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A·E·I
Lamp and Lighting Co Ltd
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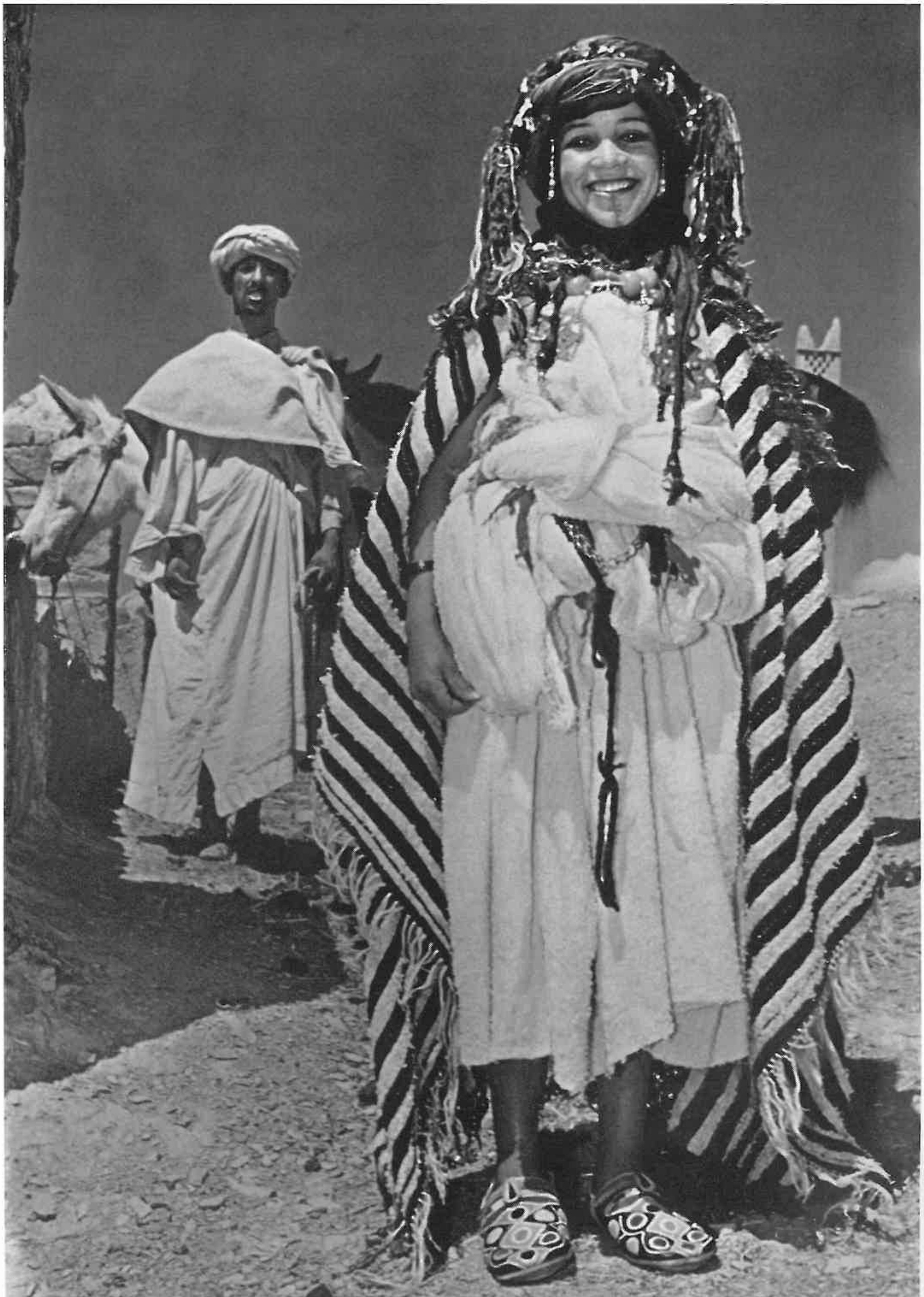

A portrait by James Bynon of a young Berber girl of the Ait Hadidou tribe. The photograph was made on 35 mm colour film at an altitude of 7000 feet in the Atlas Mountains in intensely bright sunshine. Fill-in light from a Mazda 22B flashbulb has relieved the shadows cast by her features and head-dress. She is wearing heavy black make-up round her eyes. The tattoo mark on her chin and the stripes of her cloak indicate the clan to which she belongs.

light

THE MAZDA LIGHTING JOURNAL VOLUME 4 NUMBER 2

IN THIS ISSUE of 'Light' we celebrate, with a cover design and an article, the choice of our Satina glass shade light fitting as one of the top twenty British designs of the year.

His Royal Highness the Duke of Edinburgh visited the Design Centre in the Haymarket, London on May 8th this year to see 20 products chosen by the Council of Industrial Design as 'Designs of the Year' and to present certificates to their makers. The items exhibited are chosen for good design expressed in terms of quality workmanship and sound materials. (The judges report and criticisms of the Satina G4005/3 pendant fittings are printed below.)

A possible shape of things to come in the field of light sources is disclosed in our review of items of interest at the recent Physical Society Exhibition. At this exhibition the Research Laboratory of our parent Company, (BTH), showed an 'atomic' lamp which a few years ago would have been instantly recognized as pure science fiction. The new light source is powered by radio-active isotopes with lives of many years and remains alight continuously without need of an electricity supply.

The approach to modern electric lighting is perhaps more international today than it has been for a long time; it is often hard to distinguish a Scandinavian fitting from a German or a German from a British one, but these similarities are likely to occur in any period of design with a strongly marked character that transcends national frontiers; other periods, such as the Empire or Regency, have shown the same tendency. In such a situation national differences are revealed in minor points, in weights and measures and in finishes and detailing. The judges have chosen this range of pendant fittings and this particular shade (although others almost as good are available in the range) for just these fine points—the quality of the satin finished opal glassware, which is attractive both lit and unlit; the delicacy of the bracket arms; the unostentatious use of brass in combination with black rods; and the general elegance of the range in all sizes. Ease of assembly and accessibility for cleaning and lamp replacement have also been carefully considered in these designs.

4–7 **Satina.** The story behind the introduction of one of the first ranges of British designed and British made contemporary glass shade light fittings.

8 **Stadium Floodlighting.** Sport spectators throughout the civilized world have accepted the introduction of floodlighting to stadiums. A page of pictures of recent A.E.I. installations in the Far East.

9–12 **Skyport One.** An airport of the future. Skyport One is a solution to the problems to be expected by designers of city air terminals in 2000 A.D. The article is a reminder that lighting must be included in architecture of the future at an early planning stage.

13–15 **Plastics.** The lighting industry uses a great many plastics. This article covers the history of the introduction of 'Perspex' which was developed for wartime use in aircraft. It also discusses other plastics which are being used by designers of lighting equipment.

16–17 **White House Investigation.** Lady Isobel Barnett has strong views on home lighting. At her home, White House, in Leicestershire she uses fluorescent lighting in her kitchen but dines by candlelight.

18–22 **Ship Disciplines.** An examination of architectural and lighting disciplines in ships.

23–25 **True Values in Design.** This article is the first of a series of platforms offered to eminent architects, consulting engineers and designers from which to express their personal attitude towards lighting. Authors in this series will be given full scope to express their personal opinions (with which this journal need not necessarily be associated).

26–27 A review of some of the lighting developments shown at the 42nd Physical Society Exhibition in London.

28–29 **U.V. Cockpit Lighting.** Recent developments in the lighting of instrument panels in aircraft cockpits.

30–31 **Floodlighting Salisbury Cathedral.** One of Britain's most famous Gothic buildings which has one of the highest spires in the world.

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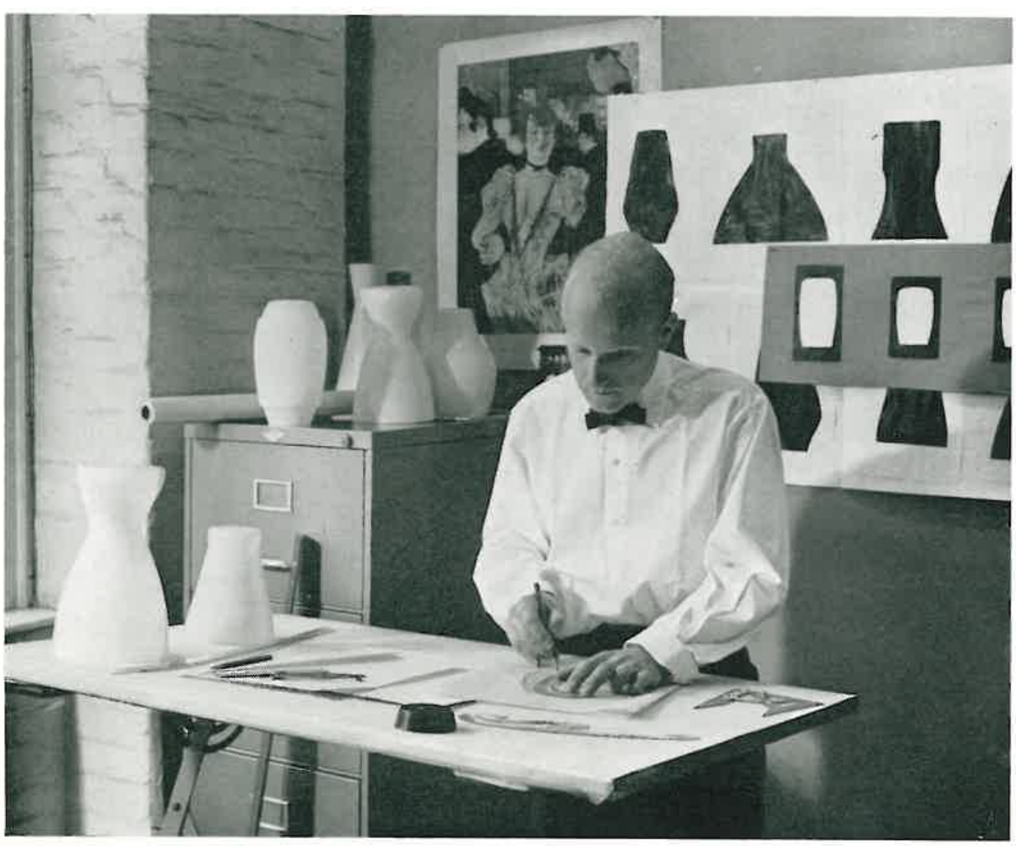
H.R.H. the Duke of Edinburgh presenting the Design Centre 'Design of the Year' award for the G4005 range of pendant light fittings to John Clement, A.E.I. Lamp and Lighting Company Sales Director.

Design Centre Award



Designer Nigel Chapman, DesRCA, produced large numbers of Satina shapes, from which prototypes were made by Hailwood and Ackroyd's glass blowers. After various modifications it was possible to select a standard Satina range of 12 shapes which included items for which a demand was known to exist and some entirely new and more adventurous shapes. Altogether there are over 70 pendant fittings available in opal white or a delicate shade of pink with either matt white or matt black flex.

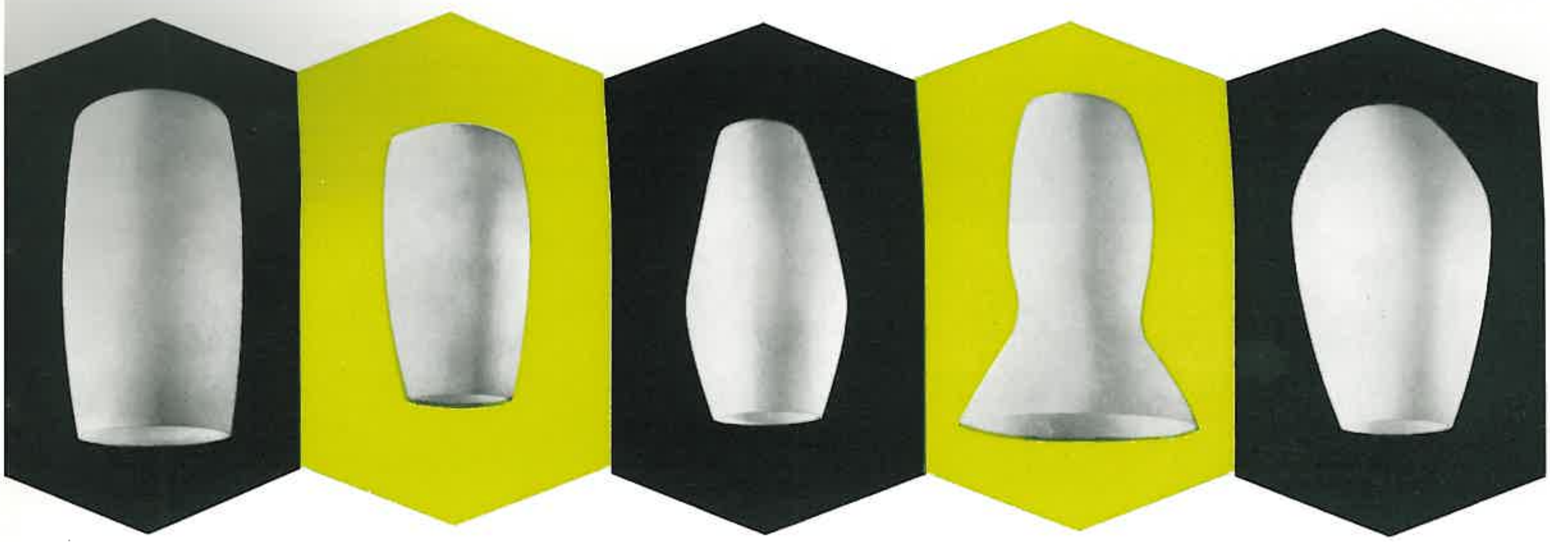
Since the war enormous strides have been made in the lighting industry in the design and marketing of lighting fittings appealing to the taste for modern interior furnishings as distinct from more 'traditional' designs.

One of the most pleasing transformations has been in the glass lamp shade field where a very wide variety of simple shapes has emerged in the wheel-turned pottery idiom, mostly of Scandinavian or Continental ancestry. Many of the better examples are both functional and aesthetically pleasing in themselves either lighted or unlighted, relying for effect more on form than on decoration and very well suited to current interior design with its emphasis on space rather than intricate detail.

The Satina range is the A.E.I. Lamp and Lighting Company's first venture into this 'contemporary' market and a reply to an often-voiced criticism that in glass-shade design and manufacture Britain lags behind the Continent.

In a recent article in the Council of Industrial Design's journal 'Design', John Blake published the results of an enquiry into the current practice among several British lighting fitting manufacturers of importing foreign glass for their more adventurous designs instead of using British-made glass and stated that in nearly all cases the most advanced modern glass shades have come from the Continent, though some of these had been designed in this country.

The 'Satina' range provides the architect and interior designer with a component with a delicate, airy quality, simple lines and a very wide variety of interchangeable designs.



This unhappy state of affairs has been blamed in the past by the fitting manufacturers on lack of initiative and ability on the part of British glass makers' who, in their turn have blamed the lighting manufacturers in very much the same terms.

Manufacturing Methods

Glass shades are normally made by glass blowers who achieve the final shaping of the glass with the aid of a mould. It has been suggested that Continental glass makers have a larger market, lower labour costs, and the secret of making wooden moulds, and that British glass makers are unable to compete due to the high cost of iron moulds in time and money in relation to a small market at the mercy of changes in fashion.

A.E.I. Lamp and Lighting have met this criticism of the industry by designing a large range of glass shade fittings which are now being made to a very high specification by craftsmen at Hailwood & Ackroyd's factory near Leeds where wooden moulds have been used for glass blowing since the glass works were built in 1915. The shades are made in three-ply white and pink-tinted opal glass with a satin etched finish and are comparable with any glass of their type made in the world. The fittings are marketed as pendants with up to six shades and the suspension, ceiling plates and even the lampholders have been specially designed and a special matt P.V.C. covered wire specially made. The suspension parts have been designed to match the simple airy shapes of the glass shades, to safeguard the electrical characteristics of the flex and to provide easy hand assembly and lamping.

