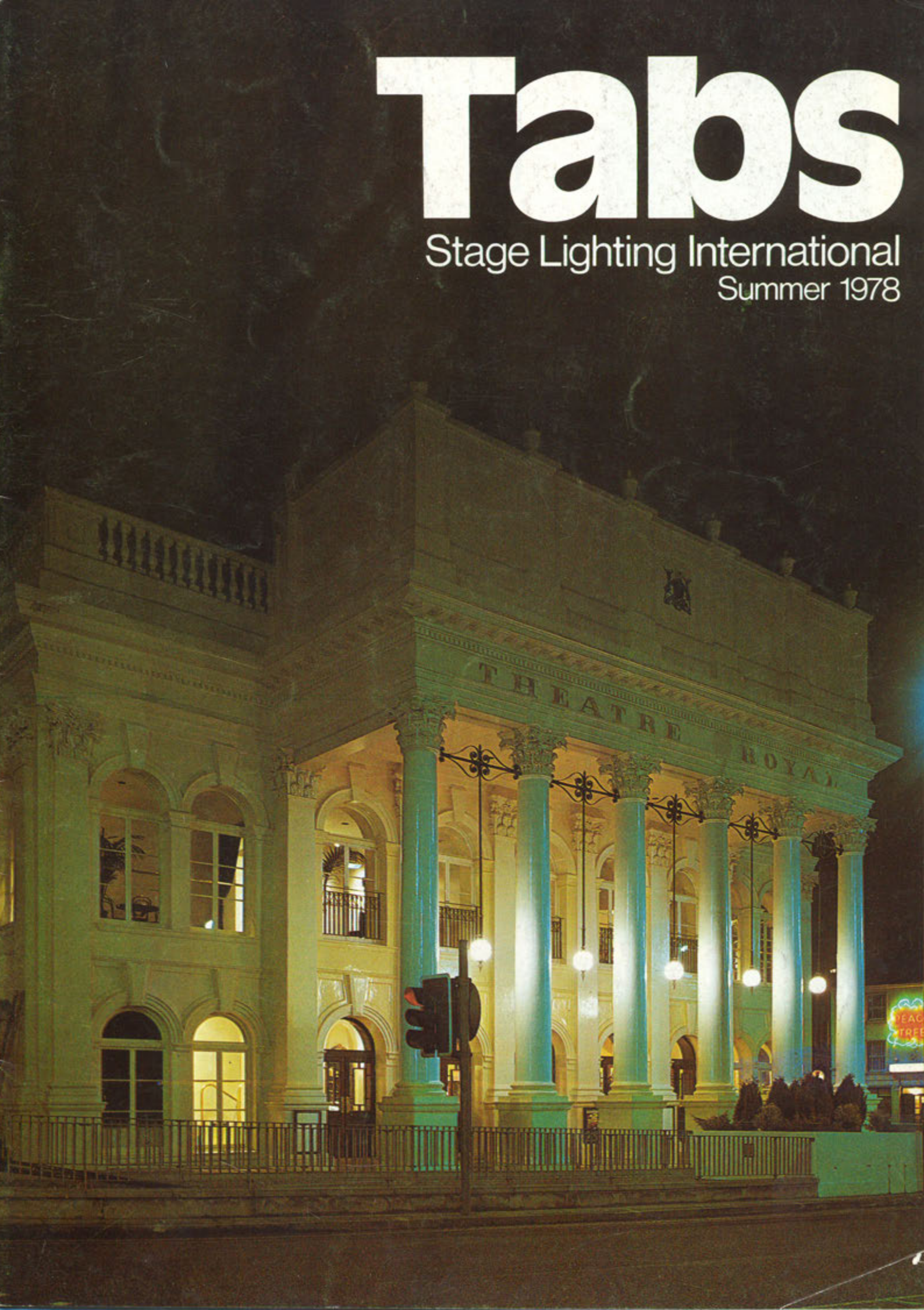
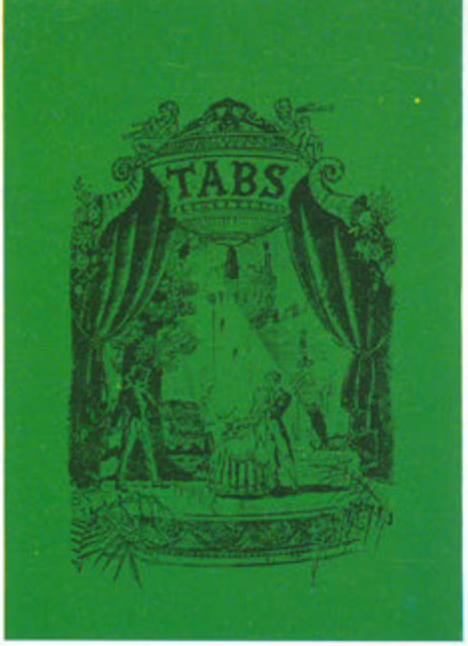
Tabs

Stage Lighting International

Summer 1978





Tabs

Summer 1978 Volume 36 No. 2.

Multi-purpose for what purpose?

In many rural communities the village hall remains the focal point of social activities. The more remote the village, the more significant and important is its hall.

True, Church and pub play their parts in village life, but their rôles are specific. It is the village hall that is the most vital arena because it encapsules most of the social and creative aspirations of the community.

These may include flower and produce shows, dances, fêtes, cricket teas, harvest suppers and the lot. And in most cases there may be some form of dramatic production. And because amenities of most village halls tend to be basic, they make high demands of those attempting to put something on the stage. It is good for community spirit.

This scenario may seem remote from professional theatre, but it is not. Its importance is that it is the most elementary form of public meeting place in a community. It has relevance within modern political thinking.

The other end of the scale is what might be termed civic centres, situated in towns and cities. They, too, try to combine as many functions of benefit to the community as possible, only on a much larger and more sophisticated scale. This may include more aspects of the arts than theatre, music and ballet. Civic functions, banquets, meetings, conferences, dances and other social gathering must be catered for.

To the theatre (and to other arts) the new civic centres are important because they are a source of badly-needed new facilities. Because of high taxation of both private individuals and companies, the main alternative provider for the arts is Government, at both national and local levels. Patronage is badly needed, but it must be the right sort.

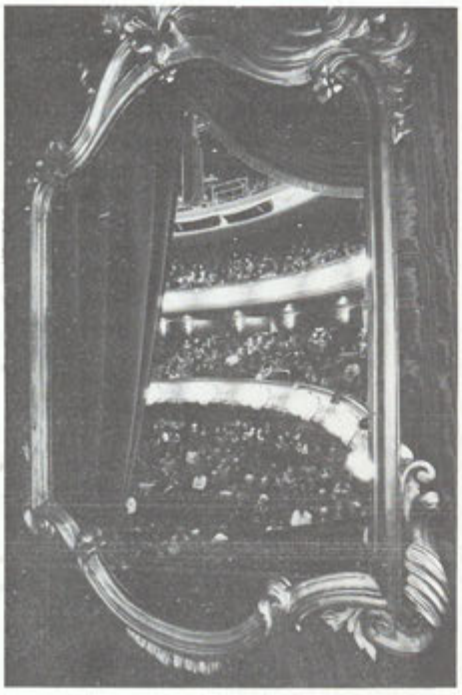
One has only to look at some of the older, purpose-designed buildings, and the accounts that accompany them, to realise the financial difficulties they face; that is true of more than theatres. And even if a building is used to maximum capacity the income is often insufficient to cover running costs. To many faced with the problem the alternatives have been closure, seeking new and supplementary uses, or subsidy.

Building and running modern sophisticated theatres can be as fraught with economic difficulties. So we live in the age of the multi-purpose building. It embodies most aspects of work and play, from theatre to open-plan offices. And modern economics dictate not only the creed of multi-purpose but that a quart should be crammed into a pint pot (or its metric equivalent).

The problem with some new civic centres is that design has not catered satisfactorily with all the different needs. It is arguable that some needs are not comparable with others.

In the need for economy facilities are often skimped. Many of the theatres in the new complexes have less than the old purpose-designed theatres, have shortcomings of design, or aspects which have been overlooked.

Hopefully, planners will learn from others' mistakes. Village halls are so basic that those who use them are accustomed to coping with the situation. But greater things are expected of civic centres where large amounts of public money are being spent.



In this issue Iain Mackintosh describes Nottingham's return to the first division theatrically speaking, with the re-opening of their beautifully restored Theatre Royal. The handsome mirror in our photograph is part of the period refurnishing of the boxes and not only mirrors the handsome auditorium but reflects the glitter of this rejuvenated touring theatre. Cover picture shows the restored 1865 Phipps portico, possibly one of the finest theatre entrances ever built.

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A Royal Return

IAIN MACKINTOSH

How do you open a new theatre or re-open an old one? Recently during a twelve-month I sampled three widely different devices: the Gala Goldini at the Olivier, a soufflé that didn't quite rise to the occasion: the much happier *Illuminatus* at the Cottesloe which, since it demanded of its audience the stamina to survive seven hours of zany happenings and humours, was fine as long as nobody takes length rather than quality as precedent; the equally remorseless three-part gala at Eden Court, Inverness—Act One, Opera and Ballet; Act Two, pit covered and *Hamlet* on stage; Act Three, theatre converted into concert hall with an entire symphony orchestra on stage under a band shell. Unmistakably, an occasion, though an expensive one.

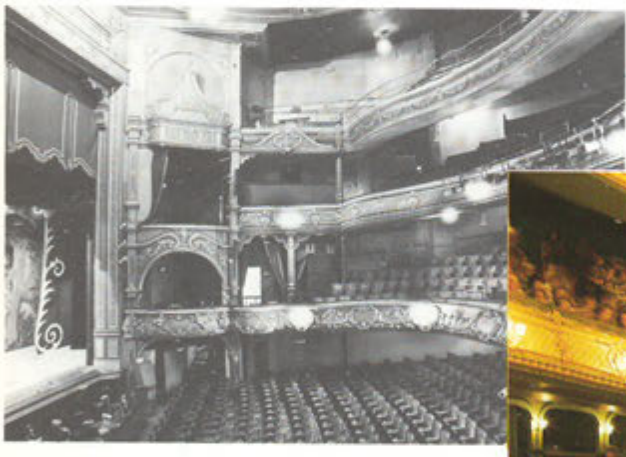
So to Nottingham. On 7 February 1978, the Royal re-opened (that 1977 over the proscenium arch will fool all future historians, won't it?) not once but twice. Twice nightly. Cool, after a complete rebuild and a closure of only eleven months. Ken Dodd performed the honours to two successive paying audiences. He announced that since much was untested (his show had come down in Manchester on Saturday night, got in to Nottingham Sunday and Monday and opened cold on Tuesday) he had been told to come on if anything went wrong and chat to the audience. Hence... naturally it was 6.0 and 8.30 and naturally the first show overran. So midnight found us all still in our seats as Ken took us on surrealist flights—"My sister-in-law got engaged to an Eskimo. Didn't work. She broke it off...", etc.

But this was the Royal's third opening. The earlier ones were even odder than Dodd. 1865 was the first opening, 25 September after a building programme of a mere six months, with *The School for Scandal,* plus a farce, *The Rendezvous,* as afterpiece. Prosperous Nottingham audience settled into elegant new theatre by fashionable young 29-year-old theatrical architect C. J. Phipps (no relation to the Arts Council's Director of Touring). National Anthem struck up and curtain rose on the entire labour force of the main contractor working like hell to finish the theatre. A good gag. In 1897 a different approach was tried: this time they didn't get it finished.

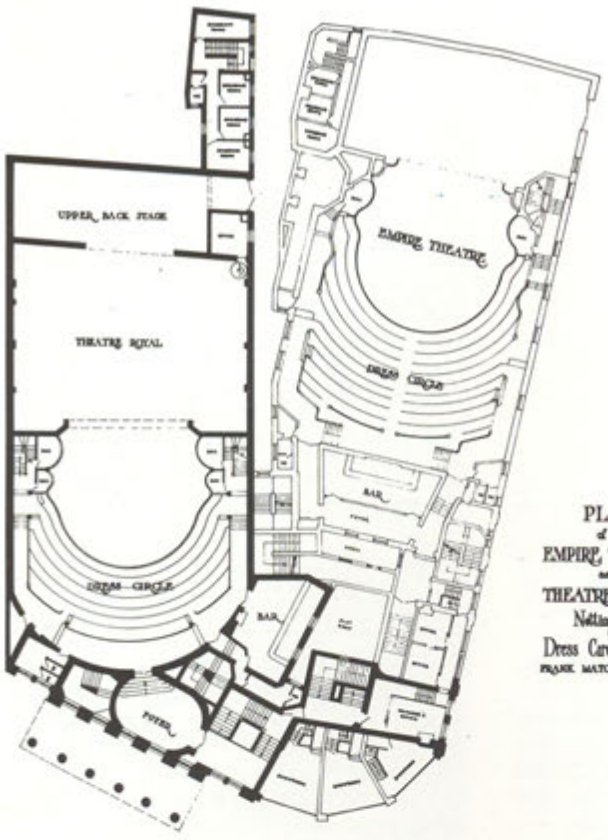
The theatre had closed in May 1897 for a fifteen-week programme in which the auditorium was to be gutted and rebuilt completely without pillars, while the stage was to be lowered two feet to improve sightlines. In *The Era* of 28 August the re-opening of the Royal was announced for Monday, 30 August, but on 2 September the *Nottingham Evening Post* wrote, "Operations have in the course of last week been assiduously pushed forward, and it is safe to make the definite announcement that, subject to the granting of the necessary licence, the re-opening of the house will take place upon the evening of Monday next (6th September)". This time the curtain did rise, gag-free, with a repertoire of five plays in a single week—Shakespeare and, once again, *The School for Scandal.*

By the early nineteen-seventies past glories had long vanished. Over some fifteen years the Royal had got tattier and tattier while Nottingham became indistinguishable theatrically from Peter Moro's impeccable Playhouse (1963). At the Royal the hemp sets, creaked although six counterweights had been put in by H. M. Tennents for *My Fair Lady* and left there. *Camelot* had needed over twenty flymen—a side I believe. In 1975 the only way to shoehorn the Festival Ballet into the Royal had been to park prima ballerinas in portakabins on the municipal car park. Coal was still delivered across the rear stage to a trap and chute upstage right. Front of house was a rabbit warren fronted by a low-cost low-rise foyer in holiday camp plastic where once had been the adjoining Empire (built by Matcham in 1898, closed in 1959 and demolished in 1969). The Royal was bottom in the league of so-called "No. 1" Touring Dates, the No. 2s and No. 3s having all vanished. Then in 1975 the commercial tenant made dissatisfied noises. A quick press campaign meticulously orchestrated by friends of the theatre on the *Nottingham Post* across the road. Six weeks for a feasibility study, a couple of months for a political decision, a few more for some drawings and specifications, and then, in May 1976, at the depth of the economic crisis, a contract was signed with Bovis to rebuild the Royal and prepare for Phase II, the Concert Hall. Adjoining buildings were demolished while the theatre remained open until March 1977, then closure.

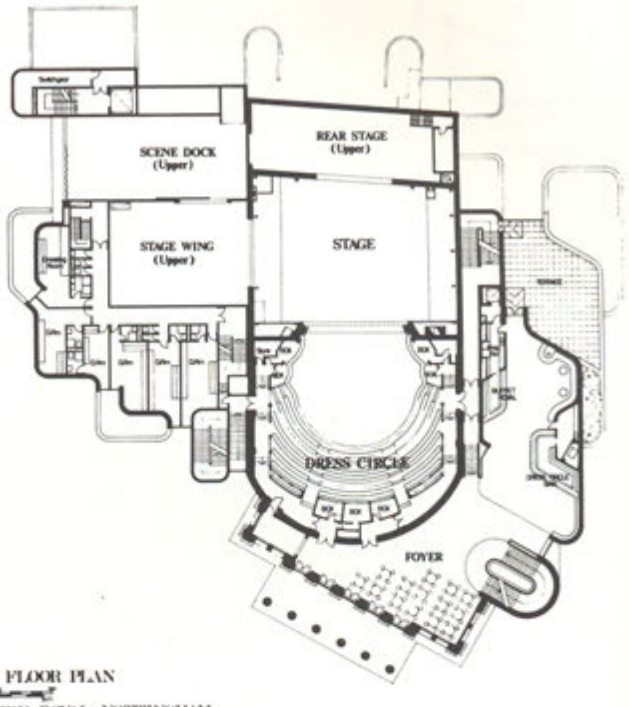
In February 1978 architects Renton Howard Wood Levin Partnership, architects in charge Nicholas Thompson and Robin Beynon, and a team of somewhat breathless consultants sat down for the opening night and realised what the expenditure of three and a half million pounds in thirty months meant. Exhaustion. Indeed many local authorities



Before and after: the old auditorium immediately prior to closure in March 1977 contrasted with a performance of the opening show in February 1978.



