of stage lighting. However, I would argue that model lighting has – at two historical moments – vitally shaped the development of performance lighting practice in the UK. In the nineteen fifties, as the professional role of the lighting designer was emerging and still being formed, two of the most significant early designers, Northen and Pilbrow, used their scale model theatres to establish themselves with directors as suitable collaborators, demonstrating both the artistic and technical expertise to reliably deliver the lighting for a production while advancing the

state of the art. The introduction of the named role of 'lighting designer' was perhaps the biggest single step in the long, slow and still incomplete shift of theatre lighting from technical to design discipline. Forty years later, lighting design emerged in drama school training and education as a recognised subject, separate from a generalised conception of 'technical theatre.' Establishing named degrees or degree pathways in lighting design was again a significant step in the professionalization of the role, while the invention of the lighting laboratory as a miniature experimental performance space was foundational in creating a pedagogy that promotes the artistic use of light as an autonomous medium, not simply a performance element subservient to text, performer and scenery.

The lighting laboratory – especially as conceived by Nigel Morgan – also proposes a third, yet-to-be-taken step. While conceived in terms of education and training, Morgan's approach opens up a radically wider vision for the scope of the artistic practice of the lighting designer, far beyond an initial learning phase. Morgan's analogy between musician and designer suggests there must be an equivalent for the lighting artist to the pianist's 'scales and arpeggios' – a systematic approach to developing and maintaining the designer's technique and sensibility. And if professional lighting artists should practice, then the laboratory perhaps offers a place to play, experiment and exercise, akin to the musician's practice room or the artist's studio.

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