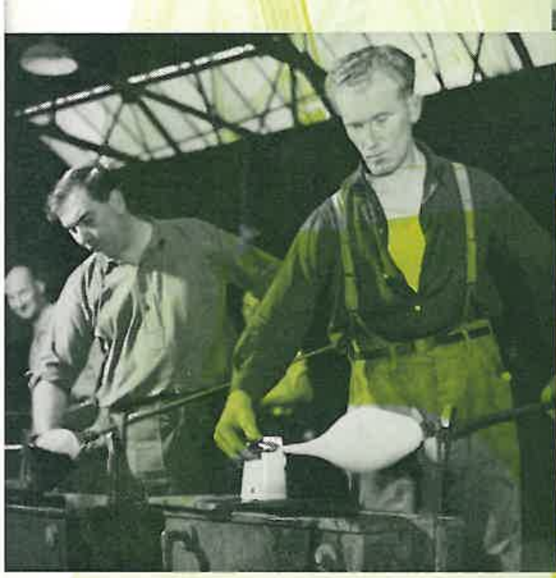
Many factors affect glass quality, from the formula of the glass and the way in which it is mixed and heated in the furnace to the skill of the mould maker and the team of craftsmen who blow it. Satina glassware is satin-etched by a process which is not only highly skilled in itself but which throws up any unevenness in shape or colour of the finished glass in sharp relief and consequently great pains are taken at the factory to ensure that no shade containing even the minutest flaw or blemish can pass the inspection department.

British design and manufacture have always been automatically associated with the best in many fields and it is good to know that here is one more product which is worthy of the tradition.

◄ *A Satina shade takes shape. This mould maker was trained by a German who joined Hailwood & Ackroyd in 1920 and believes that there are only two other men in his trade in Britain. Moulds cut from wet sappy beechwood or pear wood take about three days to make. They form their own layer of charcoal in use giving glass with a very high quality finish. A similar iron mould might take six weeks to prepare. The wooden hand tools used by the blowers in shaping the glass are also made in this department.*

▲ *A craftsman puts the finishing touches to the blowing of a shade while rotating in a wet mould. The surface of the glass is formed against the charcoaled wood of the mould and a cushion of steam. The two other balls of glass in the picture are in the hands of the ball blowers who will pass them to the glass blower to be finished.*

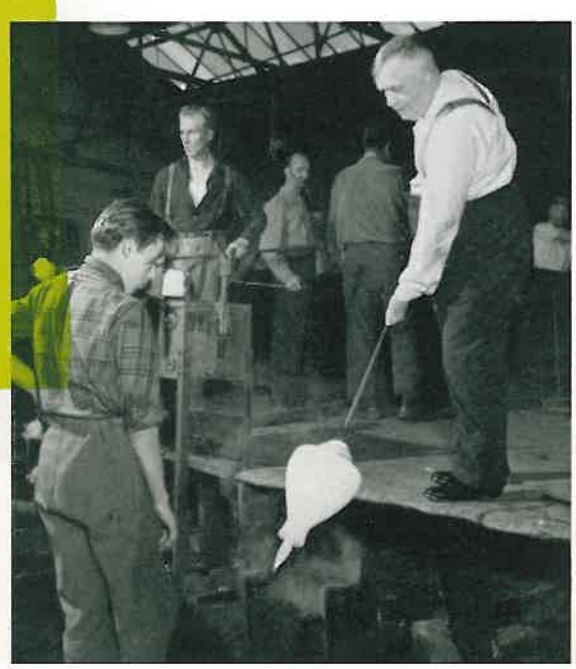
► *Stages in blowing Satina shades. The mould boy in the foreground dips the mould in water to be in readiness for the next ball which is about to be blown. The last shade to be blown is on its way to the Lehr to be annealed in a carefully graduated succession of heats.*



◄ *Molten glass is gathered on blow-pipes at the furnace and blown and hand shaped with pear wood 'blocks' and 'pointers' before being finally shaped while rotating in a wet wooden mould. It is on preliminary shaping of the molten glass that the uniformity of thickness of the finished glass depends.*

A 'taker-in' carrying the freshly blown glass to the Lehr to be annealed. ▼

► *A glass shade from the mould. Frank Stejskal is one of the team of skilled Czechoslovak glass blowers who came to this country to join Hailwood and Ackroyd's immediately after the First World War. He has trained scores of apprentice glass blowers during his 40 years at the works.*

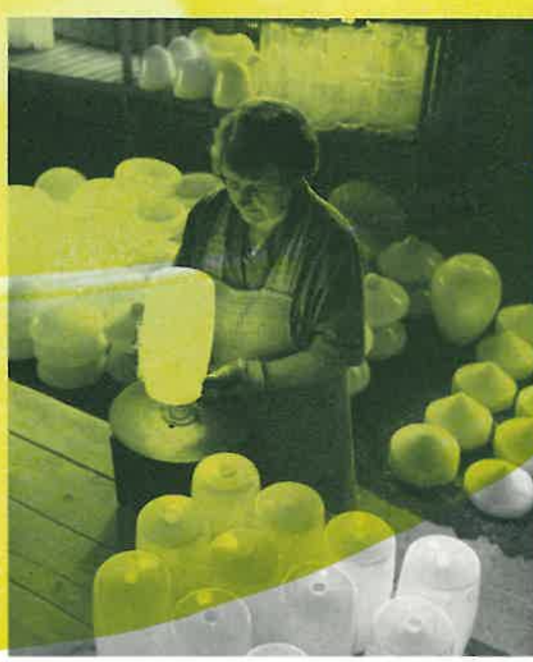


Satin etching puts the final touch to the glass. Notice the difference in appearance between the etched shade and the others which have yet to be put into the acid bath.

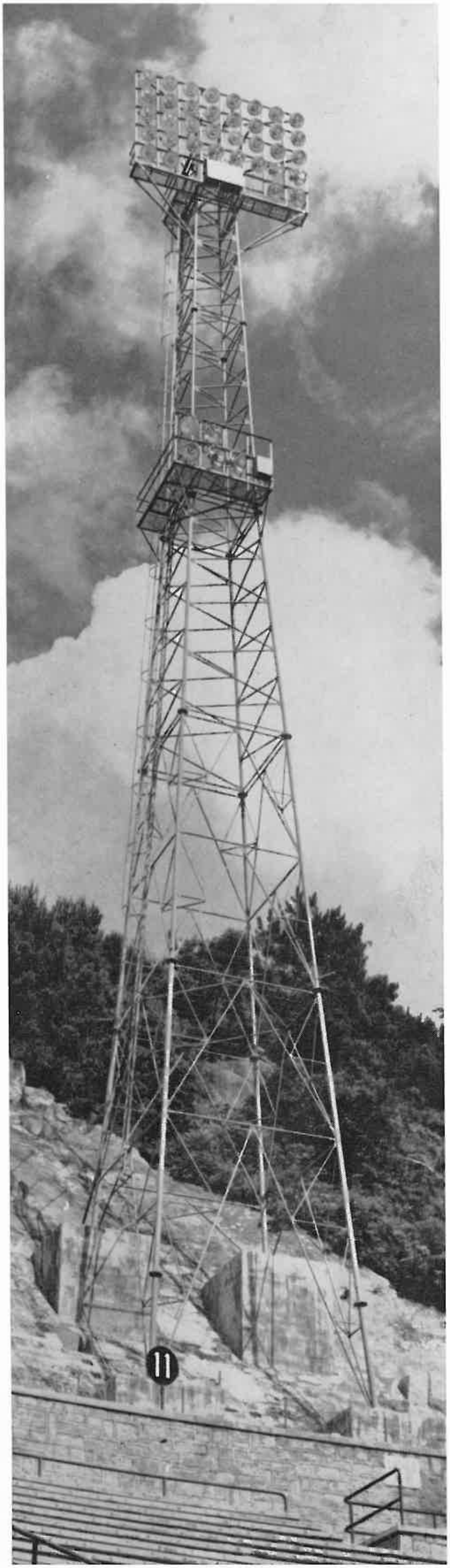
After annealing, surplus glass is trimmed from the shade by localized heating with gas jets followed by a scratch with a diamond (below) and then cut edges are ground on revolving steel plates with carborundum powder and water. (Second colour illustration below)

Assembling a ceiling plate component for a single shade pendant. The anodized matt black cover plate is held in position by a sliding rubber grommet on the flex.

A routine laboratory check on three-ply glass to ensure that no strain has been set up between the layers of opal and clear glass.



Every completed shade is carefully examined with the aid of a powerful lamp in the inspection department.



STADIUM FLOODLIGHTING

With a modern sports stadium, floodlighting is today considered an absolute necessity. During the evening leisure hours it enables large audiences to watch sporting and other events which, by reason of their working hours, they would otherwise be unable to see. These advantages have been appreciated by several countries in Southeast Asia and it is pleasurable to note here that A.E.I. Lamp and Lighting Company have been closely associated with numerous stadium floodlighting schemes in this part of the world.

Amongst the more recent projects are the floodlighting of the Merdeka Stadium in Kuala Lumpur, Malaya, the Jelan Besar Stadium in Singapore, the Soo Kun Poo Stadium in Hong Kong and the South China Athletic Stadium in Hong Kong. All but the last-mentioned of these uses the four corner, high tower system of floodlighting and Soo Kun Poo, with a minimum horizontal illumination level of 80 lux and a loading of 216 kW, is probably the most powerful floodlighting scheme in this part of the world.

Floodlighting at the Soo Kun Poo Stadium in HongKong. Four towers with lighting grids were erected at a mean height of 174 ft. above the level of the playing field and each carried a total of 41 1500-watt A.E.I. M25 floodlights.

Three of the four high towers carrying the floodlights used to illuminate the field at the Jelan Besar Sports Stadium in Singapore.

Side line, low-brightness floodlighting in operation at the South China Athletics Stadium in HongKong. In the foreground can be seen the main entrance hall and a section of the large car park.

A football match being played under A.E.I. floodlighting at the Merdeka Stadium in Kuala Lumpur, Malaya. This is one of the most up-to-date stadiums in Southeast Asia and was built at a cost of $2,300,000.

Aircraft are expected to be compound jet-rotor types capable of vertical take-off and landing whatever the weather conditions. Landing decks are 500 ft. high supported on three steel shafts.

The superstructure accommodates services and equipment for controlling and operating aircraft and handling passengers. It also accommodates a restaurant for the general public.

Shafts consist of finned steel tubes housing stairs and services. High speed lifts between the fins are visible from outside through an outer cylinder of glass.

The three vertical shafts straddle a triple-wing building with a subsidiary landing deck on its roof for private aircraft and non-scheduled flights.

In the three wings of the building there are a transit hotel, an office block and a multi-storey car and aircraft park.

Cars and taxis enter the building immediately below a pedestrian piazza at ground level.

Lift shafts are sunk to the basement where there is an Underground Station (Bakerloo Line), a 'bus station and service garages.

SKYPORT ONE AIR TERMINAL 2000 AD

An imaginary city centre air terminal of the year 2000 A.D. has been planned in the minutest detail and could be built today.

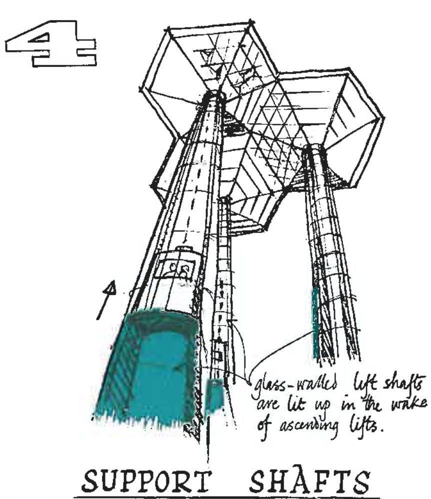
Skyport One has been designed to be sited at St. George's Circus, London, near Waterloo Station. It would have 500-feet high flight decks and include a new station on the Bakerloo line. Passenger traffic would be up to 10,000 persons per day.

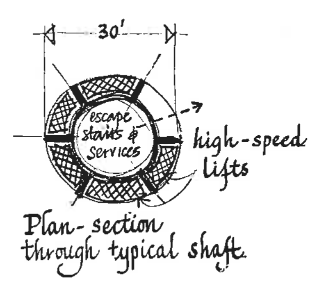
The Glass Age Development Committee, convened by Pilkington Bros. Ltd., proposes the project as an architectural means of answering the planning requirements of the future. James Dartford, A.R.I.B.A., its designer, has created an air terminus which, though imaginary, is realistically conceived and designed in practical detail.

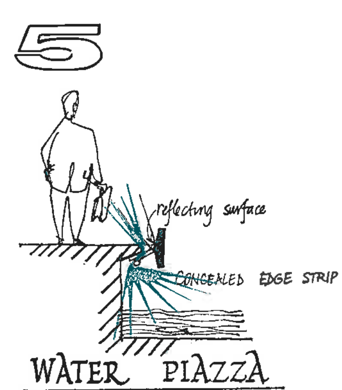
Almost every conceivable aspect of the design and operation of the terminal has been considered, yet in spite of this, problems and possibilities offered by artificial light have been almost completely ignored.

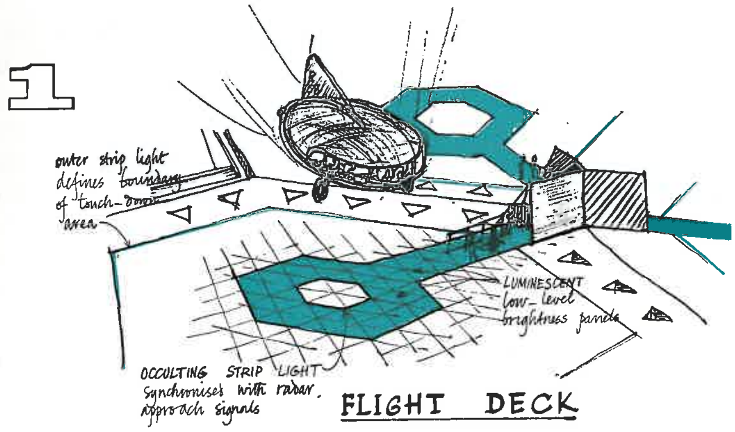
The suggestions outlined here were produced with the co-operation of the designer, and it would be possible to produce a satisfactory lighting scheme on these lines with the resources available today.

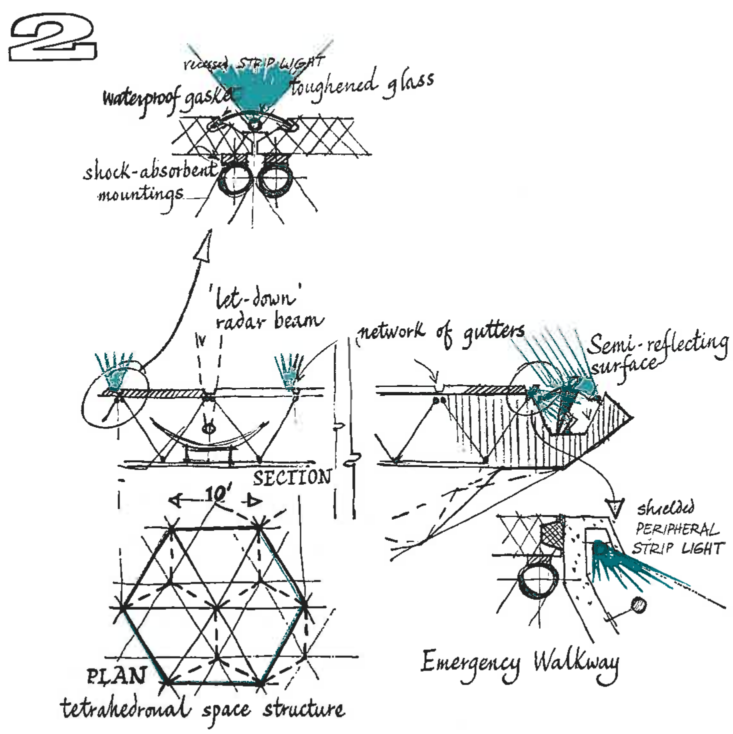
Sketches of the suggested lighting installation are by the designer of the building James Dartford, A.R.I.B.A.