PLANS
of the
EMPIRE THEATRE
and
THEATRE ROYAL
Nottingham
Dress Circle Level
FRANK MATCHAM, ARCHT



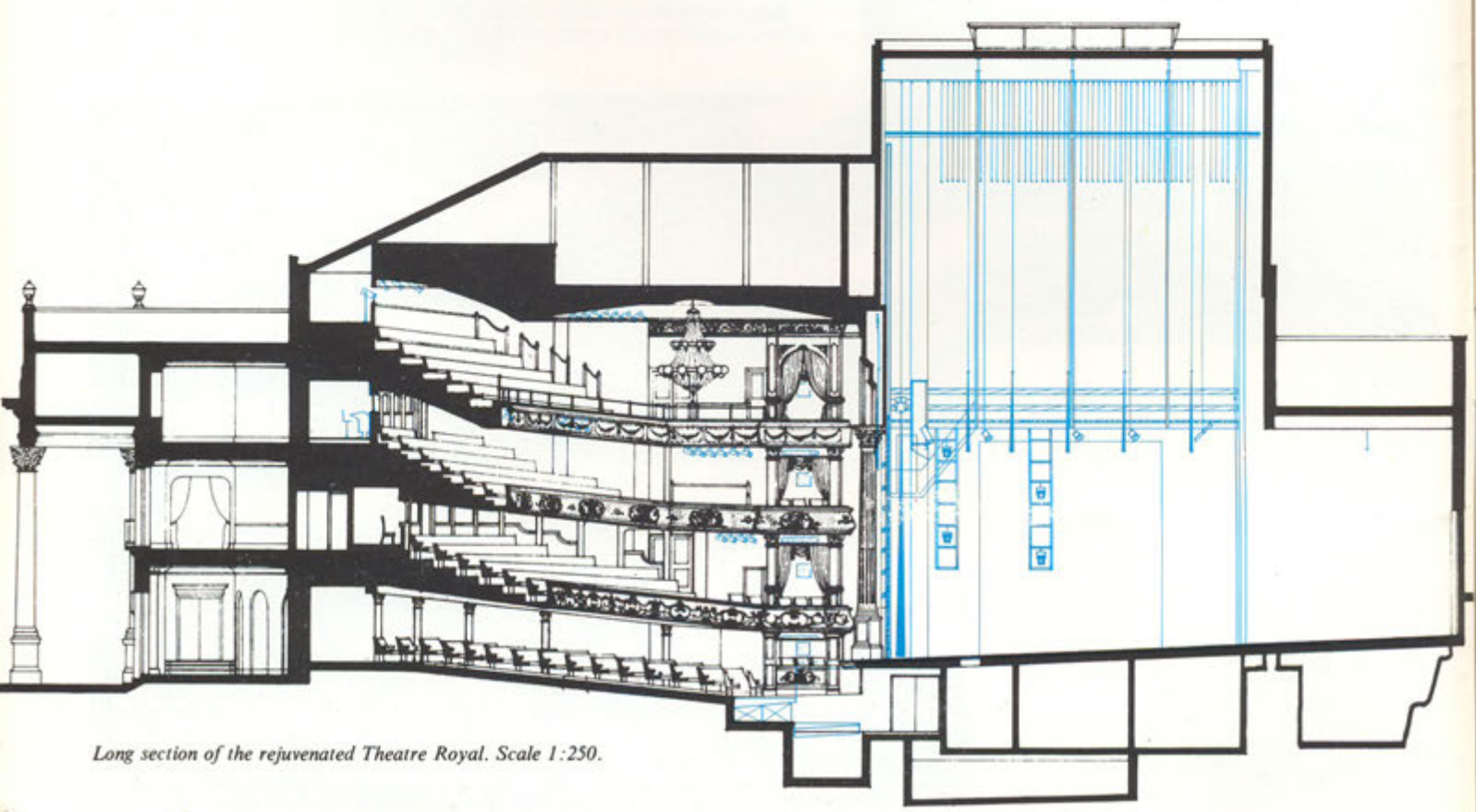
FIRST FLOOR PLAN
THEATRE ROYAL NOTTINGHAM

would have scarcely had time to set up a working party, commission a study, brief architects and lobby Parliament or the Arts Council for other people's monies! In contrast, Nottingham City Council had had the will and the imagination to spend over £3 million of their own money at a time of crisis and take Nottingham Royal from the third division and set it up at the top of the League, alongside the Forest.

What have they got for their money? Besides, that is, full houses and a queue at the box office all day every day for the first four months?

Backstage

The dressing room, get in and general service areas are lavish: nowhere is the Royal's transformation more apparent. A totally new building stands to Stage Right where once was the County Hotel. There is room in the 12 dressing rooms for a company of 100 plus orchestra of 70. There is a large greenroom divisible into smaller greenroom plus bandroom overflow when the latter exceeds 20. There are loos and showers *en suite* in twelve of the dressing



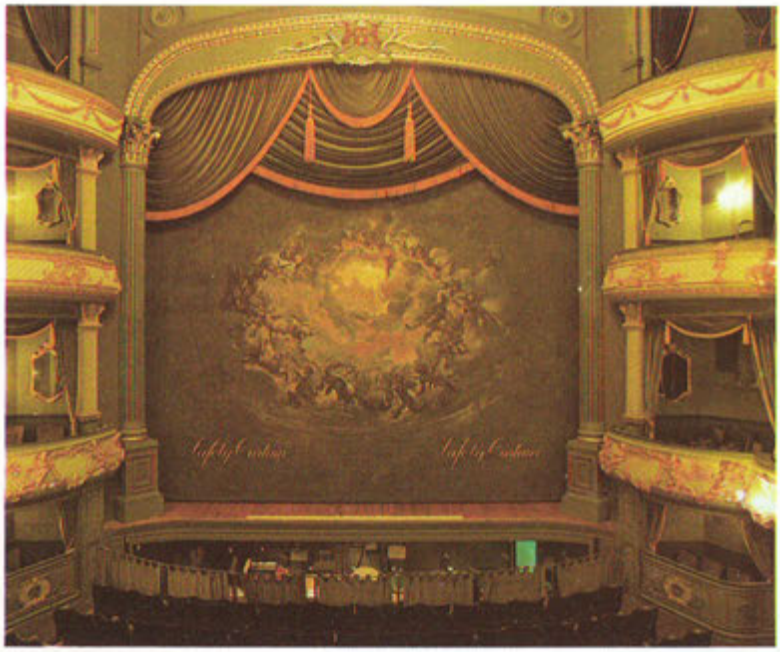
Long section of the rejuvenated Theatre Royal. Scale 1:250.

rooms, all with natural light. In the basement are four bathrooms, four chorus dressing rooms, electrics store, repair workshop, and, triumph of twentieth-century technology, a beer storage room at even temperature sending a choice of Keg, Lager, etc., hurtling up multi-core pipes to the three bars. Obviously, the hops of today are even more sensitive than those thyratron valves of yesteryear. Most significant of all backstage is an under-cover back-in scene dock which will allow one lorry to serve the yet to be built 2,000-plus-seat concert hall, while another serves the Royal via a vast, by British standards, side stage. Many seeming illogicalities around the rear are explained by the plug-in concert hall to be. Where once were the old dressing rooms, a car park, a billiard hall and the old Empire will rise the Big House. It is important, perhaps, to remember that the Royal, although a No. 1 date, is to be the Small House in the final scheme. (There may or may not be a third small multi-purpose space to complete the picture.) Administration areas seem generous for a non-producing theatre though these are, of course, designed for the entire complex. For the moment some of the spare space has been converted into a talking head television studio which is to be ATV's local presence in Nottingham.

The Stage

On stage once again the first impression is of lavish space. The old walls of 1865 enclosing stage and rear stage, originally used for spectacle and as paintshop, were too weak to hold anything substantial, and hence were retained for sound insulation only. As at Bury St. Edmunds, the steelwork supporting what's above is taken through the stage into foundations deep below; unlike Bury the roof has been raised and there is now a flying height of 18·7 m with 45 sets of single purchase counterweights, the rear guided Telestage system installed by Furse, at 200 mm centres. Downstage is a number one lighting bridge installed with a view to speeding repertoire changeover when the technical installation is at full stretch for a national touring company. Beyond that are house curtains that swag Italian festoon fashion, in the manner of the bigger ones at the Royal Opera House and of the smaller pair at Bury St. Edmunds.

Probably the most unusual part of the stage installation proper is the stage itself: a fixed rake at 1:25, which is of course the contemporary equivalent of the old standard touring half inch to the foot. Here was an agony of decision. To give the whole thing an adjustable rake was, alas, too expensive. To flatten it would ruin the sightlines from a very shallow stalls. Matcham had lowered Phipps stage by two feet, so there had been trouble before. To reassure terpsichorean TABS readers it can be recorded that Britain's leading ballet companies were consulted and did regard the sightline to a prone dancer to be more important than an absolute flat floor. And it ought not to be forgotten there are still some classical dancers who find a rake aids elevation, etc., for the more showy solo bits that start with a grand chord upstage right.



The new proscenium with safety curtain by Henry Bardon. The corinthian columns conceal advance perch lighting positions.

The forestage continues the rake. At the time of writing nobody has used it but it does lie within a reasonable sight line of most of the house and there are pass door routes both sides to allow breathless-messenger-type entrances. The small size of the forestage results of a choice of two pits: drop the forestage elevator only and you get 46 m^2, of which 21 m^2 are under the stage, take away three further rows of seats on carpet-covered rostra (and store in store provided) and you get a grand total of 75 m^2 which is just enough for a 65/70 size orchestra, the largest at this scale of touring. Fourth alternative is to have two extra rows of seats on the elevator at audience level in which layout the raked elevator imparts a subtle reverse rake to the front rows so as to maximise sightlines.

Auditorium

The old auditorium provided the design team with a problem. It was not Matcham at his best. No detailed plans survived. So it was not possible to tell either if Matcham had ripped out all of Phipps or if anyone had altered Matcham. On close examination one could detect bits of Phipps stuck on to Matcham such as the odd column on the second tier stuck in a characteristic aspidistra bowl base (see Edinburgh Lyceum or Glasgow Theatre Royal). But the Phipps interior *preceded* the Matcham rebuild of 1897. One can only presume that the 15-week rebuild of 1897 was, towards the end, a bit of a bodge as old levels were matched to new in the proscenium zone. But if that part was a confusion (a confusion of cowls, cardinal hats and curlicues) the circles themselves were sublime. Three tiers each with their own geometry and their own surface decoration. One thing was certain: no surface mounted stage lighting was to be allowed to disturb the rhythm of grand circle, upper circle and gallery. Equally, it was agreed that there would be no loss of essential front of house lighting positions. Opening the central dome as at Glasgow or the Royal Opera House was not possible due to the need not to disturb the roof trusses; anyhow, to do this often means one must sacrifice having a decent chandelier. So openings were made in the roof to each side of the dome, positions provided at the rear of gallery and side positions granted where they would not only not interefere with the architecture but, at the grand circle sides, actually fill an overlarge gap left by Matcham. The *piece de résistance* are the motorised eyebrows in the gallery front which wake up when the house lights go down and modestly lower when the interval comes.

One of the good things of working again and again with the same design team (TPC had advised RHWL on the Crucible Sheffield in 1971 and Warwick Arts Centre in 1975) is that members of the team happily exchange roles. Thus the Lotus Elite eyebrows are, it can be revealed, inventions of the architects, while it was the theatre consultants who dreamed up the screen system at the backs of Dress and Upper Circles. These screens enfold the audience, allow dog-leg lobbies from the foyers, partially conceal the two massive iron pillars that hold up the house, while allowing behind the screens control rooms for light* and sound at upper circle levels and three private boxes at Grand Circle level not unlike the stalls boxes at the London Coliseum, also by Matcham. To make eclecticism complete it can be recorded that the side arcades are inspired by the Empire Sunderland (Milburn, 1907), while the architectural detailing is out of Phipps' Lyceum, Edinburgh.

At stalls level too there is an ambulatory around the now gangway-less single block of seating. This was formed by adding six dummy columns to the four real ones. Functionalism is not quite dead: none of these new pillars obscure anybody's view.

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* *Rank Strand MMS 150 channel control.*

None of them are there for fun, they all do a job in enfolding the audience as well as adding to the spatial mystery as one threads one's way into the auditorium to find one's seat.

Photographs are better than prose in depicting this rejuvenated auditorium. One need only add a statistic to show how clever Matcham was at packing them all in shelf upon shelf. In plan area the Royal auditorium is almost precisely the same as the auditorium of the 1963 Playhouse which has, by the way, a slightly wider proscenium. But the Playhouse holds only 750 while the Royal manages 1,138 even after reseating the notorious gallery. This gallery held 600 in 1897. How, one cannot think. In

Prompt corner on the first night.

1977 500 were being squeezed in to the backless benches on big nights. Now 189 sit in comfort in individual seats. Everywhere the Royal offers a decent seat except possibly in the stage boxes which were splayed at an irretrievably extreme angle by Matcham himself.

Matcham also had trouble with the proscenium arch. He inherited broad 6 ft. wide 45° splays in the arch itself which he tried to lose by wrapping the boxes over them and then dropping drapes inside. In 1977 they would have provided perfect positions for recessed advance perches or house speakers. But the engineers said "no" pointing out that, new flytower notwithstanding, the proscenium arch was holding up the stage end of the auditorium roof. As a result a new disguise had to be found for speakers, lights and those splays. The speakers were built, seven a side, into the boxes, trebles in slices between ceilings and floor with basses at the back of the boxes. Advance perches are incorporated within the false giant Corinthian columns which appear to hold up the new three-centre curve proscenium, a throwback to the 1860s. Behind the arch is an adjustable pelmet masking a lower structural opening and upstage of that the baroque sunburst of Henry Bardon's safety curtain which restores the traditions of gorgeous painted front cloth.

Front-of-House

TABS reports do not always cover the front of house. Fortunately at Nottingham a description is quickly made. In the reconstruction everything between Phipps' portico and the drum of the auditorium was razed to the ground. Where once were a dozen staircases and a slum of saloons, pissoirs and the occasional prominent fire hydrant, there are now large airy spaces: ground floor all italianate with mirrors and terrazo; a piano nobile (first floor) like the long gallery of an English country house with a view over Nottingham through the six pillars of the portico and a top floor, serving both upper circle and gallery, more enclosed: a place for serious theatregoing or serious drinking of all that draught piped from down below the stage. At this upper level another ingenious touch: the fitting in of capacious gents and ladies within the original walls of the attic storey over the portico where first there had been merely screen walls to conceal the skew of the roof.

Electrics

TABS being somewhat connected with electricity a note on that can be added justifiably and, one hopes, authoritatively, TPC being Electrical Consultant as well as Theatre Consultant. To supply the whole theatre there is a 800 kVA intake at 11 kV serving lifts, heating, ventilation, catering equipment, exterior lighting, the motors for house tabs and for pit elevator as well as the more theatrical elements of stage lighting and the carefully designed decorative schemes for auditorium and foyer. In the auditorium, for example, there are five circuits each controlled by a separate dimmer or by the house light master thus allowing different nuances of mood as well as the opportunity to "lose" empty areas such as higher levels in a half full matinee. The foyers are cool in mood, fittings recessed wherever possible, leaving the audience and the usherettes in their long green dresses to provide sparkle. In the bars, polished wood and brass glow. Outside under the portico the decision was taken to reintroduce the original electric fittings of the 1890s rather than simulate the gas fittings of the 1860s. Another instance of how in every area a decision was needed on how to interpret the past, on what, in conjunction with the architects, to select for emphasis.

Conclusion

For the editor to ask a member of a large design team to write about the job is to run the risk of tub-thumping (see last paragraph). Also errors and omissions might get excepted. So, without resorting to breast beating, here to end is a bit of head scratching on what might have been different in this whirlwind of a job. Some thoughts which might be useful to others as the task of rehabilitating Britain's great old theatres gathers momentum.

Stage Lighting: What do we do if first-class medium scale groups insist, Dutch or American fashion, to bring their own new control boards into a theatre equipped with its spanking new MMS? Labour costs are such that time and money is saved from their point of view. If we provide tie lines where to? Kent Opera put their man and 80-way board in the orchestra pit.

Sound: Ditto with the sound. Tie lines were provided to a stage box, next time perhaps to a central box at rear of circle. But where does one put touring speakers with such a narrow prosc? Discrete pegs each side of the prosc already wired? Or upgrade the installation?

Cuts: Never cut the rising mike on grounds of cost. TPC did and it was reinstated by the first show—not so neat and just as costly in the long run. Same with second memory core for the MMS. It is in already.

Flying: Ironic to have trouble with hauling lines in a theatre from which enough hemp was removed at the start of the programme to hang us all. Still nautical indignation at polypropylene may be misplaced if in future the right sort is installed in the right pre-stretched state. Changes in temperature were not significant in old theatres permanently dank and musty. In new air-washed fly towers the advantage of polypropylene may yet show itself. Nevertheless, more thought needed.

Proscenium Arch: This has caused a bit of a stir. While pointing out that photographs of a proscenium arch with tabs or safety curtain in tend to pull the eye up, one must say that the final result is not entirely right. Better than Matcham's mish mash of 1897 which was not one of his successes as, say, the Victoria Palace, the Opera House, Buxton, or the Lyric, Hammersmith. Perhaps the best idea for Nottingham was the first idea sketched by Eric Jordan, then consultant architect to TPC. Eric proposed less radical alterations to the side boxes than were actually carried out and a tighter wrapped moulding on the three-point arch that was more akin to Robinson's arch at the Old Vic which also sprung from the capitals of the columns between 1871 and 1950. But there were other considerations. .

Luminaires: The sight of all those black purposeful clean cut T-spots at the circle sides of Nottingham suggest it really is time manufacturers, all of them, offered the service of special colouring with a smile. The Henry Ford policy of "any colour providing it is black" plus, perhaps, "give me six months and accept a limited range of colours at a greatly increased price" really is not good enough if we are to fit good new wine happily into fine old bottles.

Everyone, design team or user, can add their own second thoughts. Should one have a No. 1 bridge in a No. 1 date, etc.? But by and large it works well. Barrie Stead, first General Manager of the Royal, is under no illusion to what he has got: a first-class variety house. To pull metropolitan lyric companies and their audiences, back into an old provincial theatre all you may need is a good pit, fine acoustics, a wide stage. This need not cost £3·5 million, but for a popular house presenting Dodd, Hanson, Bob and Alf Pearson and *Lilac Time* you must spend real money to give everybody the feeling of a good night out. Puritans who wish to restore theatre to the people please copy. Showbiz is alive and well and thriving at the Nottingham Theatre Royal.

Iain Mackintosh is a director of Theatre Projects Consultants Ltd and was, with Alan Russell, in charge of this scheme.

Music on the Band Rail First

MERVYN GOULD

A few more years ago than I care to remember, being still what *I* call young, I gave my first contribution to the Art of the Theatre. I was seventeen, idealistic, and wanted to work in what I called "real theatre"; by which, presumably, I meant the local Rep. At that time, Peterborough, in the shape of Harry Hanson's Court Players, and later the Penguin Players, had folded, leaving Lincoln as the nearest Rep. Unfortunately for me Lincoln was fully staffed, with a young lad called Fraser Disney installed as ASM. He is now the respected General Manager of the Arcadia, Skegness, while I am still touring. Ah, well!

Thus it was that my first job was as ASM/Props for a touring weekly Panto, playing such dates as the Crewe New, Buxton Opera House, and the Leek Grand. By this time in theatrical history a lot of the Number Ones, and all the Number Twos had closed, but the Numbers Threes and Fours were in many cases still open—I know, I played them.

It was all a very different world from that of theatre now. Although I have always worked in commercial theatre at least now (but in many ways, sadly) the young aspiring Stage Manager or Technician hasn't got to face a train call, or double-handle the scenery, or have the band call take place during the fit-up, all during an 8 a.m. to 1 p.m. Monday morning call. Now the lighting man has Monday afternoon to light, and in the majority of theatres there is a reasonable rig and adequate control. Even Southsea King's has got some 223's, although the Pros. lengths are still *in situ*. The Grand Masters at Newcastle Royal and Bradford Alhambra have gone, and the Blackburn Starling from Leeds Grand.

So, I am sad to say, has the need for the manual dexterity of the operator. However . . .

Today, virtually all is ease and comfort. Adequate F.O.H., enough lanterns for two spot bars and a couple on each perch, and a flood bar to light the sky cloth. Then, you would find three or four battens, a float, and perchance a couple of limes. If you were very lucky, you might find a Number One bar of clapped out and filthy 43's and a couple of pageants out front.

If all this sounds incredible to you who have read your lighting history, and know of such things as Basil Dean's or Harold Ridge's experiments in the '20s and '30s. Or if you are old enough to remember the glories of Number One tours, and major panto seasons, think how frighteningly sad it all was to a young utter beginner: aware of the dramatic and artistic possibilities of lighting, but with no experienced person to show him how to do it on less than minimal equipment.

It was all terribly depressing, and not at all what any book or lecturer would recommend as an introduction to the business. Yet that disillusioned schoolboy, wanting to work in "real theatre" and prepared to work his way to the top, is now both pleased and proud to have started in the last days of Variety and touring panto.

Why, and how?

Well, firstly because of the people. Although the kind of way in which I started had died at least ten years before, the kind old pro's taught me a great deal about life and the business in general, both by their reminiscences and their practical example. I might not have learned about modern (i.e. post-War) stage management, and they knew nothing of the advances in control, in lanterns, and the use of lighting. What they did teach me was how to get a show in, up, and on (incidentally the title of a piece of mine in these pages some time ago) and not to stand wringing my hands and saying "If only . . ." or "I can't stage or light this show here". You had a time limit, and an advance to play to—hopefully, though one week we opened to an advance of £12. The simple fact was, if there were no paying bums on the seats, at the end of the week there was no money to pay the salaries.

(The latter, incidentally, now no longer a problem since Equity, quite rightly, demanded a fortnight's salary bond from impresarios not members of the ATPM, TMA, or SWET, was then very real, even in the West End. I have been told, by a man who was Production Manager for twenty years for one of the then main West End producing managements, how jewellery had to be pawned to pay the salary list of a capacity West End success. All this is by the way.)

Secondly, I am grateful for the way I started in that I was left alone to make my own mistakes and find my own salvation. I suppose it would have been quicker and easier for me to have been taught, but being self-taught at least means you know *why* you are doing a thing in a certain way, and in a manner to suit your own personality. My marking of a prompt copy is not in the approved manner, and my board plotting is distinctly odd. Both, however, get me through to run the show.

I was with the previous Editor of TABS (what a name dropper I am) the night he saw *Jesus Christ Superstar*. Afterwards, pausing with a foaming mug halfway to his lips, he delivered a diatribe against board operators in general (of whom we both once were) together with a side swipe about the ABTT being full of theorists, with not enough men up ladders in the membership.

But, indeed, as I hope I replied—my memory of that evening being rather hazy—how could it be otherwise? For the Variety theatres, and the tours attendant upon them are no more. In the West End board operators come and go, and many operate one board, a CD for instance, just for one show. Rigging is done by specialists—or more likely, by a weekend crew gathered from other theatres. Chief and Board Operators in Tour dates could tell many strange tales of lighting, but they are too busy getting the next show in to attend lectures and meetings in London or other cities. The man who tours a show and has to get it on in different theatres with different staff and equipment each week; or the resident, who has to be prepared to light, with his staff, board and equipment, a different show each week, are the real heroes of the lighting game.

On stage at the Theatre Royal, Bury St. Edmunds, 1 May 1971. M.G. points out to Stuart Munro the F.O.H. lighting angles. The set of "Luv" is on stage, the flowers being for Stuart's Wedding reception on stage later that day.

But these theatres and tours get fewer and fewer each year. Most tour dates large enough to take money are in great financial jeopardy, and managements prepared to put their money into a tour are dying out. Many things can be taught by Drama schools, but in lighting it's not much use

learning about the latest lantern, or the newest control, without thinking what is actually to be found in theatre buildings.

And what is to be found? Basically everything from an MMS to a bracket handle board, from a T-spot to a 53, from a good gel stock to a selection of not much more than 6, 19, and 39, from staff who have worked ENO and the Festival to a lad who has just started after lighting the school play on an HA board.

A photograph unusual in theatrical annals. The author appears here as performer (Fairy Nuff), as Lighting Designer, and as CD console operator for that performance at Sunderland Empire. (Note to lighting students: at least the nervous performer manages to stand in his own light.) Photograph by Bob Johnson.

So that is where my beginning and early life has led. From provincial Number Fours to the West End and back. But what I have learned, and with great difficulty in the early days, is that we all have the same problems world wide: in major touring date, in the West End, or in village halls. It is the attitude and character of the professional that matters, not the immediate surroundings. And that, unfortunately, is what cannot be taught in a rep. theatre, lecture hall, or weekend course.

I'm lucky, I started in provincial tat, and learned to cope, but others, now, haven't got that opening. What can be done? Not, I think, a recreation by public or private money of those Number Fours, nor even training courses. It may be good for young actors and actresses, on the Equity minimum, to be sent around to play school and village halls, but the stage management and the technical sides need to be the best for that kind of thing, not beginners themselves.

Whenever a youngster tells me that he or she wants to go into the business as a performer, stage manager, or technician; my first and immediate reaction is to advise them not to. For a hopeful technician, however, who seems to be set on it, my advice is to become a dayman in a provincial touring house, for that is, to me, the best training of all. To actually do it, instead of learning about it: to move from opera to a straight play, to a musical to variety, to ballet or a pantomime, all in the same number of weeks.

Any board operator in a tour date has more influence on the states or control than the designer—be the latter a tyro or a West End name. Many who are learning lighting (and one never ceases to learn) will tell of help received from a provincial Chief or Board Operator—either in the method of focusing or in the achievement of an effect. On the other hand, a youngster starting will quickly meet the whole gamut of designers, from a young lad under the wing of a well-known name, to a fellow who's come up through all departments of the business.

And perhaps that is what the name of the game is all about—those who have come up through all departments of the business. In the old days of Variety (all right, those of you not familiar with the title of the article) the M.D. would walk into the band call and pick up the first set of band parts laid on the floats or the orchestra rail. Never mind on the bill whether you were top, bottom, or in the wines and spirits, if you had laid your band parts out first you were given rehearsal in the order of picking up the parts.

Wonderful, I hear you say, and what the hell is that to do with lighting? Well, very little, except that lighting is only a component part of this business. Those of us who earn our living (however precariously) from the practise of what we know about theatre should at least be able to mount a show, in whatever hall, with whatever equipment, in the best way we can. Always bearing in mind that our professional standards must reach to the heights for we have a responsibility to the performers and the audience to give a show worthy of the name—which means, in some places, not only knowledge but also experience and hard grafting.

I regret very much the divisions that have grown up over the years: between commercial and subsidised, variety and legit., stage and LX, performers and stage management. Just as many actors started as an ASM, so a stage manager should have appeared on stage, or a lighting man run a flat—for we all need to know and appreciate each other's problems. If it's the first time you've lit an opera, and you've never sung, you might not realise that singers tend to move out of light in order to see the conductor's baton. If you've only operated a modern board, and you are SM'ing a show in a date with an LC, be warned that a fast follow on after a DBO sometimes has a split-second "ghost" of the previous cue. Or if you've suddenly been let loose on reproducing the lighting of a touring show, don't scream at the board operator if during the technical, he finds a fast sequence of snap-on cues difficult.

It's all very well to read in the pages of TABS, *The Stage*, *Sightline*, or elsewhere of new theatres and their equipment. What is more important is who is going to maintain and operate it. Some staffs may be very experienced, others all beginners. Some will have worked in other theatres—but in the provinces at least some may spend their whole working lives in the same theatre, either because they are part-timers, or because they don't want to move. In the West End, though not so common now, you will find both daymen and showmen who have spent twenty years or more in the same theatre, and so are very set in their ways. Certainly not altogether a bad thing, but it is important to keep abreast of new movements, new technology, and other peoples' way of doing things. Not to mention the problems that staff of other theatres face.

Not everyone, of course, wants to tour. Not everyone wants to work in the provinces, or vice versa, in the West End. Those who are willing to move have an advantage, for they get more experience, and so are more flexible, therefore are in line for more jobs. On the other hand, how long can one keep touring? The physical and mental strains are getting tougher, though the shows are smaller, and the body with the onset of years can't take the running up and down, the all-nighters, and so forth.

Should we sink our principles and lecture or write about lighting? (At least TABS pays!) Should we put down roots and become a resident, to sink into a comfortable groove and talk about how things were? We could move sideways into an Arts Association or Administration. One lighting man I knew is now a bingo manager. A former Production Manager is now a hotelier. A well-known lighting designer saw the portents and took to the boats (though he did bring back variety-style colour lighting with a bang in *Bubbling Brown Sugar*!) A former Chief Electrician of Scottish Opera is going to take a pub. Now there's an idea . . .

Where it all started. The author's rather sordid and chequered career started at the Regal Theatre, Boston in 1963: a touring production of Babes in the Wood. *Apart from the Regal, we played Crewe, Leek, and Buxton.* Photograph by Stuart Maddy.

In the main, though, the majority of us struggle on. My generation will just about last out with Grand Masters and CD's. But the brave new generation should beware. If you now despise us for our memories and preferences, think how in ten, fifteen or twenty years time you in your turn will be

bemoaning the good old tungsten halogen lamps—just as I mourn for carbon arc limes.

Never mind. Hardware and software will change, techniques and attitudes may do; but the game is now, and will be, summed up in two sentences:

> "Consideration should first be given to the purpose for which the artist appears on the stage. The lighting should bring out this purpose and determine the appearance of the artist and setting, at the same time providing the required standard of illumination."

So wrote Rollo Gillespie Williams in *The Technique of Stage Lighting* in 1947. (No, dear readers, I was not in the business at that time.) He was then a major factor in Furze's success in cinema colour lighting—sorry, Editor, but there used to be rivals even to the old Strand—but is principally remembered, by me at least, as the inventor of the "Delicolour" system of colour mixing control.

After the fairly unmitigated gloom of the last few paragraphs let's end on a cheery note. We're all mad for being in the business, and a lot of us drink too much. We are in a business catering for other people's leisure, and so have little chance of a life of our own, except with our own kind. Marriages break up, we get exhausted from touring, from working unsocial hours, and depressed by the constant search for work. The continual grind get us down, as tourers and provincial residents don't even get Sunday off. There's no compulsion for the public to spend hard-earned and heavily-taxed money to enter the doors of theatres and see our shows. Yet we still do it. How often do you find an ex-lighting man, or stage manager—unless they are promoted to other things—in comparison with an ex-actor or variety artist? We do it till we drop.

Our equipment may be antiquated, or it may be modern. We ourselves may be bursting with new enthusiam, sagging with age, or between the two. We must be *surely* mad—but let's raise a glass, or as this is TABS: *Stage Lighting International* (and there may be non-pro's reading), at least a cup of tea—to ourselves, lighting men everywhere:

WE'RE ALL MARVELLOUS!!

Variable Acoustics

GEOFFREY BERRY

Gone are the days when a live performance was always the best experience. In the days of AM radio, 78 rpm records and later with mono only 33⅓ rpm records, there was always the extra reality attached to a live performance. Now it is arguable that the best sound quality is heard in the house, in a space with a short reverberation time and with the required reverberation built into the recording. Electronic instruments, in general, generate their reverberation in their equipment. Acoustic instruments, in general, generate their reverberation in the volume in which the performance takes place.

It is true that there is a special quality to a live performance, especially if the acoustics of the space are good, but all too often the acoustics are not good. It is difficult to say which part of the musical market gets the worst of the deal. There are concert halls which are specifically intended for symphony orchestras, but these are few and far between. Major provincial cities might have one each, but outside the major cities the orchestras perform in a range of spaces from theatres and town halls to leisure centres and general purpose halls. In a great many performance spaces the acoustics are well below standard. On the face of it, groups performing electronic music stand a better chance. They need dead, or deadish, acoustics and if nothing else there is the open air if you can trust the weather. At one time there were large cinemas, but most of these have closed, and there are still a few fairly large theatres in the major cities. Again, they can compromise by using large speaker arrays to increase the ratio of direct to reverberant sound. The biggest problem is for the most popular groups, which, because of their audience drawing power find themselves in vast spaces capable of holding 10,000 people or more. Not all of them find it possible to build the enormous speaker array which the Grateful Dead used to fill one end of the Cow Palace in San Francisco and send a solid wall of direct sound right down to the other end to the benefit of a 20,000 audience. That equipment cost around £250,000 several years ago.

Two things are certain. The first is that the public expects ~~decent~~ acoustics whether for speech, drama, opera, musical comedy, modern popular music, jazz or for symphonic music. The second is that except in very special circumstances it is no longer economically possible to build special purpose auditoria. This means that we can expect to see multipurpose auditoria with a conscious effort to provide excellent conditions in all respects for all types of performance.

In the Spring edition of TABS, Hugh Creighton described the new halls at Reading and Hillingdon, and in this article the basis of operation of Assisted Resonance, its potential and its limitations will be discussed.

Origin of Assisted Resonance

Assisted Resonance was developed by Peter Parkin of Building Research Station as a corrective measure for the Royal Festival Hall. When it was opened the hall was very well received, it was spacious, modern and comfortable and the sound was very clear and free from echoes. After the darkness of the war years it appeared to herald a new age. As time went by opinion tended to harden in saying that there was too much clarity and not enough warmth or resonance in the lower register. The advice of Building Research Station was sought and Peter Parkin offered two solutions along traditional lines. The first was to lose 1,000 of the 3,000 seats, the second was to raise the roof by 15 to 20 feet. Neither of these solutions was acceptable.

Reverberation time is a measure of resonance and a short reverberation time results when the sound at the boundaries of the room, including the audience area, is absorbed at an unduly rapid rate. Parkin's concept in principle is to set up a microphone in the natural reverberant field of a performance space and use the microphone to drive an amplifier and loudspeaker to supply energy to the reverberant field to compensate for the excessive absorption. In this respect his technique is quite unlike its forerunner, Ambiophony, which made use of close coupled microphones in the direct sound field of the source. Parkin's microphones continuously sense the reverberant field and continuously compensate for the energy absorption.

Positive feedback reverberation control

Positive feedback in sound reinforcement systems in auditoria is a well known undesirable phenomenon. In a "straight" microphone — amplifier — loudspeaker—auditorium loop, the feedback characteristic is virtually uncontrolled. The frequency at which feedback occurs is determined by the characteristics of all the four elements of the loop; it occurs at the frequency at which the in-phase loop gain is a maximum. It is also a well known characteristic of this uncontrolled and undesirable feedback that the Q of the feedback loop increases as the gain is increased bringing on the characteristic "ringing" well before the disastrous "howl".

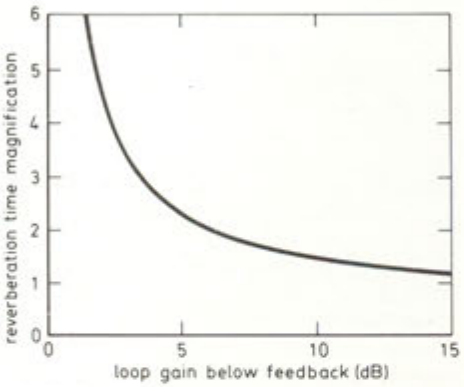
In a perfect world the gain of a positive feedback loop would be independent of frequency. It would then only be necessary to use one microphone, one amplifier and one loudspeaker. The microphone would be far from the original source of sound so as to be in the reverberant field of the space. In the same way it would be far from the loudspeaker so as to be in its reverberant field. The loudspeaker would be remote from the audience so that they too were in its reverberant field. All that would be

necessary would be to turn up the amplifier gain until the energy supplied to the auditorium compensated for the dissipation by absorption in the required ratio.