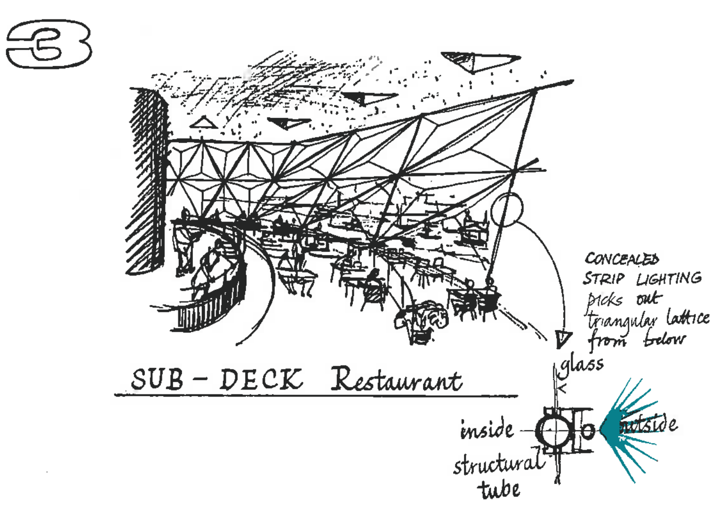


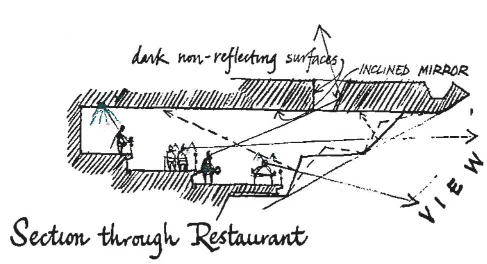












The boldness of the Skyport concept must be matched in any suggestions regarding the artificial lighting by an equally imaginative approach. In order to do this it has been necessary to make assumptions concerning light sources, which parallel those made by the architect for the project, James Dartford, concerning structural possibilities...... based on our knowledge of what is possible at the moment and what is likely to be possible in fifty years' time.

For example, although the present use of 'electroluminiscent' panels is restricted to small areas of low brightness at relatively uneconomical efficiency, it is reasonable to assume that it will be quite feasible to employ this or some newly developed source for large areas of easily controlled brightness in the foreseeable future. In some areas, small 'atomic' light sources and luminous panel sources may be provided by phosphors excited by fission irradiated gases produced as by-products cf the new nuclear power stations. These sources could be expected to be completely reliable and would provide light without consuming electricity or needing maintenance. It is also probable that concentrated light sources, perhaps taking the form of arcs of the 'xenon' type of filament operating in heavy inert gas, will be in common use, enabling smaller and more effective light fittings to be employed.

Although no radical changes in light sources have been envisaged, it is not intended to be specific concerning the nature of all the sources used. Our concern is more with lighting ideas than the means with which to carry them out, for if architectural trends demand that buildings be lit in this manner, then the technology of the day will make the light sources available.

Approach to the Problem

A building of this character would be a monument to its times, seen, as it would be seen during daylight, towering on its slender shafts 500 feet into the London sky. The lower slab buildings containing a garage for the many cars attracted to the site, an hotel and offices, would merge with the general cityscape and could be treated in a more functional manner, but the flight decks and supporting towers would be a spectacular sight and it is important that this impression is maintained at night by artificial means, both from the ground and from the air.

With the functional aspects of lighting, dictated by rigid disciplines of speed of operation, safety and comfort, is the other aspect of 'spectacle', which must be considered of equal importance. The lighting of the taller elements is therefore treated as a visual problem, meriting a solution which at night shows the building form as an organism pulsating with activity, expressive of its function, dominating London in a similar manner to the Eiffel Tower in Paris.

The Flight Decks

Since all the aircraft operating from the flight decks are assumed to be vertical take-off and landing craft controlled by instruments during take-off and landing, there would seem at first sight little advantage to be gained from lighting up the decks as for a traditional landing strip and 'flare-path'. There is however considerable drama to be derived from the visual appearance of the decks seen from the air by passengers circuiting to land, or from air taxis. Lighting would therefore serve a dual purpose of 'reassurance' and 'warning'. Furthermore it will be necessary for passengers going to and from the wind shelter in the centre to their aircraft to see the disposition of the flight-deck clearly. It is proposed therefore to construct an area of the surface of the deck of a toughened glass which at night gives off light at a low brightness, a brightness which can be controlled to the degree of darkness, so that at no time would it become 'glaring'. This area is indicated in Sketch 1. To further assist ground crew and aircraft handling parties, the central hexagon would be picked out by a strip of light in a 'signal' colour, which would flash when an aircraft was being controlled in to land on any of the decks. (Detail in Sketch 1.)

The wind velocity over the deck at 500 ft. may often be high and, to protect passengers and crews, special retractable glazed screens would be provided acting when required as wind shields. Since these might be difficult to see when raised at night, they would be edge-lit when in use to ensure that the base was adequately visible.

The boundary to the touch-down area, would be further outlined by a strip of light around its edge, as an additional warning to taxying aircraft, designed to pulsate when crossed by anything as heavy as an aircraft; acting also as a visual edge to the hexagonal luminous area.

From above, some demarcation of the extremities of the 'flight decks' is necessary, both functionally to warn other aircraft and visually as a determining edge to the structure. A walkway used to obtain views over the city offers an opportunity to outline the structure by lighting it for pedestrian purposes, whilst ensuring that the whole walkway reads as a lit perimeter seen from the air. A detail of this is illustrated in Sketch 2, showing a section through the walkway with concealed lighting on the inside, behind the person gazing out over the town in order not to interfere with his view. The opposite side of the walkway would be painted a highly reflectant colour to assist in outlining the perimeter from all directions, above the flight deck. From below the perimeter is adequately orientated by the lighting to the sub-decks, which is designed with this thought in mind.

Sub-Deck

It is impossible to rely upon the lit appearance of the various elements of accommodation in the spaces below the flight decks to illuminate the sub-decks effectively, when seen from a distance outside. The method adopted, and illustrated in Sketch 3, recognizes the need for the building to act as a self-advertisement to ensure that the form of the building is clearly outlined against the night sky.

The method is to use each of the triangulated struts of the 'mushroom-shaped' lattice as a simple lighting unit, so that the lattice reads as a lattice of light, whilst shielding the units from view from both outside and inside. The lighted lattice will read against the relatively darker areas within.

The sub-decks contain all the necessary passenger handling facilities such as custom control, baggage and traffic control points, one deck being devoted to a restaurant planned on three levels, so that diners may obtain unrestricted views over the city. The lighting of the restaurant would be controlled to ensure that no reflections impair the view through the glass and this would be accomplished by providing the light to individual tables at low level, with concentrated sources of the type already mentioned. The floor of the restaurant would be softly luminous to assist waiters, the floors themselves revolving slowly in order to obtain a panoramic view of London.

As the glazing to the mushrooms slopes up and outwards, any reflections would be of the ceiling from normal viewpoints and this would be painted a dark colour.

Lift Shafts

Each of the three column supports to the flight decks above contain six lifts disposed around a central 'finned' core of escape stairs and servicing. This is the only visual link with the giant mushrooms above and it would be possible to keep these in darkness at night to achieve the effect of flight decks floating, as it were, in mid air.

A more dynamic method is however illustrated (Sketch 4) whereby each of the lift shafts acts as a constantly changing pattern of light, following the movement of the cages up and down. Lifts are timed to leave ground level every 45 seconds and as each lift mounts into the air, light would travel up the shaft in its wake; the general effect would be that of rising and falling cascades of light, in each of the three columns. Two possible methods are suggested for this:

1. The glass walls to the lift shaft might be made of luminescent panels in very brilliant colours, which increase in brightness towards the top of the shaft. With the lift cage at the bottom, these would be in darkness, but as it shot up the shaft, the panels would be illuminated for a period of seconds after it had passed. A similar effect could be achieved by using phosphorescent panels activated by ultra-violet sources attached to the lift.
2. Alternatively the switching could be arranged to light that part of the shaft below the lift with sources of an ascending scale of brightness from the bottom to the top of the shaft.

Lower Roofs

The lower roofs to the triple-wing building, which rises some 14 storeys from the ground, would be utilized in different ways. The arms of the building are used for a large transit hotel, a multi-storey car park and a commercial office, the roofs of the buildings being used as roof garden, ramps for aircraft and a helicopter landing deck respectively.

The central area would be used for the take-off of 'air taxi helicopters' and the take-off position would be emphasized by a circular luminous panel which glows in a signal colour. The rectangles indicated in the perspective are the landing points, and these too would radiate light when landing was permitted. These aircraft, not much bigger than present-day cars and with folding rotor arms, would be taxied down the ramps and parked in spaces in the multi-storey garage below.

Car and Helicopter Garage

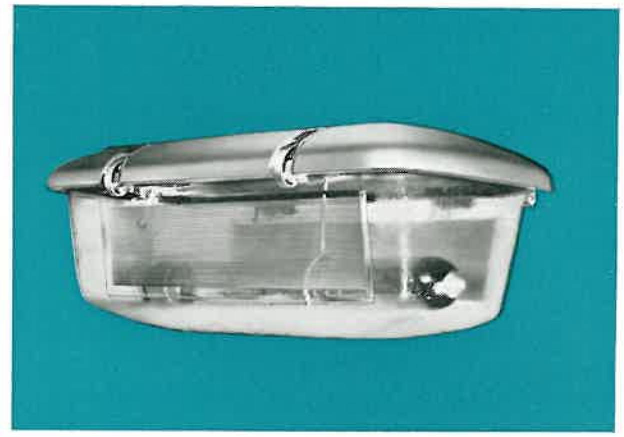
Cars arriving are parked automatically by the 'autosilo' principle, in which the vehicle is driven on to a lift and left to be mechanically handled by dollies into a suitable parking location on a floor above. The lighting for this would be switched so that wherever there was a stall filled by a parked car, the area of ceiling above would automatically light. The lifts in operation would be lit so that there would be a constantly changing pattern of light in a dynamic sequence, as the car and helicopter lifts moved up and down to the allotted spaces, the average time for collection being about two minutes.

Ground Level and Basement

The main entrance lobby is located at ground level, but entry may also be made underground from a direct Tube connection on the Bakerloo Line, whilst all servicing for the building is performed below ground via subterranean approach roads. A feature of the entrance 'piazza' are the sunken lakes, used as reflection ponds to the building. At night the edges of these lakes are outlined by light and the detail illustrated (Sketch 5) shows a method which would both illuminate it for pedestrian safety and outline it when seen from the opposite side, or when looking down into the piazza from above.

Furthermore, at night at ground level the buildings and the 'rocket-like' lift shafts would be reflected in the lakes to create a moving and inspiring pattern.

This survey does not attempt to consider all the aspects of lighting in the complexity of this building programme, but rather to stimulate a pattern of thought concerning future lighting needs......for in a future where anything is possible, it is important that much thought should be given to the principles involved, as to what a building should look like at night, and the extent to which function can be subordinated to drama to ensure that the artificial lighting of projects of this character measures up to the standards of 'daylighting' in this 'Glass Age'.



One of the latest additions to the Mazda range of streetlighting lanterns, fitted with a lightly-diffusing clear 'Perspex' bowl. (A.E.I. Amber Mk. IV.)

PLASTICS

No single factor can have had a wider influence on post-war lighting practice than the rapid growth of the plastics industry.

At the same time, the plastics industry is the first to admit that its rate of development in this field has been due in no small measure to the increasing demands of modern lighting.

It is, in fact, a happy partnership that developed largely through the accident of war and an aftermath which produced on the one side a surplus, on the other a shortage.

Probably the best known plastic used in the lighting industry is 'Perspex'. During the war, the plastics industry had built up a very large production of acrylic sheeting for use in the canopies of aircraft. If, in the post-war era, this capacity was not to be wasted, new outlets had to be found for it.

To the scientists at I.C.I., acrylic sheet seemed to have many of the properties needed for application in lighting. Its optical qualities were magnificent; it could be modified for different optical effects; it had great mechanical strength.

Metropolitan-Vickers soon put this theory to the test. They urgently needed reflectors for fluorescent lamps and enamel sheet steel, generally considered the only suitable material, was in desperately short supply.

Forced to find a substitute, they decided to try reflectors made from opal acrylic sheet. These new reflectors were an immediate success. Their use spread quickly through British industry, and soon this opal plastic began to challenge enamelled steel sheeting in its own right.

A high quality material, it was more expensive than its rival, but there were three major justifications for adopting it instead: It was more efficient; its colour remained permanent; it directed a certain amount of light upwards. This last asset—contributing to what the Americans call 'environmental lighting'—has an important psychological effect on workers. It allows a more comfortable light distribution which, like correct use of colour, creates greater efficiency.

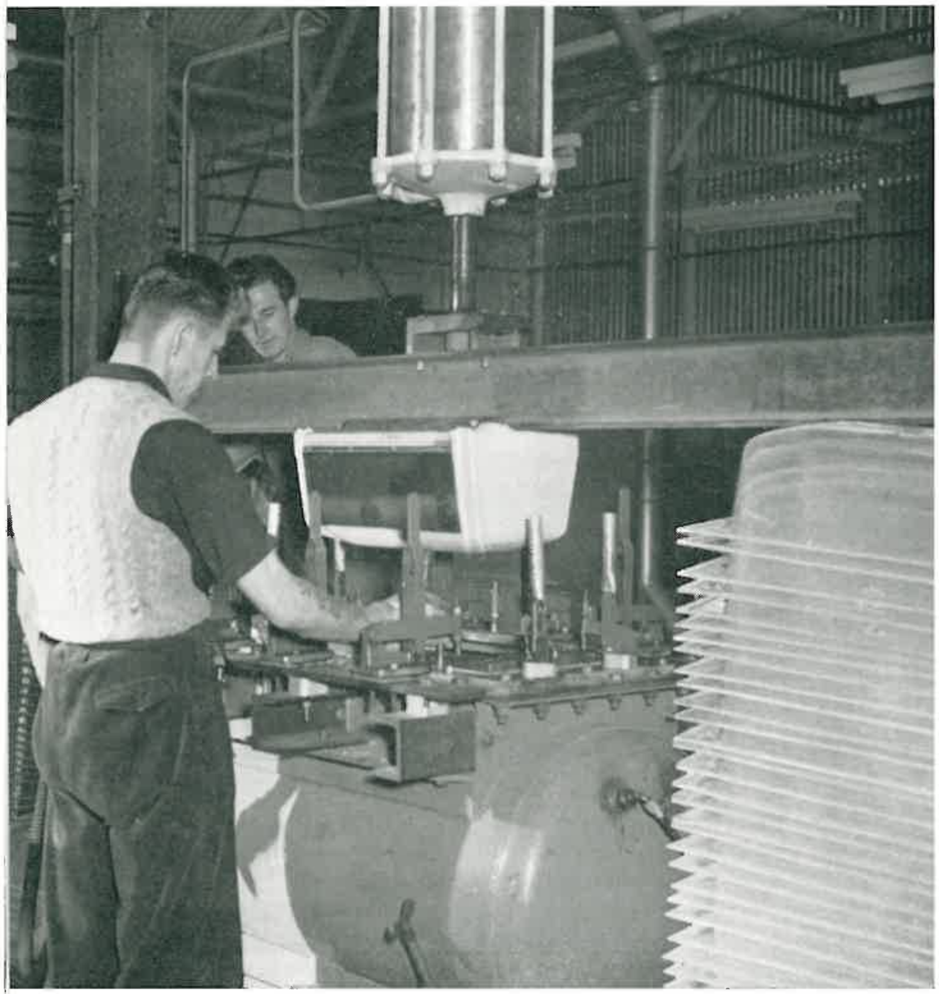
Had this been the end of the applications of plastics in lighting, it would still have led to the growth of a not inconsiderable new industry. Well over fifty thousand of these reflectors are now manufactured in this country each year.

But it was only the beginning.

Dr. W. E. Harper, of I.C.I.'s Plastics Division, was one of many scientists throughout the country who were actively investigating the future of plastics in the lighting field.

'From a wide range of very different materials, each with its own individual properties, we had to isolate those plastics that would meet the particular requirements of the lighting industry', he says.

'Perspex' canopies on a wartime bomber.



Moulding a 'Perspex' bowl for a streetlighting lantern in the 'Perspex' manipulation shop at Hereford.

These materials had to possess at least three particular properties:

1. They had to be right optically.
2. Their weathering properties had to be good.
3. They must be mechanically strong.

'These considerations', says Dr. Harper, 'enabled us to reduce the possibilities to two or three different plastics'.

In this country, it was decided that the material with the widest application was acrylic sheet, to which I.C.I. gave the name 'Perspex'. Early research was therefore primarily concentrated on its development.

'This decision', says Dr. Harper, 'has been fully justified in practice'.

Its qualities quickly recommended it to designers of buildings such as factories, shops and banks.

Its freedom from shatter enabled big sheets to be produced, with obvious advantages where very large fittings were required.

It could be produced without difficulty in a range of colours for such uses as signal lights and signs, or in opalescent sheets where diffusion was required. And being an easy material to work, it did not cause excessive wear of the machinery used in its manufacture.

From interior lighting for factories, research was directed to every type of interior work, especially for more decorative effects with lamps enclosed in special diffusing materials. This development, in which A.E.I. Companies were pioneers, was largely integrated with the growing use of fluorescent lamps and is typified today by the widespread adoption of built-in lighting with 'Perspex' diffusers mounted flush with the ceiling.

After the war the Admiralty decided to use fluorescent lighting in their larger warships and a standard fitting was developed with the co-operation of I.C.I. and the major lighting companies. This fitting comprised a shallow back channel on which were mounted the control gear and lamps, the whole assembly being completely enclosed by an 040 opal 'Perspex' diffuser.

The design of this diffuser was decided after many careful experiments to ensure that the surface brightness would be within tolerable limits in view of the low mounting heights which would obviously prevail in H.M. ships.

'Perspex' was used because of its good moulding qualities and because of its resistance to shattering under gun shock conditions.

Streetlighting

With the coming of fluorescent streetlighting at the end of the war, the claims of plastic as an outdoor material were put to the test.

Bond Street was one of the first thoroughfares in Metropolitan London to adopt this new form of streetlighting using five-foot 80-watt fluorescent tubes. Before it could be put into operation, suitable enclosures had to be found for fittings roughly six feet long. Other considerations aside, glass was considered too dangerous. So 'Perspex' was tried—for the enclosures only. As proof of its durability, the original Mazda lanterns, now more than 10 years old, are still in use.

The success of this experiment gave rise to one of the most important advances in the use of plastics for streetlighting.

'Today', says Dr. Harper, 'All the fluorescent lanterns used for this purpose, and most of the sodium lanterns, have 'Perspex' optical components'.

Most, however, have progressed far beyond those first simple enclosed bowls. The most recent incorporate the light controlling elements in the bowl, and today many streetlighting fittings are in use which would have become impossible without plastic materials.

Such applications demand a material soft enough to withstand intricate machining applications, yet strong enough to hold the built-in mechanisms: a material that is shatter-proof and yet possesses optical qualities of a high accuracy that will remain unaffected by rain, airborne dust and grit.

A 'Watershed' fluorescent fitting designed for use in humid atmospheres.

The 5 ft. submersible fitting which is built to withstand high pressure and corrosive elements in fresh and salt water.

Flameproof fluorescent lighting fittings in the underground mines roadway of Heam Heath Colliery, Staffs.

Acrylic sheeting was still the answer.

In modern practice, prisms controlling the light are machined into a piece of 'Perspex' and the entire plate is then cemented to the inside of the enclosing bowl, giving permanent, smooth surfaces inside and out that are supremely easy to clean.

With the introduction of this process, more attractive design in street-lighting lanterns became possible. A well-known example is the A.E.I. Amber lantern which has a one-piece 'Perspex' bowl with side refractor plates and slight internal figuring to obscure a direct view of the interior and enhance its daylight appearance.

Future Developments

An interesting and potentially important application of plastics is their use in lighting fittings in mines.

Here the main requirement is for flameproof equipment.

'After long investigations, which are still continuing, most major difficulties of production and design have been overcome', says Dr. Harper.

Any wide-scale adoption of plastics in this field, however, awaits the preparation of a new British Standard. The present standard stipulates glass, and glass only, for components for which plastics could otherwise be used.

There is an ever-increasing variety of plastics available to meet the developing requirements of the lighting industry. The basic material is available in many forms—clear and opal sheets, in colours for illuminated signs, in decorative finishes.

'It is unlikely', says Dr. Harper, 'that anyone will ever produce the ideal material, perfect in every aspect. But on the whole 'Perspex' has most of the properties needed. Its only major limitation is its resistance to temperature: 70 to 80 degrees centigrade is reckoned to be its maximum resistance'.

Other plastics are not being ignored, however.

Both technically and in scope of application, the use made of plastics by the lighting industry in Great Britain is ahead of every country in the world, including the United States.

Some of these materials have uses that run parallel with acrylic sheeting.

Tough, corrosion-resistant 'Darvic' P.V.C. reflectors, for instance, are widely used in industry; for luminous ceiling installations, cheaply-produced Vinyl film can often be used; extruded and injection moulded polystyrene sections are being employed in a number of types of indoor fittings.

Other materials have been developed for quite different needs and uses.

Urea and Phenol Formaldehyde, for example, are in common use as lamp-holders, terminal blocks, switches and other ancillary lighting products. Nylon mouldings are being insulated with Terylene film. Polyester resins are being used for certain components. 'Crinothene'—a brand of cellulose acetate—is an ideal material for lampshades.

'The main development of the future', says Dr. Harper, 'will be not so much in the discovery of new plastics, as in new methods of fabrication'.

One of the most significant of these methods is likely to be in the process of injection moulding, by which a powder or granules of plastic are moulded under pressure.

A notable example of this method of manufacture can be seen in the A.E.I. Lamp and Lighting Company 'Starcone' fitting. Here, new prismatic designs have been moulded from 'Diakon' acrylic powder.

Where not less than twenty or thirty thousand identical fittings are required in any year, this method of production may prove a more economic proposition than moulding from acrylic sheets.

But although its cost is relatively high and its method of fabrication crude by comparison, manufacture from sheet has the big advantage of lending itself to limited production.

Whatever directions developments take, one thing is certain: Whatever light fittings are required, and whatever their specific purpose, more and more of their components will in future be made from plastics.

Above right. 'Watershed' light fittings are used extensively in the brewhouses of Messrs Guinness Son and Company's Dublin and London breweries. Two men are seen here skimming the surplus yeast off one of the massive tanks in the Park Royal Breweries, London.

Below right. This picture shows a number of specially designed 'Perspex' 'module' fluorescent light fittings installed in the canteen of Babcock House, the large new London head office of Babcock and Wilcox, Ltd.

White House Investigation

WITH A TAPE MEASURE

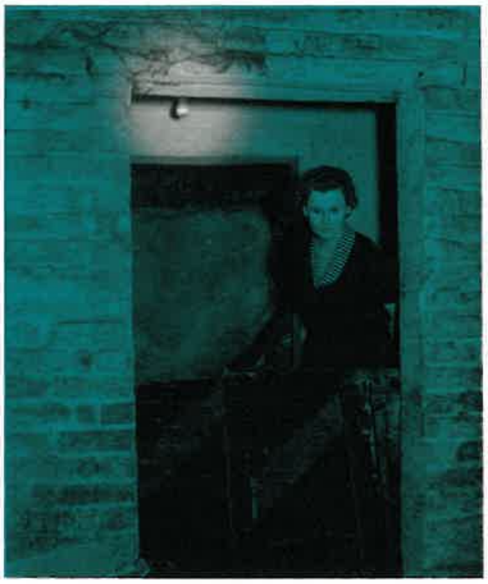
By Francis Moran

THE CURRENT EDITION of the Mazda booklet 'Lighting to Measure', which gives simple tape measure and wattage recipes for good home lighting, carries an introduction by that well-known television personality, Lady Barnett.

Speaking at a recent Variety Club lunch, she is reported to have said that in four years of show business no-one had asked her for her vital statistics. The omission was immediately remedied by a newspaper columnist but the incident prompts a parallel train of thought—As a contributor to a booklet on domestic lighting, has anyone asked to see the lighting in her home?

The pictures on this page were taken as an impartial record during a visit by the A.E.I. Lamp and Lighting Company's architectural consultant, Derek Phillips, complete with tape measure and copy of Lighting-to-Measure, to Lady Barnett's Leicestershire home, The White House, Cossington.

We started at the backdoor. Said Lady Barnett 'No-one uses their front door in the country'. The backdoor fitting lighted the courtyard and outbuilding doorways and seemed hard to fault.



Feeling slightly ashamed at the invasion of privacy, we asked Lady Barnett to show us the coal-shed and found a 40-watt bare-bulb and flex installation, with a very dirty bulb, and a similar installation in the garage. We hinted at higher wattage lamps for coal sheds and the new, more enlightened attitude towards the fetchers of coal, and passed on to the practical and economical advantages of fluorescent lighting in garages and above work benches.

The standard lamp which is the only light in the hall, has a dark shade and contains a 100-watt bulb. The room is a large one but all walls and woodwork are painted white and we found the level of illumination ample. In a hall, comparatively low level lighting can be a useful half way house for eyes which have to become adjusted to the darkness of a winter night after the high level lighting needed for sewing in a living room.

A corner of the big Drawing Room. 'I have as much local lighting as possible' said Lady Barnett, 'I hate ceiling fittings —they can spoil the proportions of a room'. Lady Barnett's writing lamp almost exactly agreed with the directions in Lighting-to-Measure. It contains three pearl 40-watt bulbs. Her collection of Stafford and Rockingham china is a feature of the room which is lighted by standard and table lamps.

There is no ceiling fitting in the dining room, or indeed at first glance any electric lighting at all. Lady Barnett insisted that she used candles in the room but we found a tungsten lamp over an oil painting commanding the room from above the fireplace. There is also concealed fluorescent lighting built into the pelmet above the curtains of French windows leading into the garden.

In this bedroom the lighting closely follows the suggestions in the Mazda Lighting-to-Measure booklet. Lamps on the dressing table contain 60-watt bulbs mounted at a height of about 15 inches above the level of the table and positioned to avoid a reflection in the mirror. Bedside lights are the right height and correctly positioned but use only 60-watt lamps which is low for a bedroom table lamp used for reading.

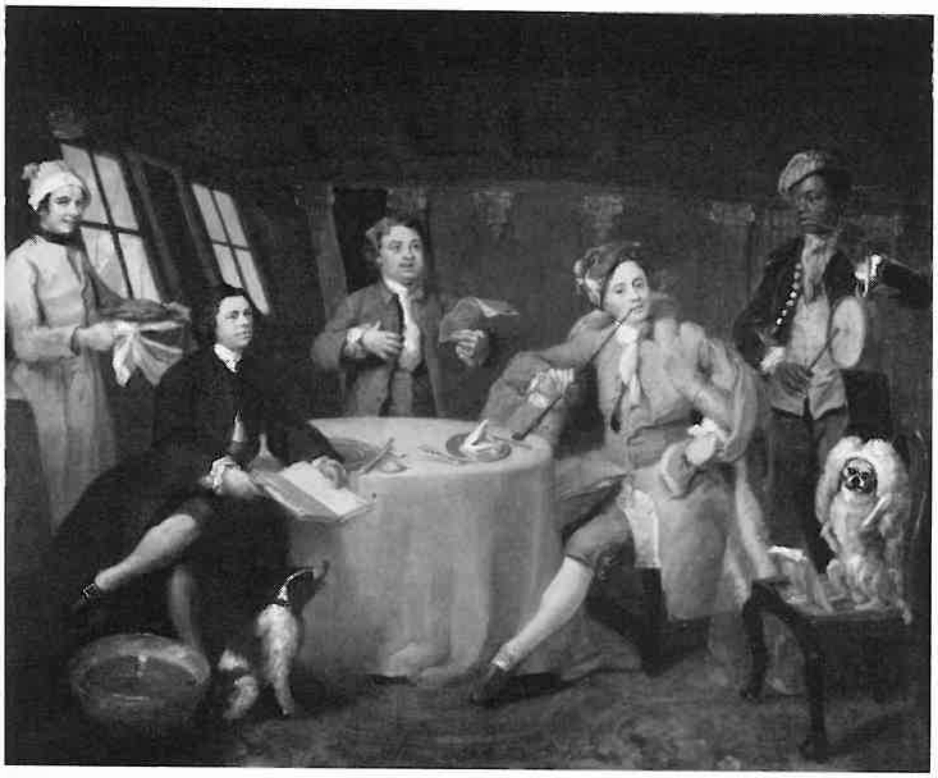
Briefly summarized, our reactions to Lady Barnett's home lighting were favourable. The lighting showed individuality yet followed the basic rules in essentials.

The exclusive use of candles for dining room lighting would be considered dangerous by the safety-conscious yet, in practice tungsten and fluorescent lamps have been skilfully used to give background lighting.

On the debit side was the lighting in the garage and outbuildings. So much light is absorbed by the dirty conditions usually found in coal cellars and so little time is normally spent there that where a bare bulb is used there is really no excuse for anything but a high wattage Silverlight.

SHIP DISCIPLINES

An examination by Derek Phillips, A.R.I.B.A., of current trends in ship interior design and lighting against a brief résumé of past practice



This Hogarth painting of 1740 depicts a scene on board a ship of the period. One cannot fail to recognize that it is a ship, even though there are carpets on the floor and the people concerned are posed as in any bar parlour on shore. The sloping walls, and the curved deckhead above, unadorned by applied ceilings, read as the structure of a ship, and ships throughout all periods of history have something of this character. The following historical survey shows the general relationship between the domestic architecture of the period and the ship interior, but in almost all cases the essential disciplines of ship design impose a characteristic quality which we recognize as ship.

The natural light in this painting comes through openings in the stern and even during the day many parts of the ship were in almost total darkness and candles were carried wherever required, but the danger was from fire as much as from unseen obstruction. Ship lighting today can transform all the darkened areas within a ship to light, but it can do more than make a ship a safe place in which to tread, in creating conditions of comfort, in establishing moods, without in any way conflicting with its character. It is the purpose of this article to examine the essential construction which determines room shape and proportion and to see to what extent the characteristics of modern light sources are able to offer a positive contribution to ship design.

Atmosphere

An architect concerned with the design of ship interiors was asked recently what basis he used for his design. He replied that he attempted to create interiors which were as much like hotels as possible, within the given discipline of ship architecture. The concept being to enable a traveller to come from an hotel in New York to an hotel in London without noticing the intervening sea passage.

When ships were at sea for many months, in some cases years, it was considered appropriate to create conditions which gave the effect of 'home, comfort and safety', as a relief from the fury of the elements outside. Now voyages rarely last more than three weeks, in many cases only a few days, and comfort and safety are factors which modern civilization largely takes for granted, the feeling of being 'at sea' is therefore not necessarily something which must be subordinated to the subtle atmosphere of the international hotel.

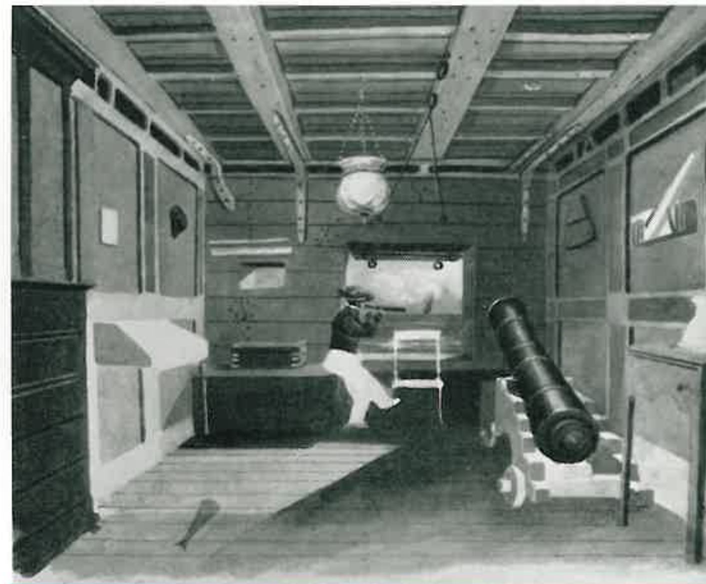
An important factor in this argument is the growing maturity of air services which reduce sea travel to that of the 'slow and outdated'. It is now possible to travel as cheaply by air as it is by sea, and it is difficult to see how sea travel can become anything but relatively more expensive.

If travel by sea is to cost as much or more than by air, and to take many times longer, how then can the ship compete? Perhaps by luxury, but then the luxury that can be provided for the comparatively few hours on a plane compares very favourably with that on the best liners, and for their own purpose they are just as comfortable. There is, however, one field where the ship can prove superior to air travel and that is by the very opposite of the qualities which aeroplanes afford, such as 'time' and the spirit of 'being at sea', the excitement and 'breezy holiday quality' which this provides, as set against the almost unrelieved monotony of the view from an aircraft window.

Time for relaxation, in some connection with the sea, the romance of a sea voyage, these are amenities upon which the ship owner may need to place greater emphasis in his appeal to the travelling public in the future. How then can this demand be met by the ship interior, surely not by the repetition of the hotel on land, since there is little advantage in going to sea in order to capture the spirit of the Cumberland, or indeed the Leofric, but rather by applying the best design traditions of domestic architecture to the ship, and by working within the existing disciplines to preserve the essential ship character which has been so apparent in the ships of the best past periods.

The story of ship interiors, illustrated here, depicting the development in ships from 1750 until 1950, shows that ships tended to express the domestic interiors of their period; but up until the beginning of this century the essential disciplines of ship architecture tended to dominate and clarify the design, so that although the decorative motives may have been those of the home, the ultimate flavour was that of the sea. Perhaps the art of disguising structural forms has developed in terms of the suspended ceiling and the floating wall to a greater extent in this century, for certainly in ships such as the *Queen Mary* and the *Arcadia*, illustrated, one might be excused for imagining that these were photographs of rooms on land.