Suppose the reverberation time is to be increased by a factor r, where

$$r = \frac{\text{assisted reverberation time}}{\text{natural reverberation time}}$$

To achieve this increase the loop must operate at $20 \log r/(r-1)$ dB below feedback. Figure 1 shows the relationship between reverberation time magnification and the loop gain below feedback. It shows that to increase the reverberation time by 50 per cent the loop operates at almost 10 dB below feedback, to increase by 100 per cent the loop operates at 6 dB below feedback but to increase by 200 per cent means operating at only 3 dB below feedback.



1. Relationship between reverberation time magnification and loop gain below feedback.

It should be remembered that the objective is to simulate the effect of removing sound absorption from the auditorium and thereby increasing the energy density in the reverberant field. If this is to be done by energy compensation the acoustic power supplied by the loop should be (source power) $x(r-1)$. To increase the reverberation time by 50 per cent the loop should be capable of injecting half the source power, to double reverberation time the loop should equal the source power and so on. Fortunately the acoustic power output of even large natural sources are not very great, a symphony orchestra at full blast puts out around 100 acoustic watts.

Of course this isn't an ideal world and one positive feedback loop is not sufficient. There are two basic requirements:

(1) To use a sufficient number of loops such that the increase of loop Q with increasing feedback does not lead to colouration;

(2) to ensure that, with the desired reverberation time, the power response of the system is "correct", or sufficiently "correct", to produce the natural sound effect.

Assisted Resonance achieves these requirements by using a large number of channels (i.e. loops) which are frequency selective designed to cover the frequency range of interest.

Number of channels

The response of a remote microphone to loudspeaker excitation is highly irregular. A pure tone sweep will show variations of sound pressure level of 20 dB or more. There are very many more acoustic modes in the auditorium than peaks in the transmission characteristic but the modes combine in magnitude and phase to produce the peaks and troughs of the characteristic. It has been shown that, on average, the peaks can be expected at intervals of

$$\frac{3{\cdot}91}{\text{natural } RT} \text{ Hz}$$

In an auditorium with a natural reverberation time of 1.3 second the peaks can be expected at roughly 3 Hz intervals. In his Royal Festival Hall installation Peter Parkin used this basis and, in his initial experiment, used 89 channels to cover the frequency range of 70–340 Hz. He subsequently extended his experiment to cover higher frequencies and increased the spacing slightly; but he still employed 172 channels to cover the frequency range of 70–700 Hz. This frequency range covered all the region over which increased reverberation was felt to be required.

In the author's view this close spacing is unnecessary, and this is fortunate since the use of Assisted Resonance would be prohibitive for any extended frequency range. In the first installation for which AIRO was responsible it was decided to depart from the constant frequency interval pattern and change to a constant percentage interval pattern. This decision was based on the knowledge that the ear behaves in a logarithmic or semi-logarithmic fashion, the musical scale in logarithmic and our ability to judge pitch intervals is more or less logarithmic. In the first installation we decided, in a fairly arbitrary fashion, to use 72 channels to cover the frequency range from 70 to 1250 Hz with a spacing between channels of 4 per cent of the nominal frequency. This means that a 100 Hz channel was followed by a 104 Hz one, a 500 Hz by a 520 Hz and a 1,000 Hz by a 1,040 Hz.

The components of a single channel are shown diagrammatically in Fig. 2. The individual components will be considered in some detail.

Components of an assisted resonance channel.

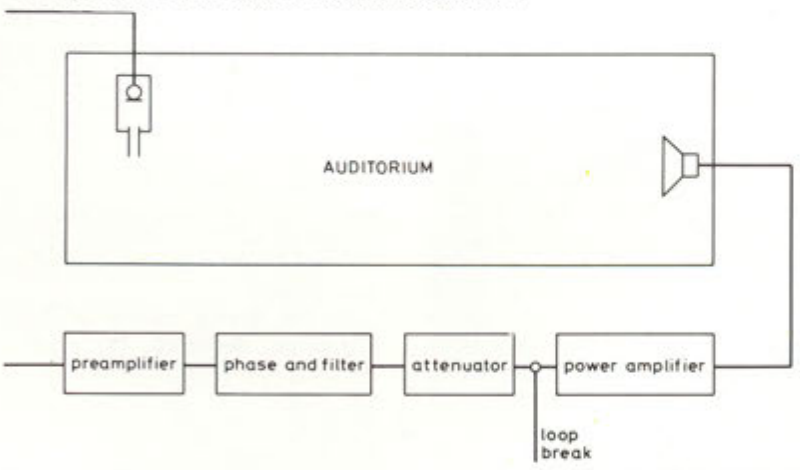


Fig. 2.

Frequency selective microphone assembly

The microphones are housed in resonant devices which are tuned to provide the required frequency intervals and adjusted to exhibit the desired Q. At 4 per cent spacing the Q would ideally be 25 whilst at 2 per cent spacing the Q should be 50.

At low frequencies (i.e. up to about 350 Hz) a Shure moving coil microphone is housed in a Helmholtz resonator (see Fig. 3). To cover the frequency range four body sizes are employed, two with a nominal diameter of 100 mm and two with a nominal diameter of 150 mm, there being two body lengths for each diameter. The neck lengths are produced at standard lengths and the fine frequency tuning achieved by sliding the tubes in the body before fixing them. At higher frequencies the volume of the bodies of these resonators becomes too small to be practicable and in their place simple parallel tubes are employed as shown in Fig. 4. These consist of three sections; an end tube carrying a Shure ceramic microphone and an emitter follower to permit transmission of the signal over long cable lengths, next is the main tube and finally a threaded end tube by which the tuning is achieved. Such a tube resonates when the length of the tube from microphone diaphragm to mouth is equal to $\lambda/4$, $3\lambda/4$, $5\lambda/4$ etc. where λ is the wavelength of sound in air at the tuning frequency.

With good sealing the Q of the resonators tends to be well above the requirement and they can be "let down" by inserting fine gauze in the throat. The Q of the $\lambda/4$ tubes tends to be high at low frequencies and falls off as the tuning frequency increases. These may be "let down" by drilling small holes through the wall of the tube. Above a certain frequency the Q becomes too small and it is necessary to transfer to the $3\lambda/4$ resonance and at very high frequencies to the $5\lambda/4$ resonance.

Why are acoustic resonators rather than electronic resonators employed? There are two reasons, the first being that the resonator with a Q of 25 gives a 28 dB gain on signal thereby improving the signal to noise ratio at the input and the second is that both resonator and auditorium tuning frequencies are temperature dependent and any drift has a degree of compensation. With electronic filters, at fixed frequency, any auditorium drifts would not be compensated.

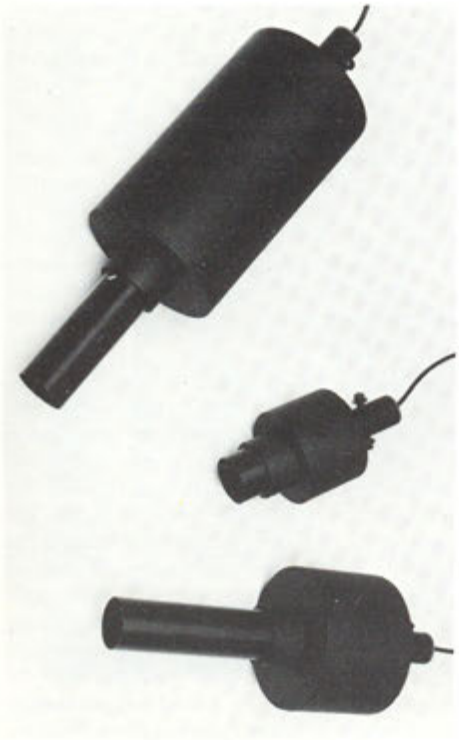


Fig. 3.

Fig. 4.

Amplifiers

Figure 5 shows a typical amplifier of current design. The primary requirements of the amplifiers and, indeed, all channel components, are that they all exhibit high gain stability over long periods of time, that they exhibit good phase stability and that they reach stable performance levels within a short period of switch on. In contrast, uniform frequency response is of little or no interest since each channel operates only in a narrow frequency band. Each amplifier is required to deliver 50 watts r.m.s. without distortion but the mean demand is very low indeed. Most of the time the amplifier sits around doing little or nothing and only when its particular note is played forte is it fully used. In the same way it is only in fortissimo passages of a full orchestra that a large proportion of the amplifiers are required to operate near full power.

Each amplifier incorporates a directly coupled low noise preamplifier input stage with two discrete component feedback loops. This is followed by a conventional operational amplifier, one stage of which promotes gain, the second providing at unity gain a 0–180° phase shift adjustment. The section from 180–360° is provided by changing over the loudspeaker leads. A filter stage follows consisting of two variable gain, variable Q, variable centre frequency sections, each using one half of an operational amplifier. The filter section has a nominal gain of unity and the overall bandwidth is usually of the order of 1/6 octave. The function of the filter is simply to suppress lower and higher harmonies of the resonators and tubes. At the end of the preamplifier is a loop break jack, the function of which is to permit a signal to be injected into the power amplifier and the return signal from the loop to be examined for phase and magnitude.

The power amplifier is of the conventional split-supply type, de-coupled, but has a quiescent current stabilisation circuit in addition. This circuit eliminates the need for setting up: it renders the quiescent current independent of the temperature of the output transistors and in overdrive conditions reduces the quiescent current to a safe level.

Power supplies used to date have been purpose-built to supply 3A continuously and 5A transiently to a total of six amplifiers, representing an output capacity of $\frac{2}{3}$ the potential of the amplifiers. This has proved to be more than adequate. The power supplies are stabilised and protected against overload and various short circuit conditions.

New amplifier designs are being considered with several preamplifiers serving a common power amplifier. It may be possible to include the full number of preamplifiers serving a $\frac{1}{3}$ octave band on one card and bring the outputs together to a single power amplifier. At the present time the electrical gain is adjusted by means of an attenuator stage before the power amplifier which consists of two series resistors, one of which is selectable by switch or relay to provide the number of gain settings (and hence reverberation time) required for each channel. The proposed modifications would allow the channels within a third octave to be set up relative to each other and, at the same time, allow the overall gain (and hence reverberation time) of the whole set to be changed by a single fader or by a stepped gain control.

The amplifiers, power supplies and all the necessary controls are housed together in standard cabinets as shown in Fig. 6.

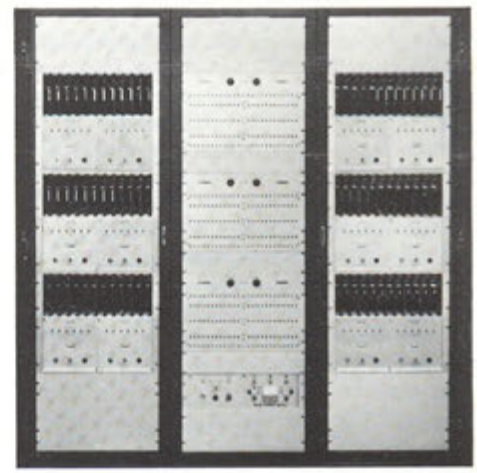


Fig. 6.

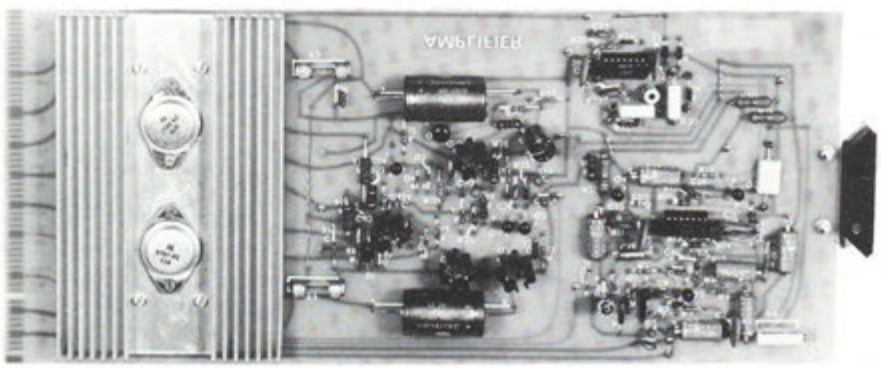
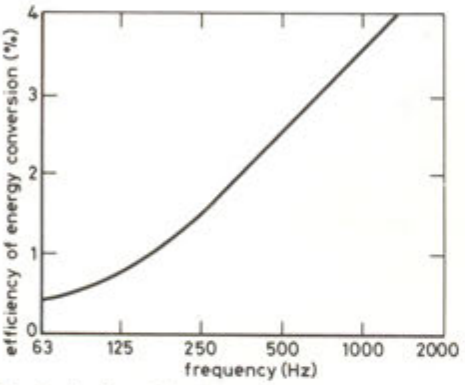


Fig. 5.

Loudspeakers

Loudspeakers are dear to the heart of the sound system engineer but, so far as AIRO is concerned, there is only one characteristic which matters. This is the efficiency of conversion of electrical energy into acoustic energy. Frequency response is of little importance. A range of loudspeakers has been tested by setting them up in a wall between two large reverberant rooms. One third octave bands of random noise were supplied to the loudspeaker and measurements made in the reverberation room of the sound power radiated. At the same time the electrical power input to the loudspeaker was measured and the efficiency of conversion calculated.

To date the most efficient loudspeaker discovered has been the Goodman 12P and Fig. 7 shows its performance in this respect ranging from 0·5 per cent at 80 Hz to 4 per cent at 1·25 kHz. This is the efficiency of the drive unit only when mounted in a baffle. Other loudspeakers tested had efficiencies of only one tenth of these values but, to be fair to them, these were units designed for use in high quality domestic equipment with fairly low flux densities. With such units mounted in cabinets designed to suppress unit resonances the efficiency was still lower but the object of their design was to produce a smooth frequency response and good response to impulsive excitation.



7. Relationship between efficiency of energy conversion and frequency for a Goodmans 12P loudspeaker.

Installation procedure

Assisted Resonance is not a wheel-in, switch on product. Since the auditorium itself is an important part of each channel the installation itself is in the nature of an acoustic experiment in that it is not possible to predetermine the location of every component.

The location of the amplifiers is not critical, provided that they are placed to provide convenient cable runs out to the microphones and loudspeakers. As has already been said the loudspeakers should be remote from members of the audience, so that they are not conscious of the sound coming from a particular direction.

In some installations they have been mounted in the suspended ceiling, in others they have surrounded the audience by being mounted in panels on the rear and side walls. The loudspeaker positions are predetermined and each one is allocated to a particular channel with its particular frequency. The allocation is made in such a way that the adjacent (in frequency) loudspeakers are kept well spaced so that there is a good distribution of frequencies around the hall.

It is not possible, prior to installation, to say where a particular microphone will be placed. It is possible to make a decision on a generalised location but it is necessary to provide choice for the location of an individual microphone. In the Royal Festival Hall the ceiling already included a large number of holes and these were used for the microphones. In AIRO installations the microphones have sometimes been suspended from high level cable trays and at York were completely exposed to view but, at Reading and in two American installations, were concealed either behind gaps between ceiling panels or by being painted black and hung above auditorium lighting level. At Hillingdon and in current designs the microphones are located behind the ceiling and communicate with the auditorium by way of 50 mm wide slots. All these arrangements allow for a continuous variation in location, either along a line or where the microphones are suspended, within a plane. The microphone line or plane is chosen to be far from the stage and far from the system loudspeakers. So far as is possible they are also located so that the direct sound from the stage reaches each member of the audience before the first sound from the system loudspeakers. This is, perhaps, not as critical as might be expected since there is an appreciable time taken for the reverberant sound to build up and to date it has not been found necessary to make use of delays.

When installation begins, perhaps at the lowest frequency and progressing upwards, a position for the microphone is sought in a region which is as far from its corresponding loudspeaker as possible. This tends to ensure that an acoustic mode or cluster of modes linking the two will also reach out into the general volume of the auditorium and will therefore link with the audience and performers. It is this full space penetration which ensures the "natural" effect. One can imagine a situation in which a microphone and loudspeaker, in comparatively close proximity, could form a feedback loop which gave the desired reverberation time for a very low gain and low system output. The audience would hear this as a local effect at some distance from them, to put it crudely as though a hearing aid were feeding back. It is extremely important that, when a general location is selected for the microphone, a particular location should be found which fulfils two conditions:

(a) The microphone would ideally be sitting on a peak both in terms of space and frequency so that any drift is into safety rather than danger;
(b) the peak should have a magnitude which, when the gain is set to the desired RT, the desired increase in sound pressure level is found to occur in the auditorium.

The loop itself is set up by use of the loop break shown as being between the preamplifier and power amplifier. A signal at tuned frequency is injected into the power amplifier and the return signal from the preamplifier is adjusted to be in phase. The magnitude of the return signal is adjusted to give the required RT and finally the increase in sound pressure level in the audience area is checked without the channel operating and with it operating. If the increase is inadequate then a new position for the microphone must be found on a pressure peak which is lower for excitation from the channel loudspeaker. This means that the channel gain must be increased to achieve feedback, and the dB below feedback for the necessary RT, and the channel will then put out more power for platform excitation.

Once the first channel has been set up, the installation continues through the full frequency range. The main problem which arises is due to the fact that the channels cannot be regarded as totally independent of their frequency neighbours. They interact: some pushing up the reverberation time of their neighbours and some waiting to interact negatively pulling down the reverberation time of their neighbours. Too much interaction cannot be allowed and negative interaction is particularly undesir-

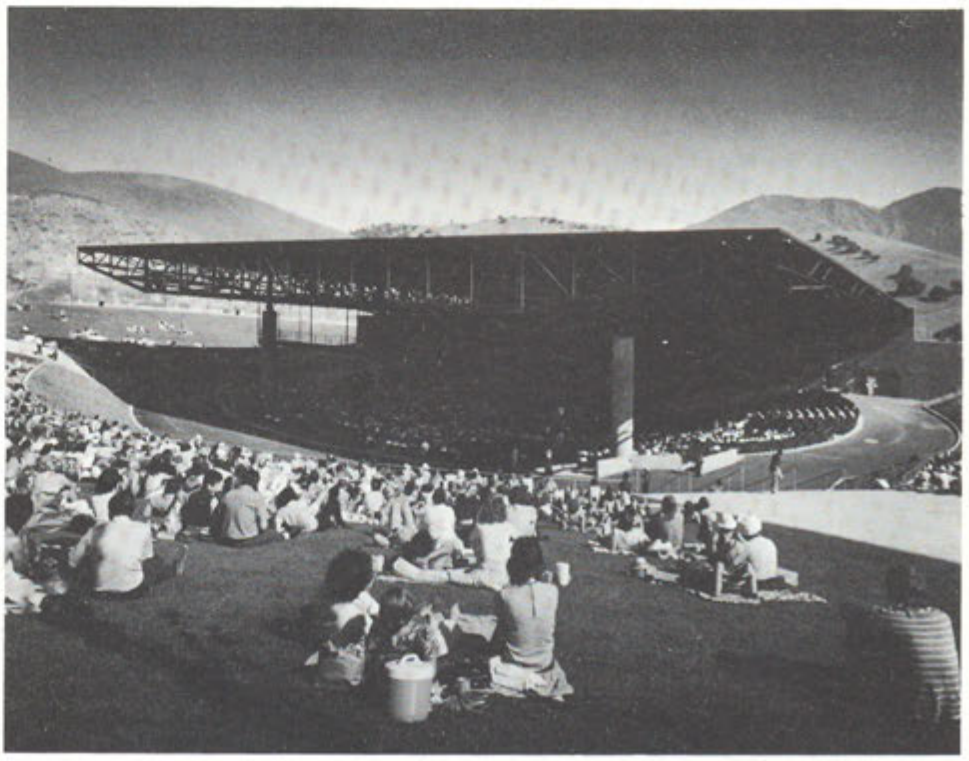


Fig. 8.

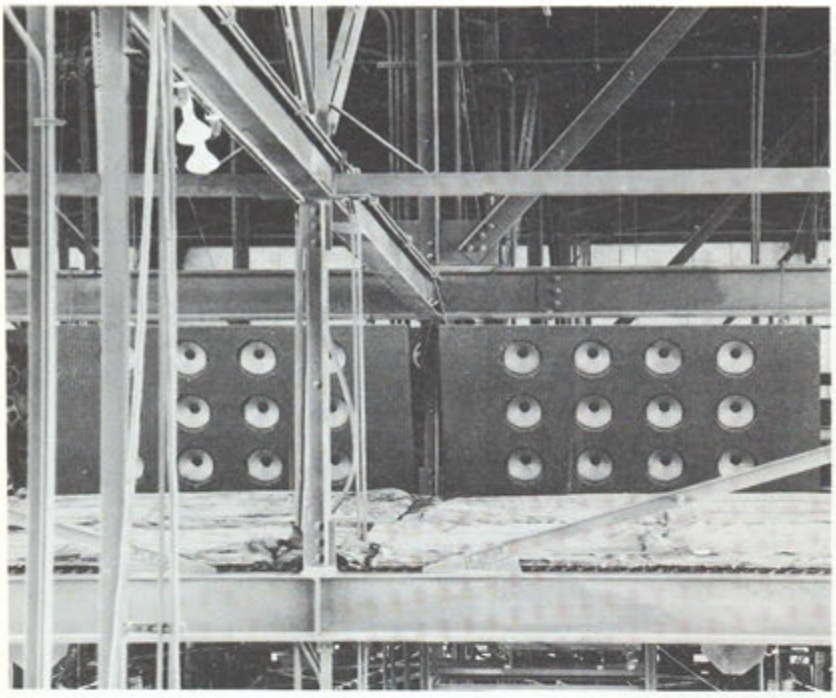


Fig. 9.

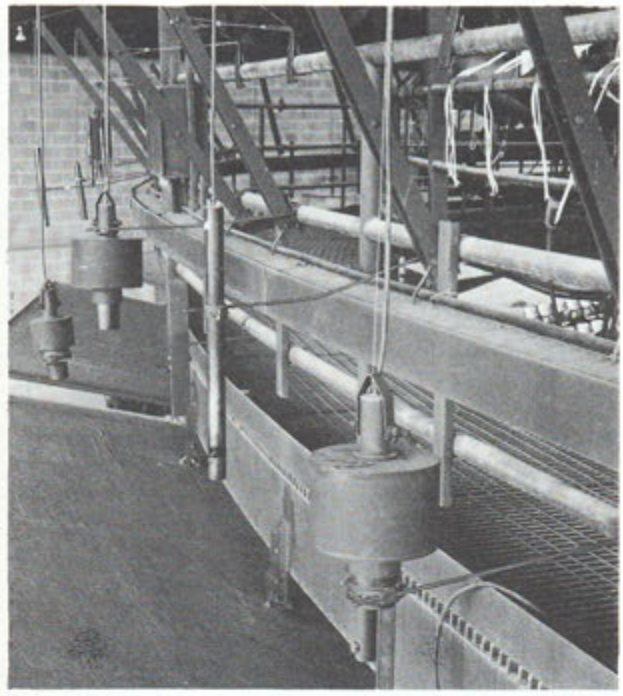


Fig. 10.

able. This could result in strong colouration or even uncontrolled howl if the key channel were to go out of action for any reason.

Californian compromise

Perhaps one of the most interesting installations was in the City of Concord, California. For a number of years the City had run a jazz festival in one of the local parks which had been extremely successful. It was decided that a permanent base should be established but all the various sectional interests in the City insisted that the space should not be exclusively designed for jazz with its short reverberation time.

Figure 8 gives a general view of the space which was created which took advantage of an area of small hills and hillocks on the City border. A natural hollow was landscaped to provide a still more effective hollow, the dig being used to build up the rim of the hollow to form a small crater. The stage, which is 60 feet in diameter, is off centre so that there are many more seats in front of it than behind it. The seating area is covered by a roof measuring 20 ft. × 200 ft. supported by the rear wall and by one column at each of the forward corners. There are seats for 3,500 people. There are no side or front walls but the volume contained is very large and even with 20-ft. high open space on three sides the reverberation time within the space had to be controlled by absorbent to achieve the short RT required for jazz, pop and speech.

Outside the seating area the slopes continue upwards with informal seating for another 4,500 on the lawn, thereby continuing the tradition of the Jazz Festival as an outdoor event. There are a series of circular catwalks at high level under the roof to carry the lighting equipment, the loudspeakers for the normal sound reinforcement and for Assisted Resonance microphones. The theatre and sound consultant decided to play safe, as he put it, and to locate the Assisted Resonance speakers at high level above the stage. A square of four baffles was employed as shown in Fig. 9. We would have preferred to see the loudspeakers with their axes vertical and distributed around the roof area. The microphones and their resonators were supported on yard arms from an outer catwalk (Fig. 10). The amplifiers along with all other lighting and sound control gear were located in a gondola suspended from the roof trusses and accessible from the catwalk.

The only problem in installation was that it began on January 5th and the old song is dead right, at that time of year California really is cold and damp. On one occasion dense mist rolled in everywhere and with a sudden drop of temperature we had rain, including under the roof. This did the microphones no good and, as a precaution, these are now enclosed in plastic bags with a drying agent at the end of each season. The season begins in late April or early May when the temperature has risen to a level acceptable to the audience and continues to late September or early October. The range of performances is enormous. They include purely local events such as school concerts and graduation exercises, the Jazz Festival with top class American performers, pop groups, well known singers such as Sarah Vaughan and Frank Sinatra, popular musicians of the style of Henri Mancini and his orchestra, folk singers, rock groups, ballet, Gilbert and Sullivan and symphony orchestras such as the Oakland Symphony and the San Francisco Symphony. There are four acoustic settings, natural and low, medium and high levels of Assisted Resonance.

In a performance space such as Concord it is possible to include reflectors above the stage to provide some response for the artists but there is not the direct sound reflection from the side walls provided in a parallel walled or fan shaped auditorium. The consultant made use of what he describes as an electronic fore-stage canopy. This consisted of a ring of speakers on the inner catwalk providing discreet reinforcement of the performance sound.

Limitations of Assisted Resonance

It is right to emphasise that Assisted Resonance will do one thing and one thing only. It will allow the reverberation time to be varied. All other aspects of the acoustics, e.g. level of direct sound, generation of early reflections, elimination of echoes, must be taken care of by other means. It is, however, something that one aspect of the problem of multi-purpose spaces can now be dealt with.

Getting it right first time in Prague

It has been decided that Assisted Resonance will be employed in the new Congress Hall currently under construction in Prague.

This Hall will have an adjustable ceiling which may be lowered to cut off the balcony. In the raised position the Hall will have a volume of 41,000 cubic metres and seat 3,000; in the lowered position it will have a volume of 26,000 cubic metres and seat 1,800. The frequency range to be covered is from 63 to 2,000 Hz and the system is to be effective in both ceiling positions.

With this installation we shall have come full circle from the Royal Festival Hall in a capital city to a Congress Hall in another capital city. The difference, an important one, is that in Prague the technique is included in an initial design.

DUET

PHILIP ROSE

In March this year Rank Strand Electric introduced its latest lighting control system, DUET. Since then it has been widely exhibited in the UK, Europe, United States and Canada to both theatrical and television users. The universal acclaim it has received has brought a blush of pride to our normally modest cheeks.

In defining our objectives for Duet we set out firstly to put all that is best in a memory system within the financial reach of all and not merely to offer a fancy manual system with some black box memory electronics tacked on. Secondly, we intended that it should be easily installed, and usable (as a portable system for example), without the need for specialised site expertise, and thirdly, field service and maintenance was to be straightforward, on the basis of easily comprehensible plug-in electronic modules. Furthermore, the complete Duet system with its various peripherals was to provide function redundancy, but maintain adequate control to professional standards.

This was a fairly challenging brief, but by making use of the latest electronic and microprocessor technology and an elegant software programme, we believe we have achieved our original goals.

In setting out to make the most of the concept of memory lighting control we believed it essential to make sure that functionally it should be readily understood even by those who had never seen a lighting control system in their lives before. For this reason it has far fewer pushes and knobs than one might expect to find on such a powerful control. At the same time we wanted to ensure that the system could respond to the imagination and demands of the most ambitious designer. It appears from the reactions of the many who have so far operated the system that we have succeeded in these aims.

The heart of the system is the Duet Console, which by itself is a complete and self-contained memory lighting control. In its basic form it will control 48 channels,

which can be increased by multiples of 12, up to a maximum of 120. Similarly, the number of memories can be varied up to 198. Increasing the number of channels and/or memories is simply achieved on-site by plugging-in extra electronic modules.

System status information can be provided either by a simple above zero LED mimic, or by a free-standing visual display unit (VDU), providing alphanumeric information of the percentage intensity and control status of each control channel, as well as the content and status of all master functions.

For both memory storage and extending the performance memory, or for library storage for repertoire, a free standing floppy disc unit can be added. Both these and the visual display unit are styled to complement the Duet Console, so they may be mounted on top of the console or peripherally, whichever is the most convenient.

For those who find that lever control is occasionally useful there is a matching two pre-set desk with a dipless cross fader. The output of this can be recorded on the Duet console. Another option is a pin-patch matrix for pile-on or inhibit grouping to 10 fader levers. Where sub-mastering is required a matching peripheral is available having 10 sub-masters which uses the memory of the Duet Console to allocate and group channels to the sub-master. For those who have an existing manual pre-set control it is possible to use the Duet system in parallel.

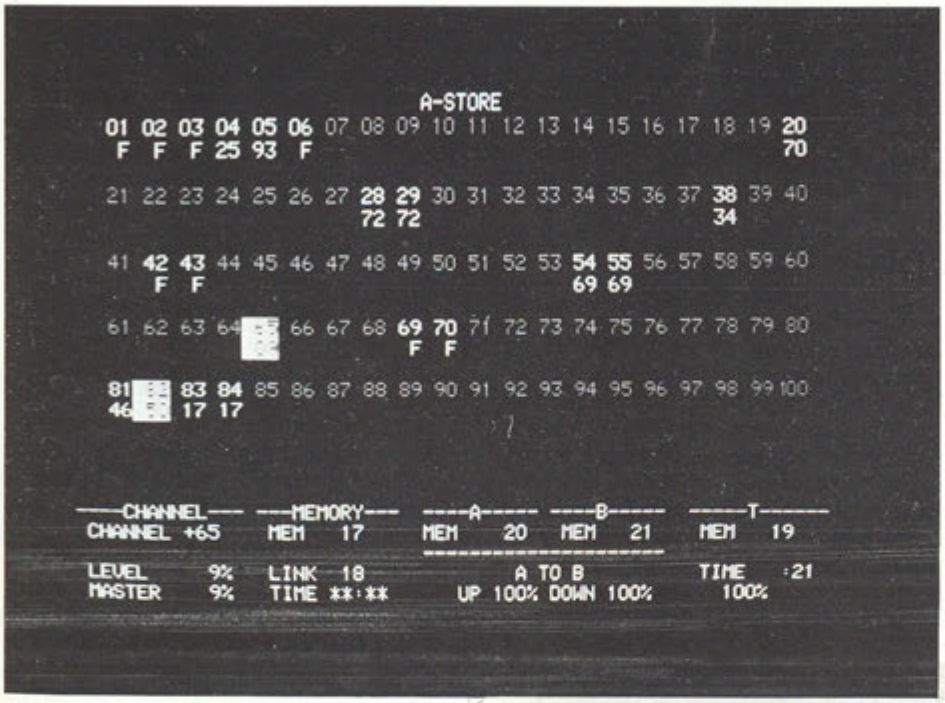
An interesting accessory is known as the Riggers control. This is a hand held unit, which provides basic on/off, raise/dim of any channels for the rigging and setting of luminaires. It is available either with a two-core screened cable for plug-in at various locations around the theatre or studio, or for radio control.

All parts of the system have a matching style and can be easily arranged to suit individual control room layouts. For those who wish, there is a special desk for permanent or portable use on which the system can be arranged.

Duet is the first "off the shelf" memory lighting control system. First shipments will be in the autumn, after which the system will be available on standard product lead times.

For those who would like more information a detailed brochure is available.

The author is Director of Marketing and Research & Development for Rank Strand Electric.



Duct console with VDU and screen close up. (Below) The mini-floppy-disc is in a similar enclosure to the VDU. Both can be located on top of the console, as illustrated, or at the sides.

Lighting with Military Precision

PETER G. RICH

The Queens own Ghurka Engineers. (Photo. Don Stephens, Hobart)

Transplanting the Internationally-famed Edinburgh Tattoo to Australia's Island State, Tasmania, was no mean feat. And not the least of the exercise was the provision of highly complex and extremely efficient lighting systems.

In the Autumns of 1976 and 1977 Tasmania's North Hobart Oval—a football and cricket ground—played host to the most ambitious and colourful Military Tattoo ever staged beyond the shores of Scotland. Crowned in 1977 by the attendance of the Queen and the Duke of Edinburgh, the Tattoo drew bands and performers from many parts of the world.

The Tasmanian Military Tattoo was conceived by John and Barbara Howell, organisers of Tasmania's Annual Blue Gum Festival. It received solid government and community support and for the two performances in 1976 and 1977 drew very large audiences.

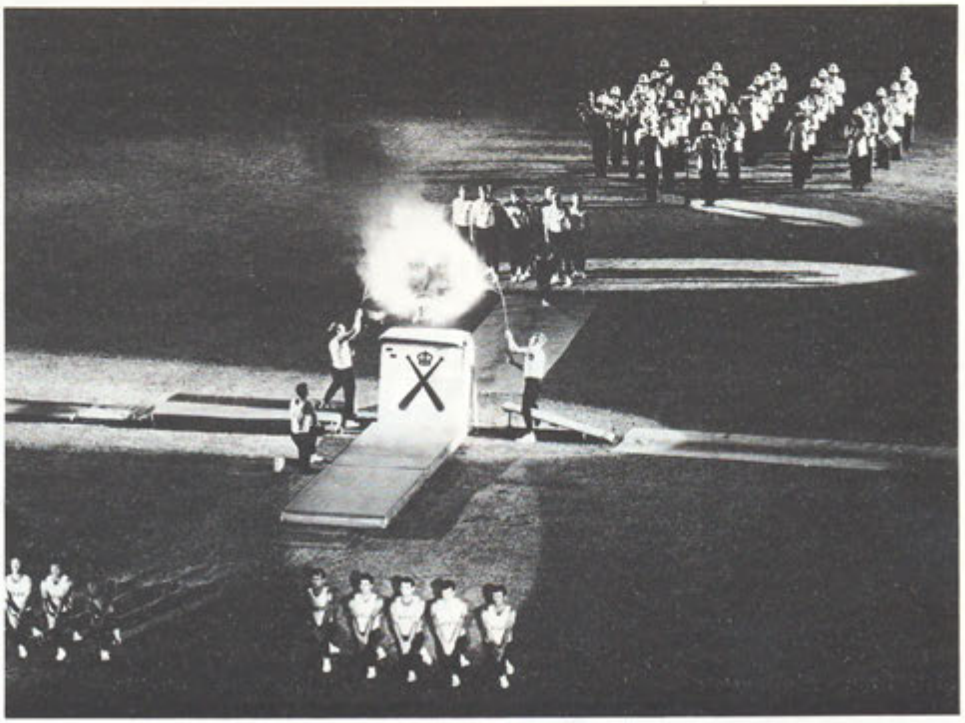
The Manager, Mr. Alex Thaine, and associate producer Colonel "Sandy" Storm of the Edinburgh Military Tattoo were invited from Scotland in March 1975 to advise on the feasibility of staging the event in Hobart. Representing the Customer Advisory Section of the Hydro-Electric Commission the author was called in to advise on the lighting of the event and needless to say was a little shaken. The job was beyond the experience of anyone in Tasmania and after some discussion it was decided to send me to Edinburgh to study the lighting equipment and techniques in use with a view to setting up the equal in Hobart.