The revolution in architecture which threw ballyhoo out-of-the-window in a desperate attempt to be 'functional' in the 30's seemed to have had little or no influence on passenger ship design, and until the post-war Italian ships, *Andrea Doria* and *Christoforo Colombo*, were built, little attempt was made to introduce the fruits of the modern movement in architecture into ships, and then more as a new 'style' than a rational approach.



The lighting and decoration of this captain's cabin are entirely superficial and confined to painted partitions, which can be easily jettisoned in case of war action, and a blown glass gilt pendant fitting, designed to hold either a candle or an oil lamp.

Architectural Disciplines

The sketches indicate the essential structure of a ship which results in its characteristic appearance. It is basically a shell with vertical shafts penetrating the contained space from bottom to different levels (a) and varying in size, from engine spaces, cargo holds, to ventilation shafts and elements of vertical circulation.

In addition to this, a ship is divided up into a series of watertight compartments, transversely (b) for strength and protection, which break up the spaces left for accommodation into two main types.

Candlelight in the Seamen's Mess of a warship c. 1810. Woodcut by George Cruickshank.

First, areas which are long and narrow and run lengthwise down the sides of a ship avoiding the vertical shafts in the centre. Accommodation generally planned in such spaces being the cabins, corridors, promenades and often ancillary accommodation such as ship's offices, bars, children's nurseries, etc. The spaces are often difficult to resolve and present a challenge to the designer. Second, areas which run across the width of the ship, limited by the watertight compartments and the vertical shafts. There are fewer such areas and these will be reserved for the more important elements such as lounges, dining rooms, swimming baths, etc. A good example of this can be seen in the illustration of the Dining Room in the *Pembroke Castle*, 1885. Both types of space can be seen (Fig. 1) representing typical spaces within the hull (c) and the spaces found at boat deck level (d).

In addition to these planning limitations, there are severe restrictions upon space, due to the low deck to deck height, the curvature of the deckhead across the width of the ship, and the construction of this, which for purposes of lateral stiffening is formed of comparatively deep sections often as little as 2 ft. apart. This is well illustrated in the picture of the Master's Cabin in the *Cutty Sark*. The curved beams low overhead, the pivoted wine bottle holders and the lamps suspended in gimbels were the unmistakable signs of life at sea in the middle of the last century.

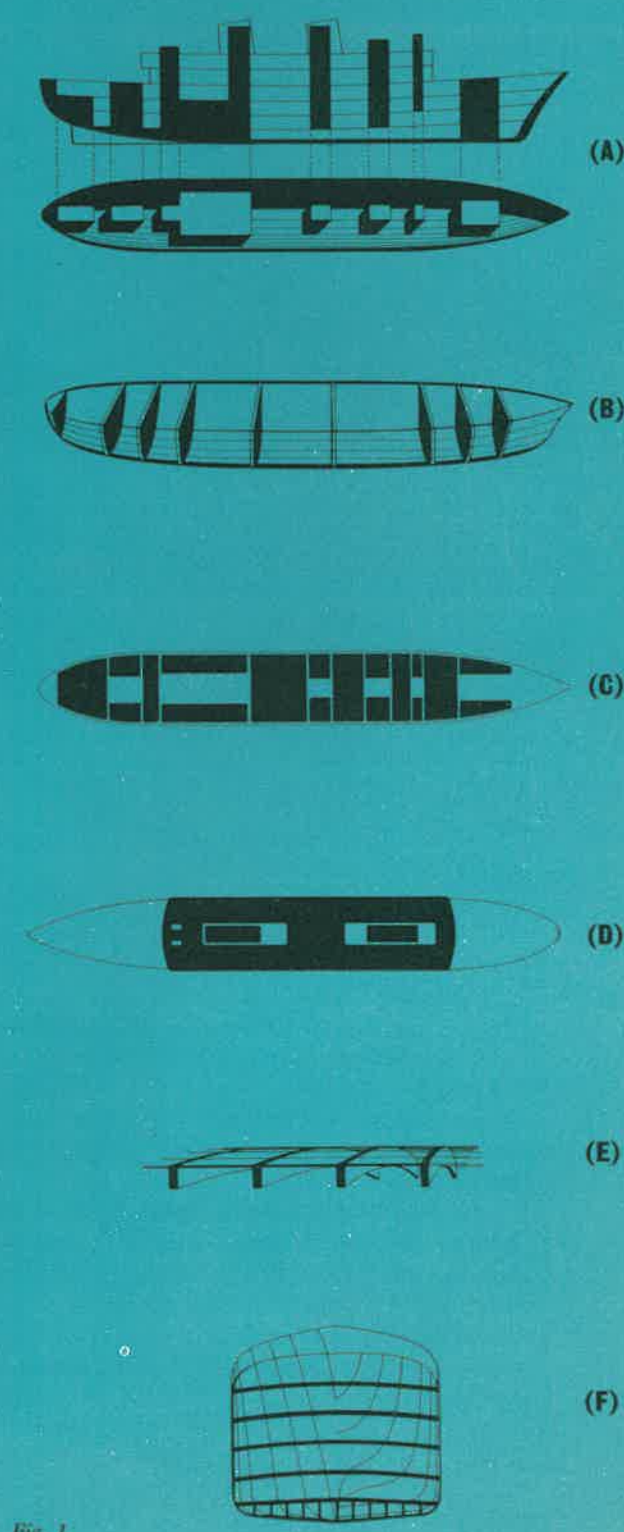


Fig. 1.

Lighting Disciplines

Although the physical disciplines imposed by ship construction are numerous, resulting in rooms of challenging proportion, curved floors and ceilings, and walls which are rarely rectilinear, there are other important 'servicing' factors which have a marked effect both on the visual and physical environment; for example, the needs of ventilation dictate the need for large areas of horizontal air duct space, initially feeding lengthwise down the ship with branches laterally leading between the transverse beams. Likewise, the environmental problem of lighting is one which is of great importance; and the application of lighting principles is perhaps even more essential for the ship interior than for any other project.

Technically, the design and construction of lighting fittings present a problem. The fittings must be constructed to withstand vibration and the corrosive effects of sea air. Access must be easy in order to facilitate fault finding and normal maintenance, and whenever fittings can conceivably be used as a hand support against the rolling of the ship, they must be built to withstand the strain.

The Royal Banquet in the Saloon of the Pembroke Castle at Copenhagen, 1883. Daylight is derived from above from a large central skylight and from small portholes set in the walls. The oil lights are positioned above each of the tables and mounted centrally in gimbals.

The Master's Cabin in the Cutty Sark, 1870 or thereabouts. Daylight is again derived from a large central skylight and side port lights. The single oil lamp is mounted centrally above the table. The Cutty Sark is preserved for the nation at Greenwich and is well worth a visit.

The choice of light source is important and there has been considerable development since the individual candle lamp was carried around where required. The tungsten filament source has been extensively used in ship interiors, as on land. The equipment and lamps are cheap to buy, easy to control, and the colour and appearance have a decorative quality which it is difficult to achieve in other ways.

There are, however, distinct disadvantages in the use of extensive filament lighting in ships, both from the aspect of heating and of colour, and due to this the fluorescent lamp has been adopted for use by many steamship companies.

The factor which weighs most heavily in its choice is the lower wattage required to obtain equivalent illumination levels (filament-lighting uses three to four times that required for a fluorescent installation) and the consequent heat reduction. It has recently been assessed that cooling plant in ships can be reduced by 9 per cent where total fluorescent installations are installed, a considerable saving in capital cost and in weight.

Furthermore a 'cool' effect can be obtained from the fluorescent lamp; various colours are obtainable which have exceptionally good colour rendering properties, but which at the same time do not give the 'hot' feeling normally associated with filament lighting, a fact of extreme importance in the tropics.

Most important passenger services run between cold and warm climates and it is more important that the lighting should be cool in warm climates than warm in cold climates.

Fluorescent lighting is especially useful for general lighting, which, due to its linear characteristics, can be installed in between the transverse beams, and in shallow ceiling recesses. For local lighting there is still a need for the tungsten filament lamp and the local interest that it can create, in affording an element of light and shade, and both fluorescent and tungsten lighting can be used successfully together when their individual functions are understood.

The balance between the tungsten and fluorescent lighting should be carefully calculated in order that it may be reproduced in cabins also, since if a lady 'makes up' under one light in her cabin, she must be fairly certain that the effect will be similar in the public areas of the ship. For example, if fluorescent sources only are used in the public rooms, then the cabin should be lit similarly. However, the problems of colour appearance and colour rendering would not be serious if deluxe warm white and tungsten lamps were used.

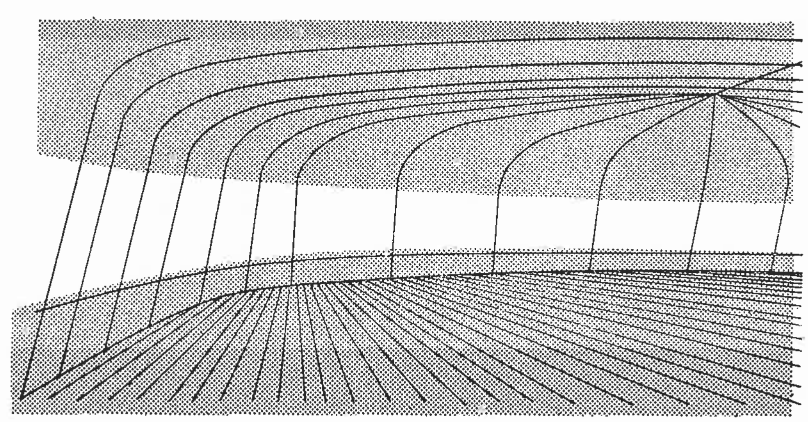


Fig. 2. A typical ship space.

Verandah Grill of the Queen Mary.

1st Class Drawing Room of The Arcadia, 1954.

Much can be done by well-planned and well-executed lighting to assist in making pleasant and comfortable interiors of the uncompromising material presented by the construction. Long and narrow spaces can be broken up by the lighting into smaller units, and colour may be brought in to assist in creating more satisfactory areas. The oppressively low ceiling height can be 'lifted' visually by the lighting in order to create limited 'sky effects', which if successfully handled, can help to create emotional well-being without in any way detracting from the essential character of the ship interior.

With the large public areas occupying positions across the width of the ship, having natural lighting on either side during the day, it is important that there should be supplementary artificial lighting at a high illumination level if the centre of the space is not to appear relatively dark and gloomy. Curved floors and deckheads present their own difficulties, since lines of recessed lighting are prevented longitudinally due to the transverse members, and lines transversely following the direction of the beams must take up the curve of the deckhead, unless suspended ceilings are provided.

The provision of suspended ceilings and floating walls which 'iron' out the characteristic ship form is indicated in Fig. 3 and shows an attitude of mind towards ship interiors. Such devices are used in domestic and commercial interiors to gain decorative effects, and their presence in ships is therefore to be expected. They are however devices which if carried to extremes can convert the interior of a ship into almost anything else, and they should be employed with reserve if the essential flavour of shipborne life is to be preserved.

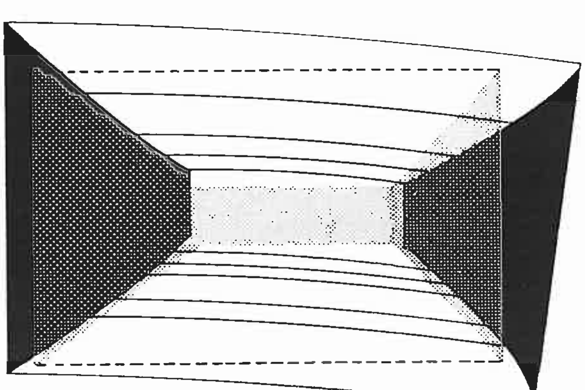


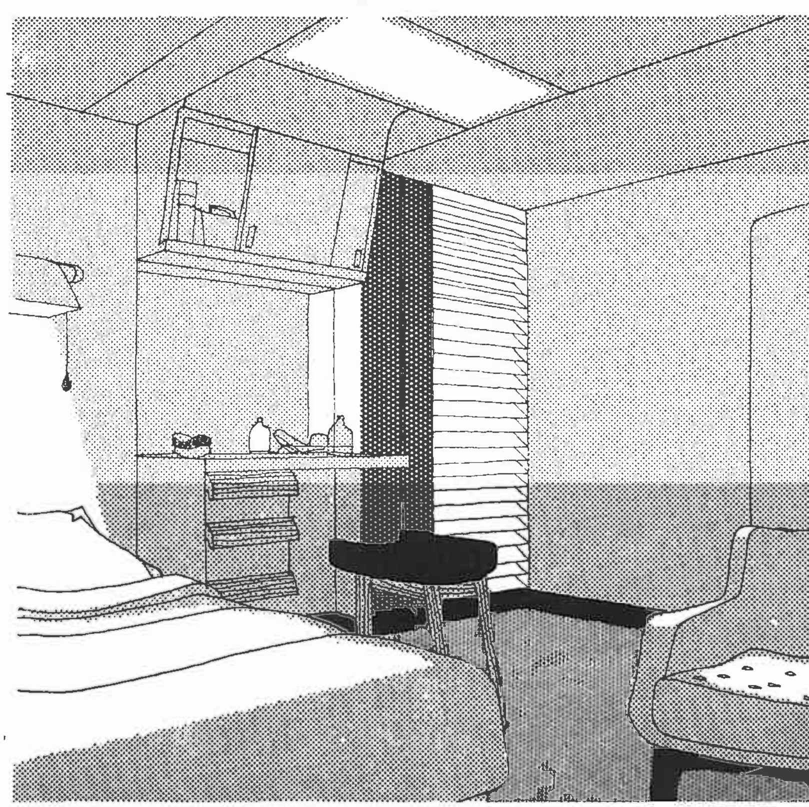
Fig. 3. In many cases the characteristic curves of decks, deckheads and bulkheads are regularized by the use of 'floating' walls and suspended ceilings.

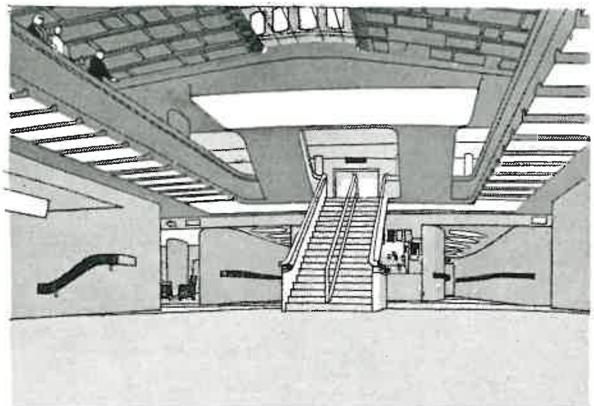
Applications

Ship owners generally believe that the most important single space in a ship is the individual cabin. This is where the passenger first arrives and has a chance to observe life on board, and his first impressions are likely to be lasting ones. The lighting of the cabin is therefore of paramount importance, and in the solution suggested in the accompanying perspective, a lighting scheme is put forward which would relate the artificial lighting to the natural light entering from the transverse access corridor terminating at a large port light in the side of the ship. A vertical fluorescent lamp is concealed within the wall, lighting both towards the dressing table and to the daylight opening, which at night would be cut-off by a venetian blind.

Other lighting would consist of a modular lighting unit recessed into the space between the transverse beams, used for general lighting, and a bedhead light as indicated. A reading light might be added on the far wall related to the sitting area.

Design for a cabin lighted by 'borrowed' daylight from a transverse corridor running to a portlight in the ship's side and by light from concealed fluorescent lamps.





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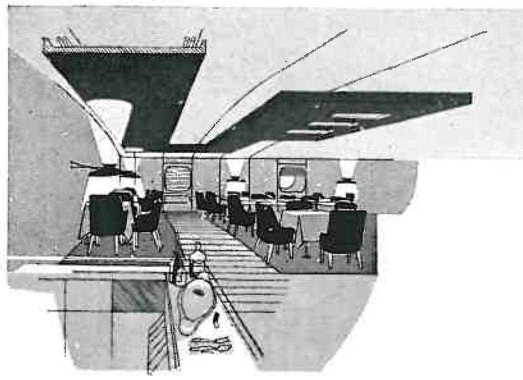

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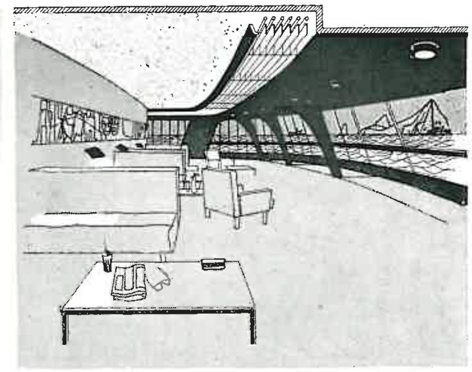


C

Central staircase, hall and circulation area

Unquestionably the most important single area of circulation will be the central hall, where it is usual to have a main staircase, and where passengers will arrive on board. The Purser's Office may be here and the ship's shop. Unlike architectural development on land where there is a tendency to achieve an asymmetrical solution, the nature of ship construction dictates a centralized plan and warrants a somewhat formal treatment. A possible treatment of a typical space is shown in sketch (A) where the opportunity has been taken to break through to a level above in order to achieve a greater sense of volume, and a lighting scheme is suggested which utilizes natural and artificial light in a logical manner.