A solution would have been to simply copy the Edinburgh lighting but this was not possible due to major physical differences. The Edinburgh Military Tattoo is held on a tarmac esplanade at the entrance to Edinburgh Castle. Three sides of this esplanade have removable terracing erected supported on tubular scaffolding. At the top and back of this fairly steep terracing are continuous gantries on which lighting is positioned.

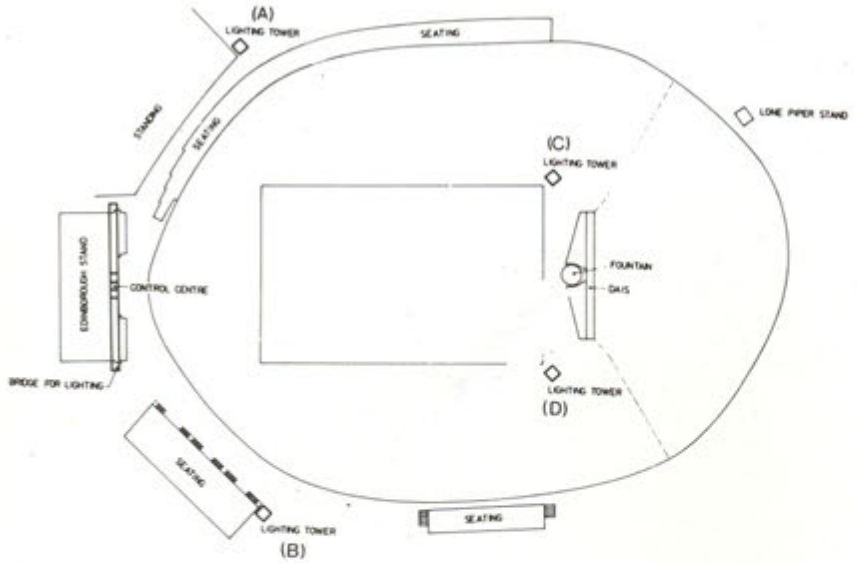
The whole layout therefore is relatively compact and no light is more than 17 m from the performance area. Lights can also be positioned anywhere along the three sides of the esplanade.

The situation at the North Hobart Oval was very different. The operating arena was to be a rectangle marked out on the oval measuring 76 m × 45 m lined up with a stand at the end of the oval. It was decided for 1976 that lighting equipment would be mounted at five positions—(see plan). The bridge along the top of the "Edinburgh" stand would also support at its centre the boxes from which the Tattoo would be directed and controlled by the producer and his staff, the lighting director and his assistant and the communication technician.

The two towers at the back of the arena were positioned close to the corners of the arena allowing a fairly sharp cut-off in light demarking the arena at that end. It was considered desirable to locate the side towers off the oval behind the audience so as not to cause visual obstruction. The top platform of all towers was 18·5 m above the arena level with a second platform 2 m down. This height was considered necessary to give a reasonably steep angle onto the arena to assist in providing a sharp cut-off of light beyond the performance arena and to reduce glare to the audience.



The RAN display team, Royal Marine Band in background. (Photo. Mercury Newspaper, Hobart)



Plan of North Hobart Oval.

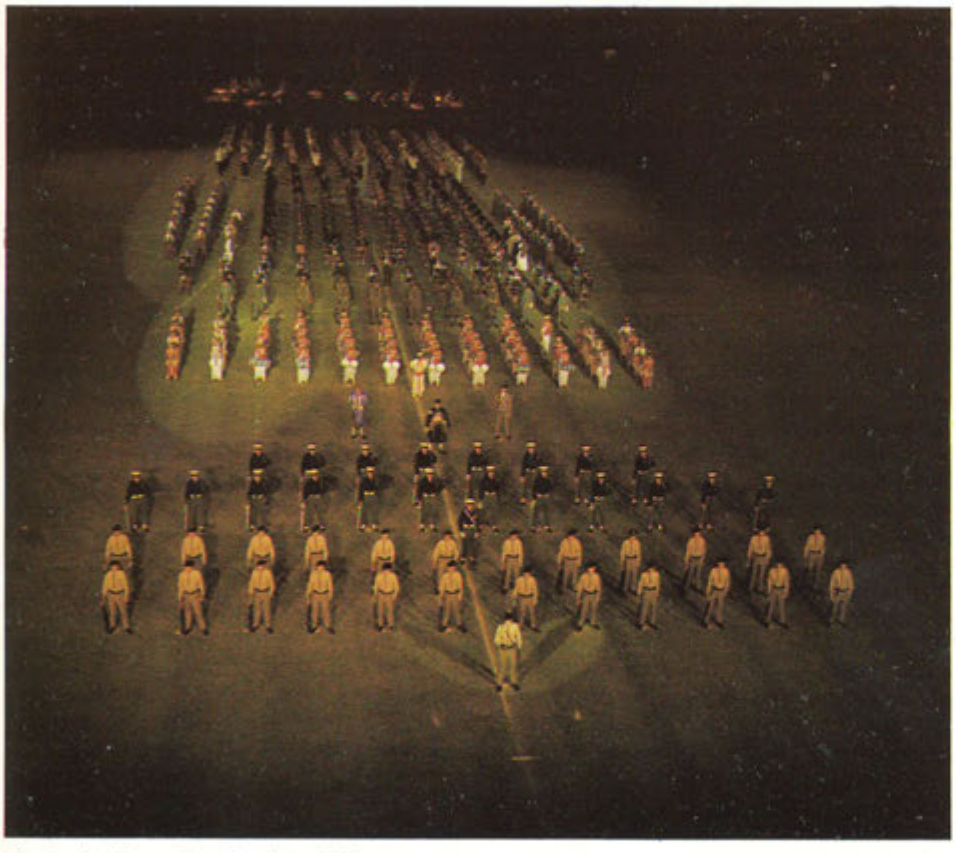
The lighting was of four basic types:

(a) The fixed arena lighting which was incandescent and totalled 161 kW being mostly fresnel spots with some profile spots.

(b) The follow spots consisting of fourteen 1 kW CSI (compact source metal halide), ten Strand pattern 765 and four Strand pattern 765N. The 765 is the standard 1 kW CSI follow spot with a beam angle of 14°, the 765N being electrically similar but with an additional "telephoto" lens assembly to give a narrower beam of only 7° with consequently a greater throw. This narrower version was especially developed for the Edinburgh Military Tattoo by the Rank Strand factory in Scotland.

(c) The effect lighting which consisted of eighty 150 W PAR 38 lamps, one hundred 100 W G.L.S. lamps and a few underwater lights for the fountain. This effect lighting was used to light the floral setting on the dais, the seven flags, the shrubs, screening "off-stage" performers and the lone piper who played from a platform on top of a small stand at the back of the oval.

(d) The house lighting consisted of eight 1500 W quartz iodine fittings and twelve 150 W PAR 38 lamps.



The Finale (Photo. Don Stephens, Hobart)

To expand a little on the first two types of lighting which form the principal lighting, the fixed lighting could be said to be "Fill" lighting in the sense of that used for camera work. The fresnel light is highly directional especially when fully focused. The beam can be broadened by moving the lamp forward and shaped by the use of four barndoors mounted on a rotatable ring at the front of the fitting. The fixed lights are aimed to cover the whole of the arena with beams overlapping a little and the barndoors are used to provide a cut-off of light at the edges of the arena. This could only be achieved with moderate success as regards the fixed light on the side towers A and B due to their distance from the arena and the consequent large angle of incidence to the ground.

In general the back of the arena was lit by the fixed lighting on C and D towers, the centre by those on A and B and the front by the bridge fixed lighting. Control was effected by means of a dimmer board and light was confined to the part of the arena on which some action was taking place.

The spotlights were the dominant lighting. They were generally used in pairs to provide a symmetrical effect and reasonable viewing for all spectators. It was difficult for operators to judge this paired symmetry and corrections were made with the lighting control. With massed bands, pipes and drums, for dramatic effect, the leading drum major was spotlit leaving the bandsmen in darkness for a period and then the whole gathering was encompassed with floodlight.

The latter was a difficult task due to beam diameter limitation. It proved exacting to cover a large number of performers covering the whole arena in groups, for example the Scottish and Country dancing.

The lighting director's job was to decide the complete lighting plot, namely: the light sequences to be used for the arena throughout the 195 minute performance: the control of the 14 follow spot operators using headsets for communication and the overall lighting control.

The assistant lighting director's job was to operate the 40-way control console for fixed arena lighting, effect lighting and house lighting. The Australian army provided general lighting back-up, with their lighting operators being directed by telephone. This was necessary to deal with lamp failure, colour filter jamming, and so on. These lights were operated by men and women of the 4th Signal Regiment from Melbourne. The functions of the spot operators were:

(a) Following of performers as directed by the lighting director.

(b) Controlling the diameter of the beam by means of a lever operated iris—as an example with the 765N it is possible at, say, 50 m to light the drum only of a drummer, leaving all surroundings in darkness.

(c) Controlling the shape of the beam by means of lever-operated shutters—this was rarely used.

(d) Shutting off the beam completely. This was done by either a shut-off lever, a black-out board pivoted down in front

of the follow spot or by pointing the light into the air which was necessary with the 765N's when they were required to be off for some time. This was necessary because the shut-off lever at the iris could not be left in this position too long or it would overheat. The follow spots could not be switched off electrically during the performance due to the time required for restriking and run-up.

(e) Colour filter operation which on the 765's was effected by means of a magazine on the front of a unit using four panels, three being colour filters and one masonite panel for blackout.

After the 1976 Tattoo a few changes were made for the following year. The side towers A and B were moved onto the oval to be much nearer the arena, reducing earlier problems. The fixed lighting was simplified by using twenty 5 kW fresnel spots, four per tower and bridge and the number of follow spots was increased to eighteen, twelve 765s and six 765Ns. There were also changes in the dais, the fountain being removed to eliminate noise.

The Tattoo is a complex event to set up electrically with a lighting load of 220 kW consisting of about 240 lamps all wired on a temporary basis and most exposed to the weather. Security of supply is important for obvious reasons with so many of the public present and suitable precautions were taken.

Maintenance was not a simple matter. Those responsible were unused to theatre type luminaires with the problems such as quartz lamps that must not be handled, re lamping fittings without disturbing their aiming, focusing or barn-door settings, and the complexities of the CSI control and starting arrangements. Major problems were caused by high winds, particularly with "barn-door" settings.

Present planning envisages the next Tasmanian Military Tattoo being staged in March 1979.

The author is an engineer with the Hydro-Electric Commission, Tasmania.
Lighting equipment and design assistance by Rank Industries Australia Pty Limited (Strand Electric Division)

Blinded by Science

JOHN SCHWILLER

A cry from our previous editor from these pages was directed towards the backroom copywriters dreaming up publicity for their new "Patt. XYZ" or "Spotette". Having recently tried to rough-out an information sheet for a new lantern I became aware of the problems these technical authors face. A new lantern can be considered as a fusion of a mechanical housing and an optical system. The former can adequately be described verbally and illustrated with various photographs and diagrams, and hopefully these will be self-expanatory. However, the problems start when we try to describe the lantern's optical performance. If our copywriter waxes lyrical about his company who have "seen the light" and have created "a larger, more useful beam" with "an infinite permutation of beam shape", then he conveys little. At the other extreme if he quotes a barrage of figures in footcandles, lux, candela and degrees he may confuse. Unfortunately, if this photometric information is not made available then the only way a prospective customer can compare products is by borrowing samples and carrying out his own tests. He would of course be well advised to do this anyway to get a feel for the quality of the beam produced. This is both the most important and intangible characteristic which defies photometric description.

The choice of a particular brand of one type of lantern, for example a Fresnel, may be exacerbated by the growing tendency, due to economic stringency, for some customers to buy all their equipment from one manufacturer. This makes it even more important for the customer to be able to obtain the relevant performance data from the equipment catalogues. However, all is not well. I imply no disrespect to readers, calculators at the ready, who are at home in the field of illumination, but many customers may truly be blinded by science. The data might be perfectly correct but still some customers will be incapable of using it, and hence they may be misled.

There is a maxim in manufacturing that whatever a piece of equipment is designed to do somebody will want to do something extra with it. In many instances this has happened in the lighting profession, and this is one of the ways in which advances are made. A prime example of this type of cause and effect development was the advent of lighting for television, which picked up early Fresnel development by Rank Strand for the theatre and took it forward. Meanwhile some current equipment development is being affected by the requirements of the rock music market to which I will return later.

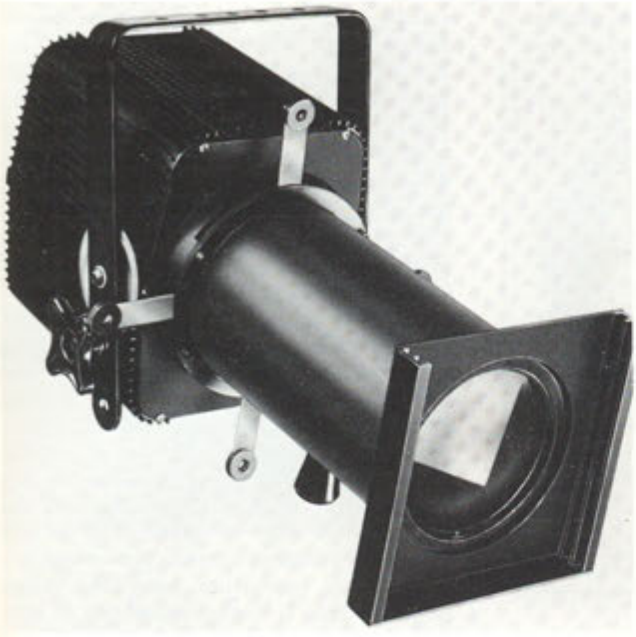
Let us briefly survey the equipment used in theatre and television lighting, which can be broadly divided into lanterns, effects, boards and dimmers. Tremendous advances have been made in control over the last decade, and some readers may even think that we have advanced too quickly. Board designers have certainly been quick to apply the available technology spun off from other work outside our industry, the microprocessor being the latest example of this. However, at the time of writing most board designers accept that excluding changes in software the boards in development now are as sophisticated as they ever can be. Dimmers may also be almost unchanged a decade from now. No, the next area in which most of the big advances will be made is lanterns and effects.

Francis Reid in one of his deeply philosophical moods brought on, as with so many theatre people, by the pulling of a pint and the knowledge that it was not his round, was heard to mutter that in comparison with control boards the state-of-the-art lanterns were like "electric dustbins". One cannot deny that the enormous development in electronics have played their part, but I venture to suggest that in the next decade we will see a small revolution in lantern quality and design. It would be impossible to examine the whole field of lantern development in the space available, so allow me to concentrate on some specific areas of interest.

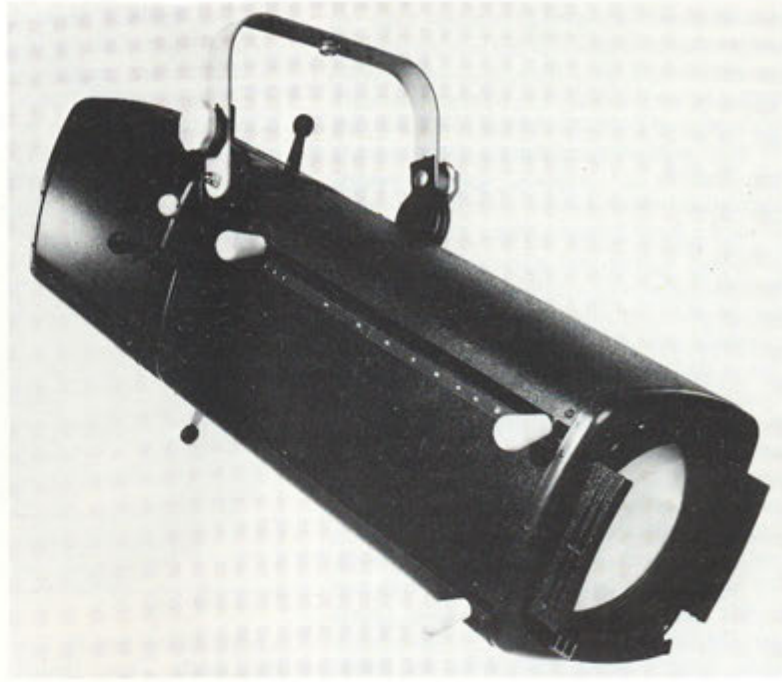
In an interesting article entitled "Choosing a Spotlight", by Louis Erhardt in *Theatre Design and Technology*, USITT, Spring 1978, the author describes in detail the photometric requirements of a profile spotlight for stage use.