The scheme is designed to relieve the natural 'crowded' character of the general accommodation, and whilst making no attempt to disguise the ship's structure, it employs the modern lighting technique of 'luminous ceilings' to give a high level of artificial lighting necessary when artificial sources are used to supplement daylight.

At night a certain drama would be gained by views of the night sky, the brightness of the related area of luminous ceiling being reduced in order not to conflict with the starlight outside. A method of arranging this might employ twin circuits of fluorescent lighting, or alternatively cold cathode lamps which may be dimmed. The lighting scheme proposed for the spaces below the balcony gains from being related to the transverse beam structure, which is exposed and may act as both a light baffle and acoustic control, whilst the appearance of 'ship' is retained.

Dining Room

Dining rooms are generally planned in areas free of obstruction across the breadth of the ship. The artificial lighting solution must be complete with or without the use of daylighting, and a dining area may well merit a solution which allows a degree of flexibility in the use of the room, so that a different emotional response can be aroused at different times.

Such a scheme is illustrated in the sketch (B) which shows the room in use during the day. Natural light is allowed to enter through the side windows, controlled by venetian blinds restricting the view of the horizon, which some passengers may find disturbing. A high level of indirect light is obtained by dropping a lowered ceiling over certain areas, with fluorescent lamps placed around the edges lighting the true structural ceiling. An effect of 'sky' is obtained which raises the apparent ceiling height. The proportion of lowered area is most important, as it is easy to spoil the effect by a solution relying on 'cornice beams' which serve merely to emphasize the low ceiling, a mistake often made in British ships. In addition to this, special wall brackets are provided along the side walls containing tungsten filament lamps for local light and shade, the light being allowed also to flood up to the undersurface of the lowered ceiling, which is stopped short of the walls to expose the curvature of the deckhead. At night it may be desirable to heighten the emotional effect by creating an entirely different feeling, relying more on isolating each of the diners in his own pool of light. The indirect light to the ceiling could be switched to a circuit of 'black light' which if the structural ceiling had been suitably prepared with colourless phosphors appearing white under visible light, would render the surface a low intensity blue under ultra-violet. The tungsten filament lighting would then be the major source, and this might be supplemented by further local lighting related to the individual tables.

Promenade Deck

There will always be a desire to exclude the 'presence' of the sea at times from most of the rooms on board ship, but the promenade deck is one area where lively contact with elements is mandatory. The artificial lighting of such an area should be carefully planned to arrange for comfortable conditions by day and night. A suitable lighting scheme is suggested here and illustrated in sketch (C). The space chosen will generally be high enough to allow large areas of glazing where it is to be enclosed at all, and the perspective illustrates 'tumblehome' where the windows slope inwards at the top, a device we associate with travel at sea and in 'space'.

The portion of ceiling closest to the ship's side would be painted a light colour and during the day, when there would be a high level of reflected light from the surface of the seas, this would help to reduce the contrast between the sky and the ceiling for comfortable viewing.

It will generally be unnecessary to resort to any artificial lighting during day.

At night the artificial light must be arranged to be cut off from the rear wall, in order to avoid reflections of the wall in the glazing......... similarly all light sources should be screened so that no images of these can be seen. In the suggestions illustrated, the portion of ceiling closest to the rear wall is raised in order that it may receive indirect light from the screened fluorescent lamps which follow the curve of the ship's side. The floor should not be too highly reflectant to avoid reflected images in the sloping glass; where the glazing is sloping in the opposite direction, the danger of reflection would be chiefly from the ceiling.

Summary

It is not the intention of the foregoing suggestions to solve actual problems in an individual ship, but rather to put forward a rational approach to the interior design of lighting in ships, based upon the need to work within structural and planning limitations, so that the essential character of the 'ship' remains.

With modern technique it is comparatively simple to make a ship look like a hotel, or a hotel look like a ship, but it is questionable whether either is wise. We are faced with the problem of creating ship interiors which carry on a long tradition of using the finest domestic architecture of their period, but without ever losing sight of the fact that it is a ship, and that this should be a source of pride.

Manufacturers' Trust Company Bank on Fifth Avenue, New York.
Architects: Skidmore, Owings and Merrill.
An exciting break with tradition showing the full use of modern technology. The glowing ceilings enhance the impact of the buildings both at day and by night.

John Bickerdike is in private practice specializing in industrial buildings and flats.
He worked for six years at the Building Research Station on problems connected with lighting and acoustics and was awarded the Alfred Bossom Research Fellowship in 1951. He has taught at the Birmingham School of Architecture and is on the Science Committee of the R.I.B.A.
The illustrations are of examples of the use of light chosen by the author from his own particular sphere of interest. Some are examples of his own work for the Bowater Paper Corporation.

TRUE VALUES IN DESIGN

John Bickerdike, D.A., A.R.I.B.A.—architect and lighting consultant

What of the future of lighting? We know engineers will continue their development of more efficient sources. We hear of new 'super-powered fluorescents', colour-corrected mercury lamps and combined incandescent-fluorescent and mercury vapour lamps.

As an architect, I see the future in a different way. I do not believe further source developments will radically change or necessarily improve the lighting of buildings; they may provide the means but there is no evidence to prove that good quality lighting is dependent on source improvements. Indeed it is likely that the recent rapidity of improvements has tended to distract designers from the less explicit but ever present criteria of high quality in lighting.

The physiological responses to conditions of brightness, contrast and glare are now well-known and there have been numerous scattered attempts by lighting engineers to formulate with precision a basis of interior design in these terms. Whilst this represents a major change of outlook and contains admirable intentions, it remains an attempt to arrive at quality in design based on strictly limited principles.

At some stage this kind of approach is inevitable and I support it for part of the way. It is a specialist's method—narrow, concentrated and exclusive. But it is not suitable for the architect. He should never lose sight of the whole picture even when concentrating on its parts.

Integration in Design

Good building (and ultimately architecture) is dependent upon the close marriage of the needs of people and the resources of structure, method and materials, which are but the tools of design.

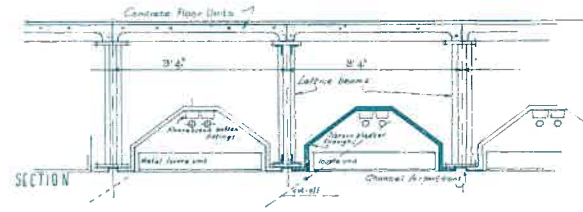
All good architecture is a whole piece of design. Neither is good architecture dependent on a high degree of technology. A Baroque church is little more than stone and paint, its design was without our vast range of aids, yet the impact of such a building on people's emotions—even of people of today—is without parallel in contemporary building. If we are unable to design in a like intuitive manner, let us by analysis derive from it some guiding principles.

The modern building has complex functions and seems to employ an incredibly extensive array of materials, techniques and components whilst lacking the advantages of quantity production. The temptation in design is to admit technological adventure for its own sake and to lose sight of the primary and acquired needs of people. These are concerned chiefly with the senses—heating, lighting and colour, acoustics and so on. They require subtle handling, a deep knowledge of people's behaviour and a balanced interpretation.

The aim of the architect is, or should be, to provide environments in which these characteristics are cradled and developed in desirable and appropriate ways. Human needs and feelings should be the real formulative forces in design. Of these needs, light has probably the greatest single influence on architecture.

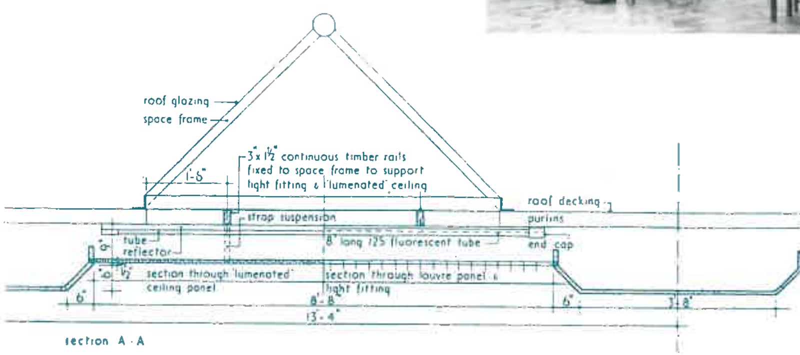
I wish to convey a mistrust of the idea that modern architecture grew out of the scientific use of new materials. Many of our best buildings could have been built a hundred years ago. New materials and techniques certainly have a bearing on development but the formulative forces remain as always. On the one hand there is the desire to invent and exploit new forms of aesthetic expression—as in painting, sculpture, music and drama—this can lead to some very peculiar results but is nevertheless the life force in design. On the other we have development linked to close analysis of human beings, always guiding and often leading the quest for new expression—this quest is in itself a basic human urge.

Part of a recently completed drawing office for the Bowater Paper Corporation Building, Northfleet.
Architects: Farmer and Dark.
Lighting by the author.
A ceiling arrangement which integrates the structure, natural and artificial lighting and the artificial ventilation. By day natural lighting from roof glazing penetrates both the 'lumenated' ceiling panels and the louvering. By night lighting is by 8 ft. fluorescent lamps above louvers and the lumenated panels are partially illuminated by spill light.



Main entrance hall of laboratory and administrative block for the Bowater Paper Corporation at Northfleet. Fibrous plaster troffers containing fluorescent lamps and control gear behind louvers act as fireproofing for the structural steel work of the building. Tungsten spotlights add sparkle.

Photo—Ezra Stoller.
Mile High Center, Denver, Colorado.
Architects: Ioh Ming Pei.
The main block of this building has large open planned offices over 70 ft. deep with a ceiling only 8½ ft. high. Here high quality artificial lighting and ventilation are necessary or the lack of direct natural lighting and ventilation will be painfully obtrusive.



Conference Room for the Bowater Paper Corporation. A dark table and specially darkened louvers in the central light fitting help to prevent the room appearing overlit yet there is an illumination of 50 lumens per square foot for the examination of drawings and documents.

Views of main entrance of Northfleet building at night showing impact of lighting from outside.

In this corridor round a courtyard the tile mural is lighted by natural light reflected from the white terrazzo floor and at night by the light from tungsten spotlights reflected from the floor.

A shell concrete building illustrating the way in which difficulties encountered when providing a high level of illumination in this type of building were first solved. This is a drawing office at Swan Hunter and Wigham Richardson Ltd. at Newcastle-upon-Tyne with an illumination level of 45 lumens per square foot. The control gear for the cold cathode lamps is mounted behind the acoustic panelling. The pendant fittings contain tungsten lamps.
Architects: Richard Sheppard and Partners.

Obstacles to Good Lighting

The idealisms in life are modified by and adapted to reality by the many and varied constraints which range from the influence of the elements to politics. Their influence is often so strong as to be mistaken for basic needs.

Let us examine briefly the effects of two of these constraints: that of present taxation and of the quality of designers in industry. The reason for the choice is that both are aspects exerting a profound and often negative influence not commonly appreciated.

Taxation

Present policy is by taxation and dearer borrowing rates to restrict capital expenditure. This is done by granting poor initial and annual tax allowances on capital expended on all things including buildings. Buildings in particular have a very small allowance—roughly 2½ per cent per annum. This is compensated by generous or full allowance on rent and maintenance.

These conditions have the following broad effects:—

(a) They induce a client to rent rather than build. This is true with even the high rents obtaining in London. The rent may be £1 to £1 : 10 : 0 per sq. ft. on a building which cost about £4 : 0 : 0 per sq. ft. to build and it is clear that without the tax imposition the client could have purchased the property in a very few years.

(b) They induce low quality low cost buildings because with the favourable tax relief it is cheaper to expend large sums on maintenance and high running costs than to expend capital initially on a top quality building.

The term 'maintenance' may cover many items, repainting, heating, extensive adaptation and modifications to the building fabric and replacement of deteriorated building parts.

Thus, taxation has a strongly negative effect on the quality of building design and has tended to move design away from the objective of close integration of the design elements and helped to create the undesirable conception of a building as being little more than so many square feet of space. These observations are particularly pertinent to commercial buildings.

It is of no avail that we may have excellent ideas on design, of good planning, lighting and heating, acoustics and flexibility; the building to rent as offered to a client is little more than a box which basically and in details fails to suit his purpose—a case of make do and rent.

We get a measure of opportunity lost by the minority example of those buildings specially designed for a client. We see the lighting as an integral part of the fabric, acoustic ceilings concealing services, the use of materials which do not rapidly decay. These are the rewards for the few firms which enjoy a prosperity so great as to overcome the taxation limitations on capital expenditure.

Can it be true that the national revenue would be impaired by a reversal of the present high capital low maintenance penalties? The effect on building design would be substantial and it is clear which would be the sounder policy in the long run.

We cannot afford to shrug off a matter of this magnitude. One can see its effect, for example, on the lighting industry. As an architect I am strongly against the design of light fittings as entities separate from the building fabric, and yet I can see that for some time to come the fitting is here to stay because we are not in the position to design the kind of building we should like.

The Designer in Industry

It is my impression that the average designer in industry does not see himself as part of the whole picture and cannot therefore befit himself for the role given to him. I say this particularly in relation to the lighting industry because in the last few years the industry has repeatedly expressed its desire to understand the architect and his architecture; an abysmal admission considering the architect has been one of its chief customers for many years.

The average designer of the enormous variety of components which an architect specifies for his buildings, is too often divorced from his client and married to his engineering. This is the fault of wrong training and of the system in industry whereby the designer graduates to his position through a method of selection predisposed to engineers. Industry at large has this weakness but the effect is more critical in the lighting industry, which is on the borderline of engineering and aesthetics.

It leads to the situation where the designer is of small consequence instead of a key man. Yet the designers should be the life spirit of an industry; the position should be highly placed, commanding the best men, for the future of a firm must be largely invested in the quality of its products.

Consider the light fitting; we have an inherited conception of a light fitting as an object suspended in space. This was inevitable with the fire risk of oil, candle or gas sources. Also, it was inevitable that with the low efficiency of these sources the fittings were multi-point and large. Nevertheless, in the hands of an artist or the building designer, these fittings were developed into things of beauty; the crystal chandelier marking a peak in this era.

Today the sources are changed, the fire risk is almost eliminated and the sources have high efficiencies. The designer is also changing; he has been predominantly an engineer whose aspirations on the aesthetic side are limited to aping the past and endowing his unit with a style of its own, distinct from, and unsympathetic to the character of modern architecture. This practice shows signs of abating but the fittings styled as 'objets d'art', irrespective of their ultimate environment, still outnumber those of simple lines and good proportion. This weakness allied to a predisposition on the part of some manufacturers to measure the merits of a fitting by its light output unrelated to the principles of surface brightness and lamp screening does little to foster mutual understanding. Must the architect put up with this kind of constraint? Why should he not be able to choose from the hundreds of fittings on the market, some of which are in sympathy with his designing?

I would not wish my later remarks to be taken in the wrong spirit. It is a consumer's opinion and is intended to highlight, perhaps by overemphasis, a weakness in an industry which is ultimately dependent on good quality of design. In some respects it is a reflection of the low standard of design appreciation in this country—the consumer gets the kind of article he is willing to accept.

Looking Ahead

Some of the illustrations I have chosen show buildings where problems of natural and artificial lighting have been considered together and full attention has been given to the concept of integrating lighting with the building structure.

The architect finds himself restricted in the application of his ideas by such constraints as the effect of present-day taxation. When and if the time comes when the client is in the position to be able to ask for, and get, his exact requirements, only then may we expect to see the kind of co-operation between architect, engineer and specialist which will ultimately produce a degree of integration in design which proves entirely satisfactory.

In my opinion, the true value of fully incorporating lighting, acoustics, fire resistance, ventilation, heating, durable finishes and flexibility in a building, has yet to be appreciated by the client.

42nd PHYSICAL SOCIETY EXHIBITION

Some notes by:
H. R. Ruff, B.Sc., M.I.E.E.,
Manager, Application Development
A.E.I. Lamp and Lighting Co. Ltd.

The first Physical Society Exhibition was held at the Royal College of Science in 1905 and later exhibitions in the Imperial College, where the BTH Company had one of the few stands allocated for research investigations. New discoveries and techniques from universities and other research establishments were shown and stimulated popular interest in scientific research. A large part of the exhibition has always been concerned with physical and electrical measuring equipment, and the exhibition became, for a time, the main exhibition of scientific instruments in this country and gained world-wide recognition.

With the rapid growth of developments in the scientific field, the exhibition outgrew its university surroundings and has, in recent years, been staged in the two halls of the Royal Horticultural Society. Research and commercial exhibits have been merged but, while the rapid extension of electronic instrumentation has changed the outward appearance of some of the stands, many still contain 'rig-ups' and the atmosphere of the development laboratory.

University and commercial research laboratories have been reinforced by government research and development establishments and many instruments are shown for the first time at the Exhibition. Exhibitors and visitors are usually scientists or student scientists and the exhibition is an important vehicle for the exchange of new ideas between university, commercial and government research establishments.

It was interesting to compare the Physical Society Exhibition held in London in March with that of the Electrical Engineers, held at the same time at Earls Court. The Electrical Engineers' Exhibition showed the enormous development that has taken place in lighting with the introduction of electric discharge and especially of fluorescent lamps. The stands showed quite clearly that today the electrical industry has taken over responsibility for practically all artificial lighting. By comparison the stands in the Physical Society Exhibition were more crowded and data was often poorly displayed, but, as always, there were interesting experiments and developments. An important link between the two exhibitions is that many of the developments at the Physical Society Exhibition are the forerunners of lamps and lighting equipment shown later at specialist exhibitions such as the Electrical Engineers'.

Atomic Lamps and other Light Sources

Light source exhibits at the Physical Society Exhibition are generally limited to the latest invention, or to sources particularly suitable for research problems. This year the newest light source, which was shown, we believe, for the first time in this country, was the so-called 'atomic' lamp on the BTH stand (Fig. 1). This lamp consists of an approximately spherical bulb of 1 ml capacity (Fig. 2), internally coated with fluorescent powder with the exception of a small window. Beta radiation given out by the atomic fission of the tritium gas filling directly excites light from the fluorescent powders; this can be projected through the window on to a lens system (Diagram Fig. 2). On the day the exhibition opened one of the national papers reported the meeting of a town council at which it was suggested that these lamps should be installed at once in the local streetlighting columns. Our exhibit helped to put this in perspective. The lamps we showed had a predicted half life of 12 years but during this time dissipated only a total power of about 0·01 of a kilowatt hour at a rate of 80 microwatts. In spite of this low total power, special precautions had to be taken to transport and show the lamps to ensure that no radiation contamination could occur through leakage of gas. In the absence of any leakage the glass envelope prevents any danger since it will not transmit the beta radiation. Our experiments had been made jointly with Dr. Wilson at Harwell who lent us one of their lamps filled with krypton 85 gas. At the present state in their development these lamps could be used as marker points during darkness where the use of an electricity supply is undesirable or none is available.

Flashing light sources have helped many research studies. Examples of these were shown by BTH, Siemens Ediswan and Ferranti. Very powerful lamps of this type are now being developed. For example BTH showed a 15,000 joule xenon tube (Fig. 3) on their stand.

Some laboratory lamps were shown by the G.E.C., including a 4-volt krypton sub-standard lamp and a mercury discharge lamp containing only the 198 isotope, resulting in the production of the minimum line width for accurate spectroscopic calibrations. They also showed their versions of a number of items which the BTH Research Laboratory has shown in the past including a fluorescent black lamp, a tubular quartz lamp and a demonstration of solutions to a number of the problems encountered in the development of higher loading fluorescent lamps.

Studying new experiments to see whether they might one day lead to the discovery of new light sources, I was attracted by the water stabilized plasma jet arc shown by the Royal Aircraft Establishment. By making the water whirl in a jet inside a glass cylinder a cylindrical air space is formed through which an arc between carbons is formed. With a power of about 25 kilowatts, it is possible to obtain temperatures of some 12,000°K as gases and water vapour are ejected at speeds of several thousand feet per second for short periods. This might help further developments in arc lamps.

Lighting

A demonstration of many of the problems of colour tolerances in different industries, arranged by the Physical Society Colour Group, was of direct interest to lighting engineers. The difficulty of remembering colours was demonstrated by inviting visitors to memorize the colour of a sample of face powder which was included in a range of samples later in the exhibit. With the samples on different backgrounds the task was particularly difficult. I was also interested in the apparatus built by Dr. Crawford at the National Physical Laboratory in an attempt to investigate the problem of tolerances in the spectral distributions of light sources.

As usual, there were a number of light meters and colorimeters for special purposes.

Again I was interested to note the use of fluorescent tracers added to agricultural sprays to enable the distribution of these to be checked. Many special studies can be simplified by the use of fluorescent tracers and portable black lamps. For example, we have supplied fluorescent dyes for marking insects so that their movements can be studied in the fight against disease in Africa.

Allied Developments

To research and development workers, the attraction of the exhibition lies in its wide range of exhibits, which makes it difficult to pick highlights for a short review. I have selected four that attracted me.

(1) Rectifiers and Transistors

The main progress at the 42nd Exhibition was in the increasing use of practical rectifiers and transistors, particularly from germanium and silicon, which has resulted from the intensive studies in solid state physics. It is now possible to convert d.c. to high frequency a.c. without rotating machinery or vibrating contacts.

On the G.E.C. stand this year was a 40-watt fluorescent lamp operated in this way and providing 20-watts. Operation of lamps in this way at full wattage and over should be practicable soon.

Lower power units enabled us last year to operate electro-luminescent panels from small dry batteries.

(2) Modulated Light Sources

It was interesting to see cathode ray tubes being used as special light sources. The E.M.I. Log Electronic Photographic Printer used a cathode tube to provide the raster to illuminate the negative in an enlarger. A feedback system regulated the light intensity so that details could be printed, both for the highlights and the shadows—a valuable technique for examining X-ray photographs. A closed television system was shown by the Hatfield Instrument Company for gauging the true exposures required for coloured prints.

(3) Digital Computer Techniques

These were being applied to simple instrumentation. The skill necessary to read an instrument pointer accurately has been transferred from the operator to the instrument designer. Instruments were shown in which measurements to 0·1% accuracy would be indicated by large numbers; these would possibly help to speed routine testing in mass production.

(4) Photo-Electric Cells

Photo-electric cell developments have been closely allied to those of light sources, photo-electric cells being operated by light from lamps which they can also control according to natural light intensities. Simplification of photo-electric control is made possible by the introduction of cadmium sulphide photo-conductive cells as shown on the BTH stand. The material can be formed into a layer whose electrical characteristics can be matched to electro-luminescent panels.

Again, for the first time in this country, BTH demonstrated a single plate image converter unit. As shown in Fig. 4, an image in deep red radiation was projected on to the thin film of cadmium sulphide. This changed its electrical impedance according to the light intensity at each point. The electrical potential was thereby transferred from the cadmium sulphide to the electro-luminescent layer which consequently showed a visible light image corresponding to the almost invisible one falling on the barrier layer. In this way light can be amplified.

Once again, in bringing together advances over a wide range of physical and electrical techniques, the Physical Society Exhibition has served to stimulate progress in many fields, including lamps and lighting.

Fig. 1. An 'atomic' lamp which runs without electricity was shown on the BTH stand this year at the Physical Society Exhibition.

Fig. 3. A 15,000 joule Xenon tube shown on the BTH stand.

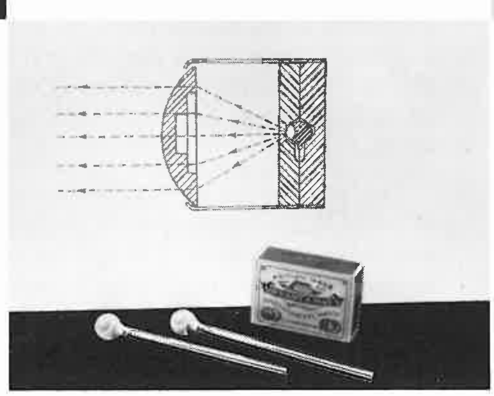
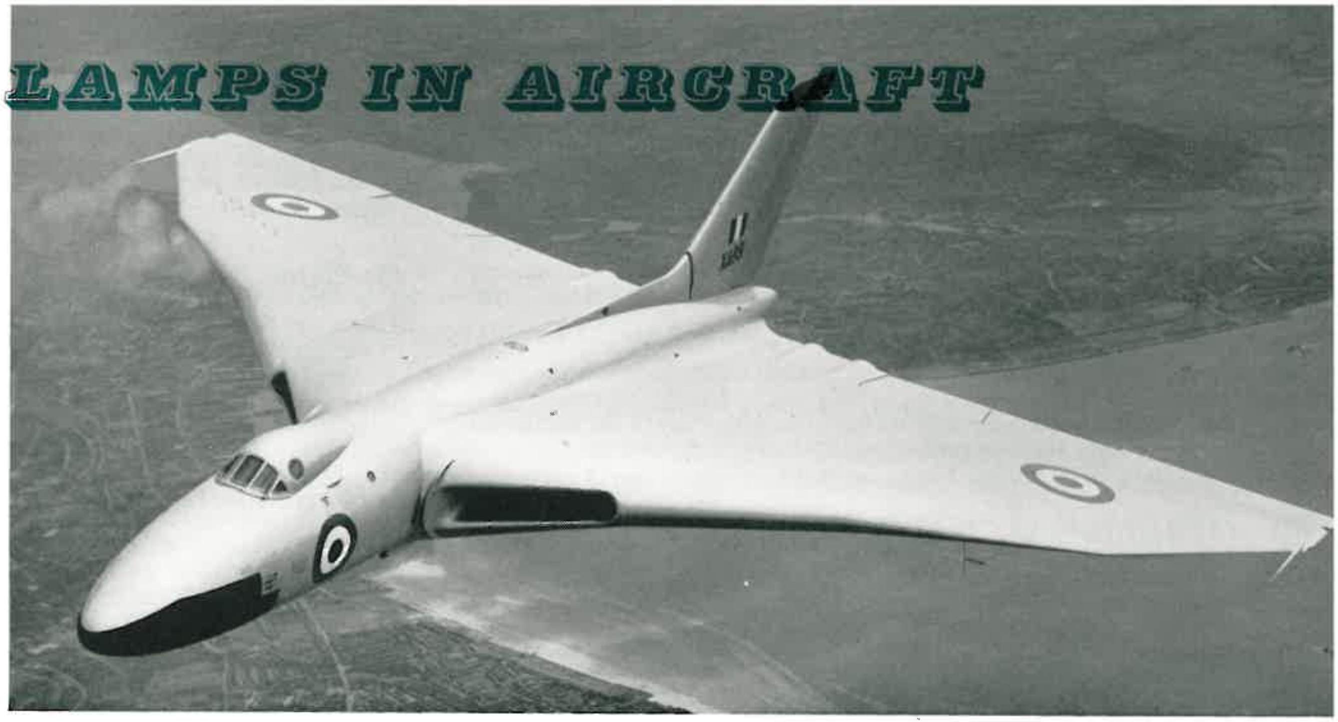


Fig. 2. Two 'atomic' lamp bulbs which have been coated internally with fluorescent powder. These bulbs when filled with radio-active gas may be used fitted in a housing of the type shown in the diagram.

Fig. 4. A demonstration of a method of amplifying light. The equipment is a single plate image converter (shown by BTH) using cadmium sulphate crystals.

MAZDA LAMPS IN AIRCRAFT



Right. The Avro Vulcan, one of the first 'planes to be fitted with tubular u.v. and fluorescent cockpit instrument lighting.

Below. A night view of the cockpit of a B.E.A. Vickers Viscount Type 802. Lighting is from one tubular u.v. discharge lamp placed centrally and a further lamp mounted vertically at each end of the instrument panel.

THE history of ultra-violet cockpit lighting goes back many years to the early days of the last war when the main requirements of cockpit lighting were that it should be: (a) adequate for the safe navigation of the aircraft; (b) of low enough intensity to avoid attracting the attention of the enemy; and (c) permit the crew's night adaptation to be maintained. It was found that the best way to attain this was to paint the instrument markings with fluorescent paint and to flood them with ultra-violet light. Only the pointer and the markings would be seen by the pilot and this could be dimmed down to a minimum as maximum night adaptation was reached.

The u.v. light was obtained from a tungsten lamp with an over-run filament, and the lamp was made with a Woods glass bulb to filter out all visible light.

This lamp, it will be realized, was not a satisfactory solution but in those days, it was adequate for the job. As well as being susceptible to vibration which resulted in a very short life, it was most inefficient, less than 0·2 per cent of the energy input to the lamp being emitted as useful light. Dimming was fairly easy, a simple variable series resistor being all that was required.

After the war u.v. continued to be used in aircraft, but it was found that the tungsten lamp, unless used in large numbers, did not give the higher instrument brightness which the civil aircraft required. The supply available in aircraft at the time was generally limited to 28 volt d.c. and experiments were made with a cathode glow lamp, visible light being eliminated by external Woods glass fittings. Whilst this lamp showed some improvement in efficiency it was not sufficient to warrant its general use.

When 110 volts d.c. supplies were introduced, consideration was given to the use of 4W 6-inch fluorescent lamps, and installations of both white and u.v. lamps of this type were made. It was not practical to dim these lamps on d.c., and mechanical methods were used, an example being a fixed and a movable cylinder with holes of varying spacings and diameters. By sliding one cylinder around the other, some control over the light emitted was possible.

As high frequency supplies were introduced into aircraft and became available for lighting purposes, the use of fluorescent lamps was again considered and with the co-operation of Messrs A. V. Roe, a circuit was developed for use in the 'Vulcan' and the 'Shackleton' to use white, u.v. and red 4W 6-inch fluorescent lamps. Later white and u.v. lighting was installed in the B.E.A. Viscount '800's' and u.v. lighting sets supplied for conversion of their '700' series Viscounts.

Lamps

In these installations the white and red tubes are standard 4W 6-inch MCF/U lamps, but the u.v. tube was specially made for this application and merits closer examination.

Dimensionally and in electrical characteristics, it is identical to the 4W 6-inch tubes, but the tube used in its construction is manufactured in specially dense Woods glass made and drawn in the A.E.I. Lamp and Lighting Company's glass works at Chesterfield. This glass is opaque through the visible range and has a narrow transmission band to u.v. at 3500Å.

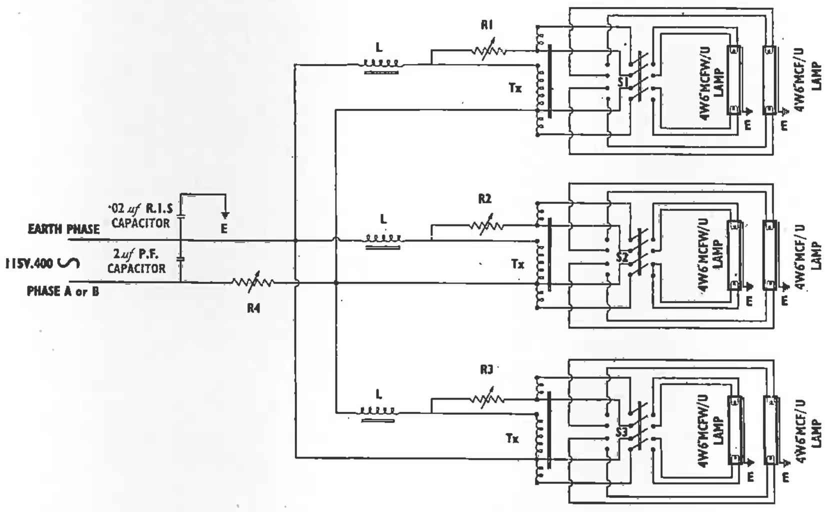
The inside of the tube is coated with a fluorescent powder which is activated by the short-wave u.v. in the discharge and emits long-wave u.v. radiation at about 3500Å. The energy of the lamp is therefore transmitted to and emitted in the safe long-wave u.v. bands and the small amount of visible light (amounting to about 2 per cent of the total energy) which originates in the u.v. discharge is filtered. The result is a u.v. source more than 100 times more efficient than the old type of tungsten filament lamp, a remarkable achievement considering the size and wattage of the lamp.