The article reproduces various tables of helpful general information as well as the performance data for spotlights made by Electro Controls, Kliegl, Strand Century and Berkey Colortran. As far as I am aware only the Berkey lanterns are available in Britain, and the only zoom or variable beam angle spotlight he refers to is Electro Controls' Parellipsphere. Erhardt states that in order to achieve different degrees of spread from one lamphousing... "... it is necessary to employ lens systems of longer or shorter focal lengths. This may be accomplished by interchanging lens heads with varying focal lengths, by inserting other lenses in a lens head—sometimes changing their spacing as well—or by employing a zoom system of lenses. Interchanging heads or repositioning lenses is more economical when the problem is specific and known. If continuous variability from a single unit is essential the added costs of a zoom system may be justified." Fortunately, in Britain at least this important last point is not pertinent and the available variable beam angle spotlights include CCT's Silhouette range in 1 kW and 2 kW versions and Rank Strand's 2 kW Patt. 808 and 650 W Patt. 813. As the optics of a zoom spot are the general case of all other fixed twin and single lens lanterns they merit a closer look. In passing it is worth noting Erhardt's comment on zoom lens systems of which he appears to disapprove.

"If a zoom system is employed the unit will be larger for shorter throws than one designed specifically for the lesser distance." This is true of the present lanterns available but it is not an inherent feature of variable beam angle units, and future models may get round this minor problem. The geometrical optics below are relatively



CCT Theatre Lighting's Silhouette *variable beam angle lantern. This is the 1 kw lamphouse fitted with a detachable lens tube, of which there is a choice of four. This unit has a cut-off angle range from 22° to 40°.*



Rank Strand's Patt 808 *variable beam angle lantern. The 808 is a long throw 2 kw profile which is particularly useful for opera houses, arenas and large concert halls.*

simple and are given for completeness only. The final relation may be considered equally well without examination of its derivation. Consider the system of *thin* convex lenses of focal lengths f_1, f_2 shown, and the path of a ray passing through point B. The image of B produced by the first lens is C. This acts as an object with respect to the second lens which produces the final image which we shall assume to be at infinity. The deviation of a lens Δ is given by h/f, where h is the height from the principal axis and f the focal length of the lens. Thus δ is given by h_2/f_2 and the deviation at the first lens is given by h_1/f_1. The total deviation δ' of the ray by refraction at both lenses is thus given by

$$\delta' = \frac{h_1}{f_1} + \frac{h_2}{f_2} \qquad \text{(i)}$$

Now if F is the combined focal length of the lenses, the deviation δ' of the ray is also given by

$$\delta' = \frac{h_2}{F}$$

Substituting for δ' in (i) it follows that

$$\frac{1}{F} = \frac{1}{f_1}\cdot\frac{h_1}{h_2} + \frac{1}{f_2} \qquad \text{(ii)}$$

Now triangles OPC and AXC are similar thus

$$\frac{h_1}{h_2} = \frac{f_2 - d}{f_2}$$

therefore substituting for h_1/h_2 in (ii) we get

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$

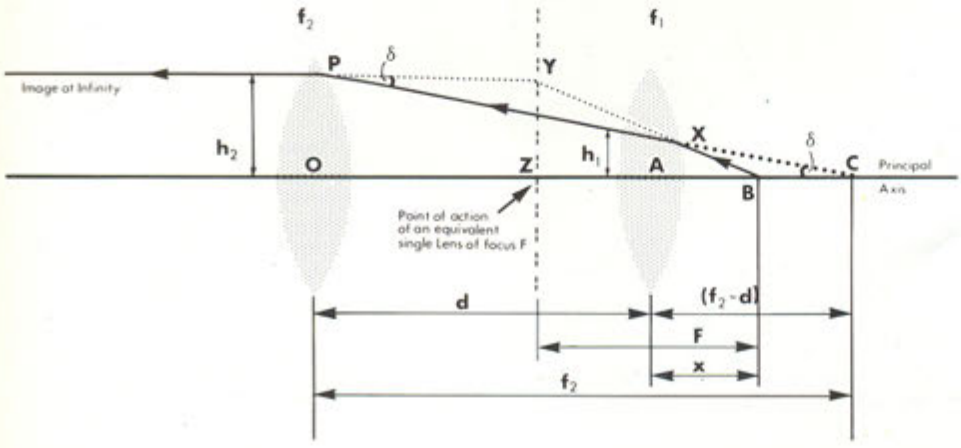
also as triangles ZYB and AXB are similar

$$\frac{h_2}{F} = \frac{h_1}{x}$$

and solving for x

$$x = \frac{f_1(f_2 - d)}{f_1 + f_2 - d}$$

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2} \quad \text{Relation } A$$



We therefore have a relation for the equivalent focal length F of the two lenses in terms of their individual focal lengths f_1 and f_2 and their separation d. We also have a relation for the position of the focus of this equivalent lens in relation to the first lens. The theory holds equally well for plano-convex lenses as for convex lenses. Now the magnification of a single or effective single lens in this context is given by:

$$\text{magnification} = \frac{\text{throw}}{\text{gate to lens distance}}$$

$$\simeq \frac{\text{throw}}{\text{focal length}}$$

We can make this approximation as the throw is much larger than the focal length and hence the gate may be considered to be at the focus of the lens. We therefore can see that

$$\frac{\text{field diameter}}{\text{gate diameter}} = \frac{\text{throw}}{\text{focal length}}$$

And thus for a narrower beam angle, i.e. a smaller circle diameter for a given throw, we need a greater focal length. Taking an example we have the Patt. 23 with a single lens of 5in. and a cut-off angle of 30°. To convert this into a wide angle version with a 40° cut-off we add another 5 in. focus lens to the rear of the first and this lowers the effective focal length of the system as seen from relation A. In another example the focal length of a system of lenses is varied by changing their relative defined positions. In the Berkey Colortran Ellipsoid a 30° field angle obtained with two 9 in. focus lenses can be converted by moving one of the lenses to another position to give a field angle of 40°. Finally, in the variable beam angle spotlight each lens is allowed to move independently so that the beam angle can be varied within a given range. Thus taking the Silhouette 30 as an example a 6½ in. and a

9 in. focus lens are used to produce a cut-off angle ranging from 22° to 40°, dependent on the position of the lenses. A lantern which does not have a facility to change the beam angle may still use two lenses to advantage. By careful positioning during design it may be possible to reduce the chromatic aberration which causes coloured fringing around a hard focused edge.

Now it is true that variable beam angle lanterns have been available for many years but despite their advantages they have been relatively slow to catch on. One reason for this is that because of the second lens the variable beam angle lantern may be less punchy at a given angle than its fixed angle counterpart with only one lens. Another reason may be due to the fact that they are harder to focus than a conventional profile. This is because, as Erhardt points out, the two lenses must be positioned individually for spread and sharpness, and each lens affects both characteristics. I have found that the best way to focus a variable beam angle lantern is to start with the lenses always at their extreme positions with a maximum separation between them. This as we can see from relation A will give us the narrowest beam angle and, if the lantern is well designed, a sharp focus. Now to select a wider beam angle if we require it, the front lens should be moved back to give the desired angle. The process marginally softens the edge of the beam and this can be refocused by moving the rear lens forward. There is then a choice of two modes of softening available. Moving either of the lenses back slightly will greatly soften the image and make a small corresponding change in its size, in a direction as would be expected. Alternatively, moving either of the lenses forward will marginally soften the image and at the same time change its size as indicated by the equation. Consequently a spotlight as described need only have one set of shutters as these may be soft-focused by use of the lens. If the user wishes to back up a soft edge to make it harder certain modifications to the shuttering need to be made. It should, however, be remembered that for the highest efficiency the rear lens should be kept near to the gate. Even if the design permits removing the rear lens to a point near the front of the lantern this positioning should be avoided. In this way the point where the beam converges can be kept within the lens tube and away from the gel mounting position.

Erhardt in his article goes on to discuss reflector design and he points out that a true ellipsoidal surface will probably result in a poor image of the filament which will be almost impossible to remove. He then describes the faceted ellipsoidal reflector which is formed of many small plane mirrors each directed and sized to fill the gate. This kind of reflector is less sensitive to off-axis lamp position, and is the type used by Berkey and in most of Rank Strand's profiles. These spun reflectors are crafted by skilled metal spinners to a metal master chuck, and I will never forget the first time I saw a faceted reflector being *created*.

The early lanterns developed by CCT were designed for the television market and a requirement was for the lanterns to have a flat field. They therefore developed a theoretical way of calculating a reflector shape which would result in a particularly even, flat field. When the first reflector was tried out it did indeed give a flat field along with a perfect picture of the filament, and this was eradicated by planishing the reflector. It would now appear that some users prefer the flat field, wherein the beam angle coincides with the cut-off angle, for long throw work. In "Choosing a Spotlight" reference is made to a suggested optimum intensity distribution which would, it is proposed, result in a very smooth multi-lantern field. Regrettably, the author does himself the disservice of blinding us with science in his attempted explanation of this theory.

On the subject of reflectors, Erhardt seems to be particularly scornful of one recent development. By modifying the design of the reflector it is possible to create a situation whereby when the position of the bulb is moved slightly the beam to field ratio will change. Both the Parellipsphere and the Silhouette have non-faceted reflectors and the Berkey a faceted reflector which exhibit this property. Consequently the user is able to vary the beam from a flat field say for projecting a gobo to a peaked field with a brighter centre for acting area blending. A lantern with this facility is surely more flexible, and to reproach with "only the trained operator will utilise its full advantage" and that "the average user . . . will more often have the unit at a wrong setting and not know the proper procedure to correct it," is a little condescending to say the least.

The theoretical reflector may not behave quite as expected when it is built into a lantern. In theory a true point source is usually considered but in reality this of course does not exist. In practice the American lantern designer has the nearest approximation to an incandescent point source with the axial coiled-coil lamp, in comparison the British designer is normally limited to a larger, grid filament due to the higher supply voltage.

Normally the lantern designer is limited in his choice of bulbs by the manufacturers' catalogues but in some rare cases he may be able to get a bulb made to order. The source is normally HMI, CSI, Xenon or tungsten halogen, the latter being used in the majority of cases. Bulbs of this type are available in a plethora of wattages, colour temperatures, voltages, filament structures, burning angles, cap types and lifetimes, but if the designer chooses the wrong bulb the consequences may be grave. The lantern may have a dismal light output or run too hot causing premature lamp and lampholder failure. It is also interesting to note that the increasing penetration of overseas markets may cause problems for the lantern designer. For example a lantern designed around an axial bulb may not readily take to a grid filament with its limited burning angles.

Let us now return to the main point in my introduction regarding the pitfalls in evaluating photometric data of lanterns. Again it is vital to point out that I do not intend to imply that the essential qualities of smoothness and lack of chromatic aberration can be adduced by the photometric data. These aspects of the beam quality have to be observed. Unfortunately there is no agreed standard method of presenting the data but the relevant information can usually be extracted. Firstly, it is important to know the wattage of the bulb used when measurements were taken and whether it was being run at its rated voltage. For example a bulb which is overrun by a voltage of 4 per cent will give about 10 per cent more light. This will also result in a higher colour temperature by about 50°K, but the lifetime will be reduced to about 65 per cent of its former value. Bulb manufacturers will usually supply information on the interrelationships between characteristics such as voltage, light output, rated life and colour temperature for their products.

To see how some of the comparisons go let us take an example. Lantern A has a 1,000W 240-volt twin coiled-coil lamp and a centrebeam candlepower of 78,000. A has an adjustable beam to field ratio and this is peaked with a beam angle of 15° and a field angle of 40°. Lantern B has a 1,000W 240-volt grid filament lamp and has a variable beam angle and beam to field ratio facility. When peaked B has at the narrow setting a field angle of 22°, a beam angle of 13° and produces a centrebeam illumination of 538 lux at a throw of 11·2 metres. At its widest setting the respective values are 40°, 17°, 538 lux and 10·6 metres. In the latter case we see that lantern A with its 15° beam angle is peaked more than lantern B with 17°, and so all other factors being equal, and if there are no central holes in the beams, we would expect A to have a greater centrebeam

Photometric information

Field angle is where the light output of a beam falls to 10 per cent of the centrebeam peak ($\frac{1}{10}$ peak).

Beam angle is that within the 50 per cent of centrebeam peak (1/2 peak).

Cut-off, or beam spread, is the total angle of the beam.

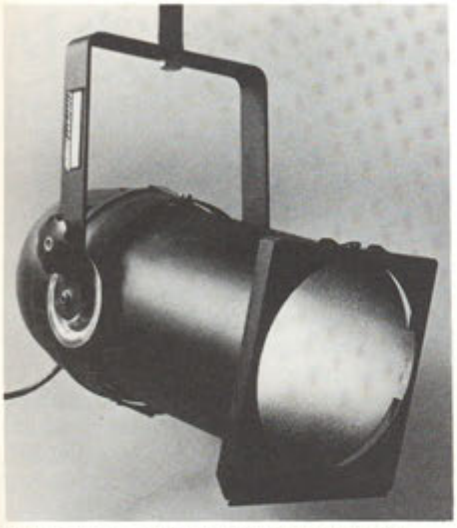
The unit of flux is the lumen (lm). Illumination is measured in lm/ft^2 in footcandles (fc) or in lm/m^2 in lux (lx). To convert an illumination in footcandles into lux multiply by 10·76.

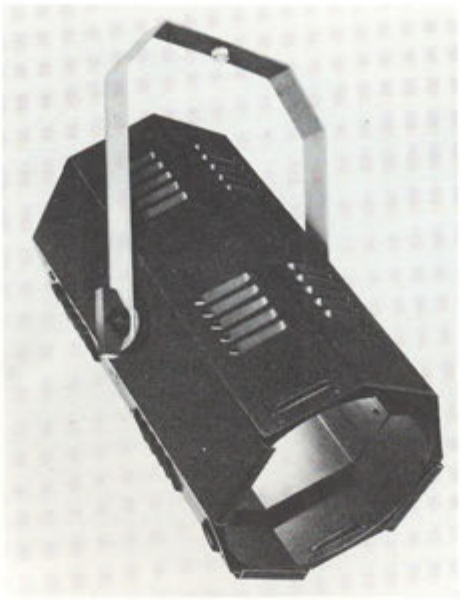
Intensity of candlepower is measured in candela (cd):

$$\text{illumination (fc)} = \frac{\text{intensity (cd)}}{[\text{distance from source (ft)}]^2}$$

$$\text{or illumination (lx)} = \frac{\text{intensity (cd)}}{[\text{distance from source (m)}]^2}$$

Beam angle and field angle are terms now rarely used outside North America, having been replaced elsewhere by $\frac{1}{2}$ peak angle and $\frac{1}{10}$ peak angle in accordance with the recommendations of the Commission Internationale d'Eclairage. By the same token a lantern is nowadays a luminaire. Beam angle is the term which spreads the greatest confusion—it has a colloquial meaning somewhat different from the old photometric definition, especially different in N. America! (Editor).





Two examples of lightweight lanterns using PAR 64 Lamps.

In this PAR lantern designed by the author the support of large pieces of colour media is achieved with an integral hinged plate which stretches the colour medium over the front of the tube. As excess gel is folded out of harms way the colour medium need not be cut to an exact size.

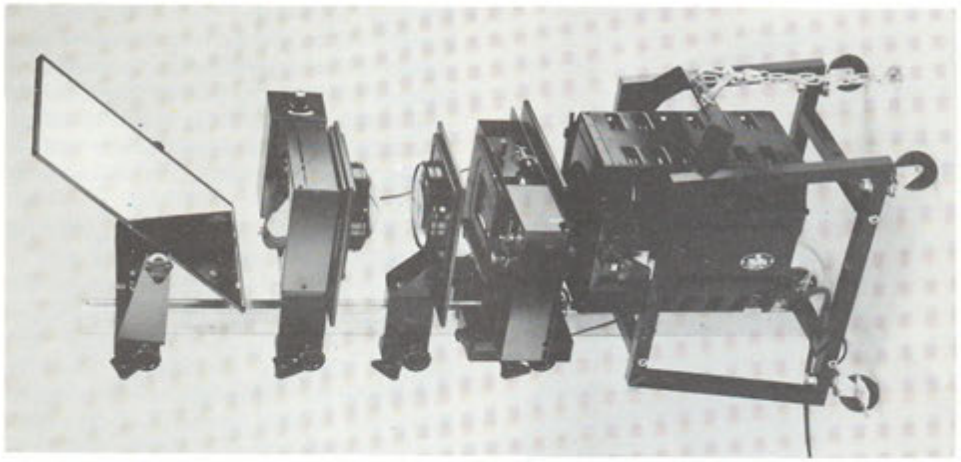
candlepower than B. Using the relation between illumination and intensity for B we get a beam candlepower of 60,500 for the wide angle and 67,500 for the narrow angle. So it would appear that A is more efficient than B even at its narrow setting, but is it? If we are merely after high illumination at any cost then A is the best lantern. However, if we look more closely it turns out that A's bulb has a life of 150 hours whilst B's is 750 hours. To obtain a fair comparison we should compare the performance of B when fitted with a bulb of similar life or better still the same bulb. When we do this we find that the output is at least as great as that of A. Hence it would be wrong to assume that lantern B was less efficient than lantern A. Is it a coincidence therefore that the data published for A makes no mention whatsoever of which bulb was used for testing purposes? Luckily in the U.K. most T class theatre bulbs have a standard average life of 750 hours although the colour temperature is not guaranteed and individual lamps may vary. For television use on the other hand a fixed colour temperature, usually 3,200° K is required and the CP class lamps have up to about half the life of a T class lamp.

One other important characteristic affected by the bulb wattage is the temperature of the lantern. Therefore for a lantern which accepts a range of bulbs it would be wise to check which was used in any temperature tests reported. The designer must ventilate the lamphouse well without causing any light spill, and the internal temperature at the lamp seal must be kept below the failure temperature. Equally important the control knobs must remain cool enough to be usable, preferably without the need for gloves. One spotlight which was recently launched attained an external temperature of above 200° C rightly judged by some users as being excessive.

This brings us on to the design of the housing which could merit an article to itself. As a piece of stage equipment the lantern must be designed to be strong whilst remaining as lightweight as possible. The shutters, iris and tilt control must be suitable for the job and the lantern must be electrically without compromise. One often forgotten requirement is for the lantern to warm up and cool down silently without ticking. Also access must be available to clean or replace the reflector and relamping must not interfere with the setting of the lantern. In fact it is possible that the mechanical facilities and the look of the lantern are at least as important as the photometric characteristics. One recent development on the mechanical support of colour media was prompted by the growing use of PAR bulbs in Britain. A solution I used to overcome the need for support of a large piece of colour but allowing for quick replacement of bleached filter without the use of cross-wires is shown.

So to the future, what lies in store? The growing use of lighting in the field of contemporary music, and in particular rock music, is prompting many new products. Here in Britain we are starting to discover the range of PAR bulbs which have been common in America for many years. Many firms are now able to supply housings for these very efficient light sources. The PAR 64 lamp has until now only been available in a coiled-coil 120 V version, but hopefully this article will coincide with the launch of Thorn Lighting's new range of 240 V grid filament PAR 64's, the CP 60, 61, and 62. Unfortunately there will be a difficult alignment problem for users of these bulbs

Lightweight alloy grid at Earls Court equipped with Altman PAR cans and American 120V PAR 64 lamps. Rolling Stones 1976. (Photo. courtesy T.P.A. Electro Sound)



The new Ryudensha *Modular effects projector allows the designer to create his own unique optical effects. It utilises either a tungsten halogen or CSI light source. It can be used on a bar or the overhead stand shown, and provides what is essentially an optical bench. The add-on effects include film loops, slides, spiral effects, rotary discs and a five slide or gobo turret. Additional effects may be used after the lens and these include prism, kaleido and flicker movements.* (Photo. David Hersey Associates)

but this, hopefully, will be overcome. The temporary nature of touring lighting rigs for rock tours is also stimulating further development in lightweight truss systems and pneumatic power stands.

Conventional lanterns will soon be subject to the stringent higher safety standards which are being introduced around the world. Several designers are of the opinion that the bureaucrats composing these regulations are being too stringent and that in some instances theatre lanterns will surprisingly be less safe due to some of the regulations.

However, in general, the requirements are welcomed, even though by necessity these will force up the prices of equipment. This illustrates another problem for the lantern designer who wishes to add extra facilities to his new equipment. In most cases if the price is substantially affected he will have to be particularly single-minded to achieve his goal.

Other likely changes in the near future may include a growing upward tendency in the power of lanterns available. This will come about by the diversification in use of other light sources such as HMI and other arc sources. We may see a greater use of plastics, and one manufacturer has considered moulding lantern bodies out of a plastic with low thermal conduction. The heat must still be removed from the lamphouse somewhere but at least a plastic lantern body would not require finishing, be it black or yellow. One lantern designer I know of would like to hear of anyone who has invented a black metal which likewise would need no finishing. A manufacturer might one day make the fully automated lanterns proposed in a very thorough specification which was recently circulated by the J.F.K. Center for the Performing Arts in Washington D.C. This makes a fascinating read describing what surely must be the ultimate in follow spots and lanterns, but I have my doubts whether this approach will necessarily lead to better lighting. Effects and colour changers may become more sophisticated in the years to come and we might eventually have the delights of a totally variable colour filter, but the development of this rests with others at present. A likely fore-runner of more flexible effects systems may well be the Ryudensha projection system which allows the designer to create effects to order and is also available in America.

It would appear from recent publicity material from some American lantern manufacturers that whilst the quality of the products offered is continually rising the quality of the publicity is steadily falling. Let us firmly hope that this latter trend does not catch on here in Britain. Over the next few years the range of lanterns and other lighting equipment is bound to increase in size and quality. As Louis Erhardt says, care in the selection of equipment can mean a lifetime of excellent service, particularly if we do not let ourselves be blinded by science.

The opinions expressed here are solely those of the author who is a design engineer for CCT Theatre Lighting Limited and also a lighting designer.

International broadcasting

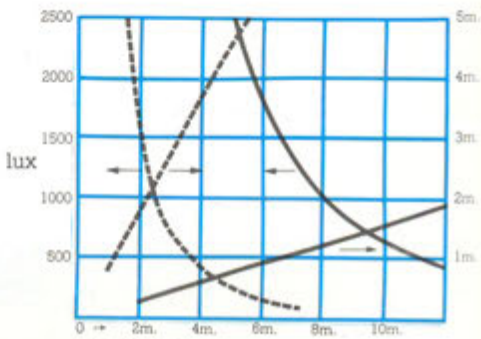
All the exhibition space has now been sold for the International Broadcasting Convention, which takes place at the Wembley Conference Centre in London from 25 to 29 September.

This will be the seventh Convention, and there is a record number of 83 exhibitors. It is sponsored by the Electronic Engineering Association, Institution of Electrical Engineers, Institute of Electrical and Electronics Engineers, Institution of Electronic and Radio Engineers, Royal Television Society and the Society of Motion Picture and Television Engineers.

New Data on Luminaires

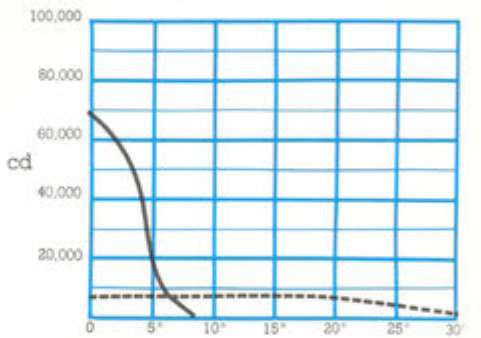
Rank Strand have begun to introduce a new series of luminaire data sheets. It will be some time before the whole range is covered. The new sheets will include two visual presentations of photometric performance with the object of providing information in a form palatable to both the user and the specifier, and to allow either to make a meaningful choice between one luminaire in the range and any other.

There are two graphs for each spotlight. The first provides, by reference to the straight line and the right hand vertical axis, the useful spread (in metres) at any *practical* throw distance (in metres), and also the peak illumination (in lux), by reference to the curved line and left hand scale. This is an adaptation of a method used in Germany, but modified to practical maximum values of 5 metre spread and 2,500 lux. These two vertical scales are common to all spotlights, but the horizontal scale differs for wide, medium and narrow angle spreads.



Throw Distance :
Spread shown → is to ½ peak angle

The first graph alone does not fully describe the distribution of the light across the beam; therefore it is supplemented with a distribution curve showing whether the beam has a flat or peaky field, or is adjustable between the two.



Degrees from axis :
Model 803, 650W, 13,500 lm, T/13 lamp

An essential qualification for both graphs is the nominal lumen output of the recommended lamp for theatrical use at the rated voltage. In addition a table gives the peak candela and ½ peak angle, $\frac{1}{10}$ peak angle, or cut-off angle for maximum and minimum spread or field distribution adjustments.

Alas, our conductor has become ruptured

BRIAN BENN

Lighting equipment catalogues are not the sort of books that I read for laughs. Apart from the odd misprint and the searchings of the copywriters to find an alternative to "fantastic", they offer little in the way of a chuckle. I opened a French company's offering with a feeling of deja vu, prepared for the usual conflict between the superlatives of marketing and the terms of business, and in seconds I found pure gold!

The company is one well known EEC-wide, and where I need to refer to them I shall use the fictional title of "BAL-LUXE". The book was printed in impeccable French, charming Spanish and the sort of English that can only be described as a communications failure. In stirring terms, the introduction makes it very clear that:

"BAL-LUXE has never stopped improving since birth. Today, and more than ever, BAL-LUXE presents its last general catalogue, a new, wider and larger range of the famous equipment.

New, because nowadays a great number of people is interested by modern light, and gives it a more important place.

Widest, because BAL-LUXE makes an equipment which is able to answer to every need inside and outside as well (even underwater).

Largest, because the new types, the new colours the new shapes is issued from technicians and designers last research works.

BAL-LUXE has made a lot of things about lighting for 20 years and everyone can see it!"

Totally hooked, I turned to the Contents of the Last General Catalogue and was instantly drawn to:

"CLIGNOTEUR 908 — ELECTRONIQUE unit permitting up to 300w incandescent bulb adjustable twinkling. It sticks between the fitting and the 230V sector".

"Flash-monted lighting", like Winston Churchill's Mr Bossom, was neither one thing nor the other, but "Electronic animator with 4 outings" offered a more pleasing picture.

Fitting No. 1400 was a little alarming in that "alternative movement (90°) may become wholly rotative" while its close relation Fitting No. 1401, unlike the pickled onion, was "entirely orientable on fork", and also had "a very pointed beam with Quick Connection".

Here are a few more nuggets:

No. 177A "Both framing and optical focussing. Caution! Works in a maxi. 30 or 45° angle regards to the vertical (low socket)".
No. 1500 to 1510 "Have fixation systems or are pendative".
No. 800 "adhesive fixation after the TV set: white isolating matter".
No. 231 "Free to swinel". Swinel?

"Le Système Rail" which sounds a lot more panache-y than Track Lighting, was all good stuff, possessing among other features "Double insulation—sheath and oxyde and a grand collector". I was reassured to note that even if I had monophased or triphased alimentation that "In all these case of connections, the locating pin put off every kind of raccording mistake. Raccording accessories and adaptors are made in inextinguible or auto-extinguible matter in grey colour".

To be scrupulously British and fair, most of the 100 pages were accurate, informative, and dull, as a proper catalogue should be, but I send my thanks to that brave and unknown copywriter who ploughed on regardless, and I offer his image to any lighting designer struggling in a darkened auditorium with a maddening, totally in-orientable lampe du table Anglepoise vintage 1959, battered veteran of your actual visual poetry.

CORRECTION

In our last issue reference was made to L'Empire's changeover to broadcasting and television. The MMS control board illustrated was in fact supplied and installed by Eclalux who have always been exclusive distributors of Rank Film Equipment and Rank Strand Electric equipment in the French T/V industry. Our apologies to Messrs. Eclalux for any misunderstanding which may have resulted.

Design for the 80's

PHILIP ROSE

The sunshine and warmth of Phoenix in March was a welcome change from soggier climes for many of the 500 and more delegates who assembled for this year's Conference of the United States Institute for Theatre Technology.

The wide ranging programme, *Design for the 80's*, included something for all, covering as it did architecture, costume, education, engineering, scenography and, not of least interest, health and safety.

The design display attracted much attention, as did the commercial theatre exhibition, which this year was bigger and better than ever. From its tentative beginnings, the annual exhibition has become a looked forward to opportunity for reviewing the state of the art and discussing problems and needs, great and small. This year there were 50 commercial exhibitors covering the industry from tools to books, rigging to scenery paint and sound systems to colour filters. The lighting industry was well represented with two or three interesting luminaire innovations to be seen (Strand Century, for example, had their new 1 kW Diecast Leko on show), and memory lighting control systems were thick on the ground. I counted at least 12, and suspect there were one or two tucked away behind the scenes. The spin off from space and military technology has had a significant impact on lighting control, but so far there is little evidence of it similarly influencing sound, rigging and instruments which in many respects are technologically back in the days of mechanical dimmers.

For me, as I am sure for other delegates, the annual Conference is a welcome chance to meet old friends and associates both for the pleasure of seeing them and the chance to exchange views and discuss common problems, as well as participate in the more formal programme.

The one sad note was learning of the death of Tom de Gaetani. The existence of the Institute owes much to Tom's vision. Those of us who remember the early days of struggle to get the Institute off the ground can only, at this point in time, recognise how much Tom's time, effort and encouragement helped to make it happen and achieve its present position of influence.

Surely the time is long overdue when the Association of British Theatre Technicians through an annual conference and exhibition should be doing for British Theatre what the USITT has done for American Theatre.

The author is Director of Marketing and Research & Development for Rank Strand Electric.

Tabman's Diary

CORRESPONDENCE

From Mr Simon Nickerson

Dear Sir,

Many lighting folk, particularly perhaps in the amateur theatre, will welcome the introduction of the new Rank Strand Micro 8II control, replacing as it obviously does the former (and much loved) Junior 8. From an operational point of view the Micro 8 is clearly to be preferred, possessing all the advantages of variable load dimming, plus, I am glad to note, a master dimmer (that bit of two-by-one timber for "mastering" my Junior 8 can now be pensioned off at last!) What was technically somewhat surprising to gather about this new control is its use of triac semi-conductors, rather than thyristors (as per Mini 2 *et al.*); when these ingenious devices first became popular for controlling AC mains, I recall at a Rank Strand lecture given at the King Street demonstration theatre asking the lecturer of the day, Brian Legge, if triacs had any place in future stage lighting controls. He gave me an assured "no", as the answer. Realising as I do that Mr Legge was not the only influential person in the company to consider this to be so at the time, I would be interested to read why Rank Strand now feel sufficiently confident to utilise triacs in this way.

Yours faithfully,

SIMON NICKERSON
43 Leith Towers,
Grange Vale,
SUTTON,
Surrey SM2 5BY

¶Today, some ten years later, the answer to the same question would be yes, but a qualified yes. In spite of the rapid advances in solid-state technology the introduction of the Micro 8 with four 2 × 1,000W max, dimmers had to wait upon the development of a Triac which would meet our standards of reliability and practibility for controlling 220/240v r.m.s. tungsten, or tungsten halogen, projector lamps. An important factor was that a sustained overload, a lamp failure, or a load fault should destroy an inexpensive fuse-link rather than a relatively expensive Triac—a problem not unknown to many DIY enthusiasts, who also fail to realise that the inrush current of a cold high wattage tungsten lamp is very different from that of a number of low wattage lamps. TABS readers in North America may find this correspondence rather strange: but a 120v r.m.s. supply does have some advantages!

BRIAN LEGGE

Instant Stage

My note (TABS, Spring 1978) about strengthening the stage of the North Alberta Jubilee Auditorium for the weight-lifting events at the Commonwealth Games has prompted information on another aspect of the event.

It comes from Mr. Robert Dubberley who is the Co-ordinator of Festival '78. This is an arts festival which is being staged in Edmonton to complement the sporting pursuits. As such it claims to be the first ever Commonwealth Arts Festival. It covers most aspects of the arts, and some 25 Commonwealth countries are participating.

In a city which bursts at the seams during the Games, one of the difficulties must be to stage so many different aspects of the arts, especially since one of the best stages was pinched by the weight-lifters. Room has had to be found for paintings, sculptures, photographs, concerts, ballet, theatre and films.

The answer has been provided by a firm from Calgary called Sprung Instant Structures. It has engineered five outdoor stage pavilions and a special tent structure. The ones provided for Edmonton have a 50-ft proscenium arch and small thrust stage. There is an elaborate outdoor sound system, but because in the summer darkness does not fall until 10.30 or 11.00 p.m., lighting is minimal.

Technical aspects of the structures will be the subject of an article in a forthcoming issue. But the manufacturers think that there are world-wide applications and, as Mr. Dubberley says, they are selling tents to the Arabs.

The Pianist

The occasional TABS *article about the perils of school stage lighting brings this cautionary tale from a reader who finds it useful when producers and others need "taming"*

Once upon a time there was a concert pianist who, because he had practised hard for many years, was quite good for an amateur. Indeed, many people began to forget his amateur status and expected professional results from their very amateur instruments. One day some promoters came to him and said, "We've decided to entertain our friends, so we've put you down to give a concert." When they described the programme they had chosen for him to play he looked horrified. "No one could play that on YOUR piano," he said, "It's only got half the notes needed, and is likely to break in the difficult bits."

"Don't worry," they said cheerfully, "You've always managed in the past."

"No!" he said, "You'll have to repair your piano if you want THAT programme", so eventually but reluctantly they agreed to do so.

But the night of the concert approached and the piano was still unrepaired and unusable. "I must have plenty of time to practise the hard bits" said the worried pianist, "When are you going to start work on the piano?"

"Don't worry," said the promoters, "We'll ask the repairers to come soon". But still nothing happened, and the concert was to be given the next day. Even the management began to realise that something was wrong when the piano was still not repaired one hour before the concert was due to start.

At last the repairers arrived, but now they had to rush the repairs, and connected up some of the keys in the wrong order. When they had finished there were only five minutes left for the pianist to try out the piano, find all the wrong notes, and practise the whole concert. The result was inevitable—a disappointing performance full of wrong notes which few of the audience enjoyed. "Not very good." they said as they left, "Other managements can give much better concerts than that!" And the pianist went sadly away, his reputation tarnished, feeling he could never give a concert there again.

And the management lived happily ever after.

OPTIMUS

New over the counter sales arrangements

Rank Strand Electric have announced the appointment of Donmar Productions as their Selling Agents for over the counter sales in London's West End.

Donmar will be running Rank Strand's old counter at No. 32 King Street until the end of September when it will transfer to the main Donmar premises in Earlam Street, Covent Garden.

A full range of lighting, controls, cinemoid and lamps will be carried and the counter will be open for normal business hours Monday to Friday.

Rank Strand's own counter at their Head Office at Brentford remains open so Londoners now have two separate stocks of Rank Strand equipment to meet their needs and, of course, other theatrical suppliers will continue to have Rank Strand products available.

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