Circuit

The use of these lamps entails the incorporation into the circuit of controlling equipment, and the precise nature of this will vary according to the type of aircraft in which they are installed. Military aircraft require lamps to be smoothly dimmed over their entire range from the maximum brightness to extinction, but the maximum instrument brightness is not generally as high as that necessary for civil airlines, who do not generally consider dimming to extinction a necessary requirement.

Early circuit experiments were made with wire wound dimmers, but because of the electrical characteristics of the circuit they proved to be so large that they were unacceptable, and a rotary stud switch with fixed resistors was ultimately used. A typical circuit diagram is illustrated. This circuit can be used to control three u.v. or three white fluorescent lamps from the same dimmer by the use of a 12-pole selector switch. This switch is marked S.1, S.2 and S.3 in the diagram.

Four sets of variable resistors are ganged together in banks on stud plates which are wiped by arms fixed to the spindle of the controlling



Circuit for controlling and dimming three 4W 6-inch lamps on 115V 400 cycles supply.

U.V. COCKPIT LIGHTING

dimmer. One bank of these is arranged in series with the three individual lamp circuits in parallel, one of each of the other three resistor banks, are arranged in series with the individual lamp circuits. These are marked R.4, and R.1, R.2 and R.3 respectively on the diagram.

When the lamps are first switched on, R.4 has its full resistance and R.1, R.2 and R.3 are open circuit. R.4 therefore controls the current flowing in the transformer primaries and the current flowing through the lamp cathodes. As R.1, R.2 and R.3 are open circuit, no voltage appears across the lamp and the ends glow in the manner of a cathode glow lamp. As the resistance of R.4 is decreased, so the brightness of the lamp ends will increase until a point is reached where R4 has no resistance and the lamp cathodes are passing their maximum current.

As the dimmer is revolved further, R.1, R.2 and R.3 are brought into the circuit at maximum resistance, volts appear across the lamp and the arc strikes immediately. As the resistance decreases, the lamp becomes progressively brighter until a point is reached where the circuit has no resistance and the lamp arc current is limited by the choke 'L'. During this stage the transformer primary winding and the lamp are in parallel, with the choke in series with them. As the arc current increases, the volts across the choke increase and the volts to the transformer primary decrease, thus reducing the voltage across the cathodes and the heater current flowing through them.

Future Trends

Pilots are now required to fly in conditions of increasing glare. The brightness of lights at airports is increasing and instrument brightness must be increased to allow them to be clearly visible to a pilot as he glances from the ground to them. Other glare conditions arise when aircraft are flying at high altitudes over white clouds in sunlight. Pilots find it necessary to wear sunglasses under such conditions and the instruments must still be readable.

Recently instrument brightnesses in the region of 100 ft. lamberts have been mentioned as necessary to combat these conditions and it is probable that a u.v. lighting system of this type will provide the answer. Ordinary white floodlighting would be adequate to meet conditions of daytime glare but this is not practical for night flying.

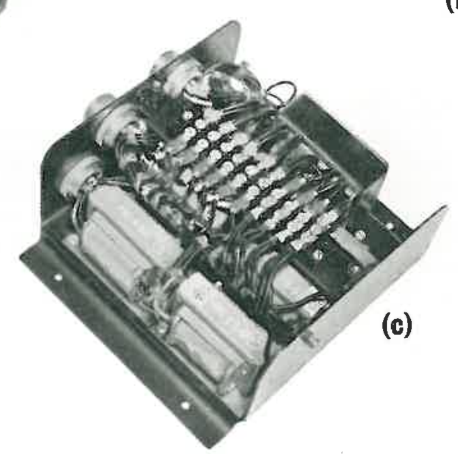
a. Rotary stud dimmer switch and housing designed by Vickers Armstrong (Aircraft) Ltd.

b. Lamp housing designed by Vickers Armstrong to take one white and one u.v. 4W 6-inch lamp. Red floodlights are mounted in the housing at each end of the fitting.

c. Control box containing three Mazda MR 524 chokes and three Mazda MD 442 transformers and all associated equipment.

(a)

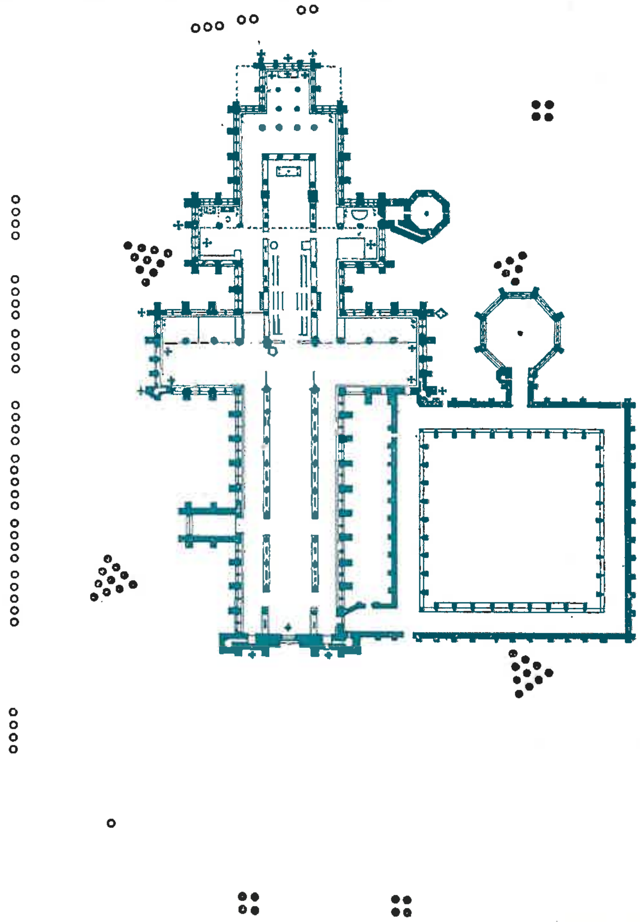
(b)



(c)

SALISBURY 7th CENTENARY

By S. G. H. Hoddinott



An almost perfect instance of medieval skill and inspiration in building in the Gothic style, Salisbury Cathedral was consecrated in 1258—38 years after the first stone was laid. In connection with the 7th centenary celebrations it was decided that the Cathedral should be floodlit for a period of six months, commencing on Easter Sunday, and the A.E.I. Lamp and Lighting Company was given the task of carrying this out and of supervising the electrical installation by the Southern Electricity Board, Salisbury.

Of the many and varied problems which confront the lighting engineer, probably those connected with floodlighting prove, ultimately, to be the most rewarding. In this particular field, his efforts are creative—he becomes, as it were, an artist painting a picture. When, as in this instance, the subject is one of character and antiquity, the work is all the more fascinating.

The setting of Salisbury Cathedral is one of the most beautiful in Britain. It is surrounded by a magnificent green and Close, and so situated in a valley that the tower and 404 ft. high spire can be seen for miles from the high ground surrounding the city.

Throughout the centuries the church spire has been a symbol—a finger pointing to the heavens—and in recognition of this, it was decided that the spire should be the focal point when the building was floodlit and that it should be emphasized by greater brightness than the rest of the cathedral. This decision, while easily made, was less easy to implement due to the great height of the spire and the extent of the green surrounding three sides of the cathedral.

Tower and Spire

In order to reduce the waste light factor to a mimum, it was necessary to use a floodlight with as narrow a beam as possible, consistent with maximum efficiency and of compact design and small size—the latter because of the considerable number of units required for each main bank. For this purpose the Mazda M. 25 High Tower floodlight was ideally suited, having a main beam angle of 23°. It follows that this angle had a direct bearing on the angle of deflection if maximum coverage was to be obtained—a most important factor in the calculations.

Owing to obstructions in line with the four faces of the tower, it was necessary to project to the corners and this, of course, helped to provide wider coverage. The north-east and north-west sitings are in banks of ten 1500 watt projectors at ground level. The south-east bank is split into one of six units and another of four, the tower section being more to the south to project up between two low-level obstructions. The south-west bank is positioned on the west cloister roof to avoid a large tree in the centre of the cloisters.

To calculate the number of floodlights to each bank, brightness levels, based on the anticipated reflection factor of the stonework, were predetermined at set vertical intervals. The candlepower to be directed at each of these positions was calculated from the basic formula $I = \frac{EH}{Cos^3 \theta}$ and the approximate total number of floodlights necessary was found by careful plotting of intensities. In theory it would have been possible to obtain the same brightness at the top of the spire as at the base of the tower but, of course, the waste light factor and the electrical loading would have been considerable. It was therefore necessary to effect a slight tapering off. However, the spire is more weathered, making its reflection factor higher than the main fabric. It is nevertheless interesting to note that of the 60 kW projected, 18 kW were used to light the 100 ft. tower and the remaining 42 kW on the narrow, tapering 200 ft. spire.

The Main Fabric of the Cathedral

The large area of green surrounding the cathedral is used considerably by citizens and visitors during the summer months and this made it necessary, from the aesthetic viewpoint and to avoid obstruction, to site the projectors lighting the fabric as far back as possible. This introduced a further problem in that the public would be viewing the cathedral from three sides and it was important to avoid glare. A.E.I. low-surface brightness projectors with a narrow vertical and wide horizontal throw have been used, and have proved to be almost ideal. A combination of clear and bowl-frosted lamps are used to get the best results from the Chilmark stone from which the cathedral is built. This stone is lichen-covered in places and has aged to a colour which varies with the weather. In wet weather it darkens and is not an easy subject to floodlight.

The west front required a particularly dramatic effect in order to bring out the many statues and tracery which have weathered to a variety of shades and tints. This face, which is comparatively small, is lighted by M. 25 units with which it is possible to provide a concentrated effect with a minimum of waste light. Here it was also found that bowl-frosted lamps produced the best effect.

In all, the east, west and north faces were covered by a total of 41 low brightness and 9 M. 25 floodlights, each housing a Mazda 1500 watt lamp, giving a loading of 75 kW. The overall load for the whole building, with the exception of the hidden south face, which was not floodlit, was 135 kW.

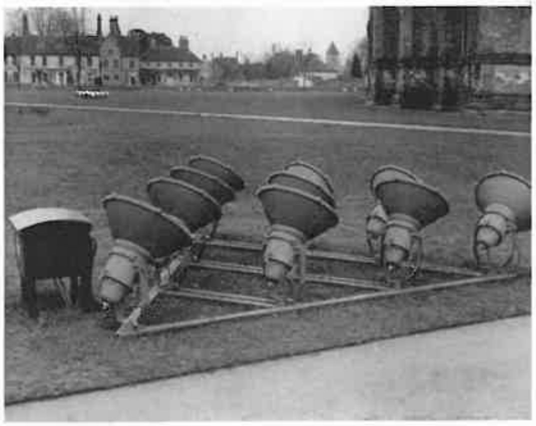
Installation

Approximately four miles of varying sizes of cables were installed. It was fortunate that the Southern Electricity Board with instances such as this in mind, had had the foresight to install a substation within the precincts of the Close. From this a permanent main cable was fed to the control point in the north-west corner of the green. The switching is by time-clock operating a BTH 300-amp triple-pole contactor feeding into a multi-way switched fuse which in turn feeds the sub-distribution points.

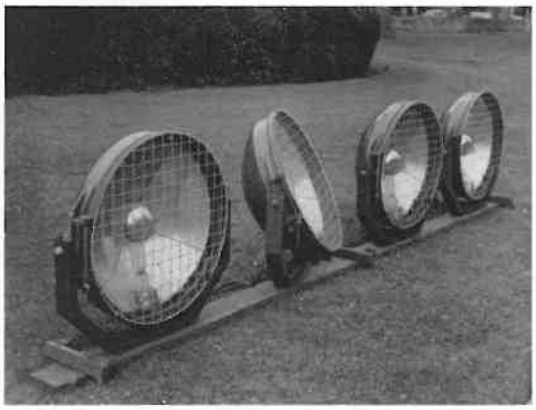
In view of the temporary nature of the floodlighting, it was decided merely to lift the turf and lay P.V.C. covered cable in a shallow trench beneath. The turf was lifted by the cathedral Clerk of Works Department who also made the small wooden boxes on legs christened 'beehives', which house fixed 13-amp plugs and sockets for the individual floodlight feeds. The floodlights for the tower and spire were mounted on Dexion frames in triangular formation. The larger area floodlights were fixed in banks of four or five to wooden plinths at 60 ft. intervals and pegged to the ground by two-foot wooden stakes.

The project was first mooted in late January and the Southern Electricity Board had the installation ready for final testing and adjustment by the third week in March. All concerned were no doubt inspired by the majesty of the building in the shadow of which they were working.

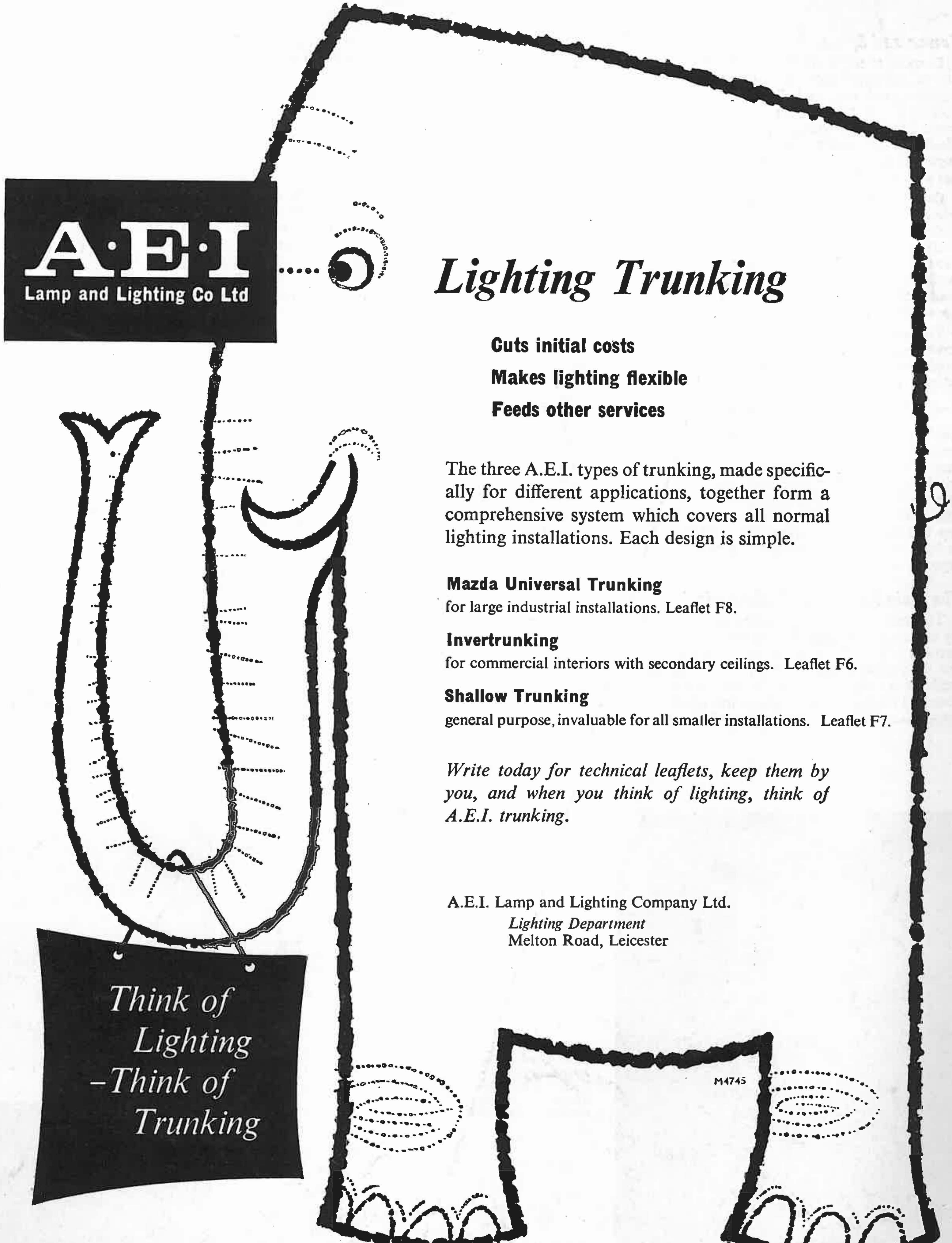
A photograph taken from the point chosen by Constable for his famous painting, 'Salisbury Cathedral from the River'. The passage of time has not much altered the setting.



A closely-spaced triangle of ten high tower, narrow-beam floodlights near the base of the building lighting the tower and the spire. Note the 'Beehive' distributor box.



Set well back from the building, low-surface brightness projectors are used to light most of the main fabric of the Cathedral.



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