Lighting Journal 20

Very truly yours
Joseph W. Swan

Swan Centenary
1879-1979

9 **BULB No. 6** (FAIRY).

One Candle-power, E.M.F. 2-8 volts.

Price - - - 3/9 each.

Fig. 4.
FULL SIZE.

10 **BULB No. 5.**

2½ Candle-power, E.M.F. 5-8 volts.

Price - - - 3/9 each.

Fig. 5.
FULL SIZE.

11 **BULB No. 4.**

2½ Candle-power, E.M.F. 9-35 volts.
5 ,, ,, ,, 10-20 ,,

Price - - - 3/9 each.

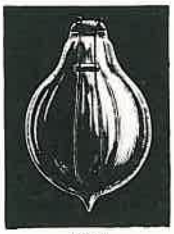

Fig. 6
FULL SIZE.

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14 **BULB No. 2.**

This Bulb is used for a large variety of Lamps, a list of which is given below.

8 Candle-power .. 41-120 Volts.
16 ,, ,, .. 41-160 ,,

Price of 8 & 16 C.P. 3/9 each.
,, 25 & 32 ,, 4/- ,,

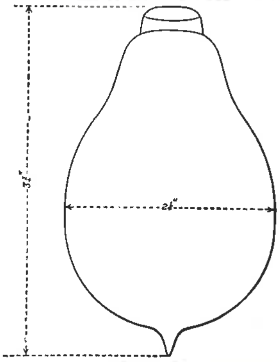

Fig. 9.
FULL SIZE

15 **BULB No. 1.**

This Bulb is used for 50 Candle-power Lamps, 80-105 Volts, and a few of the 25 & 32 C.P. Lamps.

Prices, 25 & 32 C.P. ... 4/- each.
,, 50 C.P. ... 5/- ,,

NOTE.—The Company recommend 50 C.P. Lamps to be used with Lug Terminals in preference to Caps of any kind fixed with plaster. For suitable Holders see page 66, par. 77.

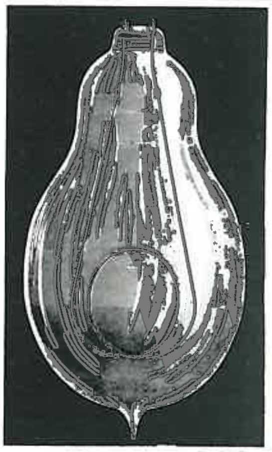

Fig. 10.
FULL SIZE.

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18 **200 C.P. LAMP.**

The accompanying Engraving represents the style in which the 200 c.p. Lamps are made.

Lamps of low Voltage would not have a curl in the filament.

Standard Voltages and Prices of these Lamps will be found in the Table, paragraph 4.

For Holders see paragraph 78, Fittings Section.

Fig. 12.
ABOUT HALF ACTUAL SIZE.

19 **300 C.P. LAMPS.**

The Filaments of these Lamps are similar in appearance to the 200 c.p. Lamp described above (Fig. 12), the Bulb being of the same size as that represented by Fig. 13.

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20 **500 C.P LAMP.**

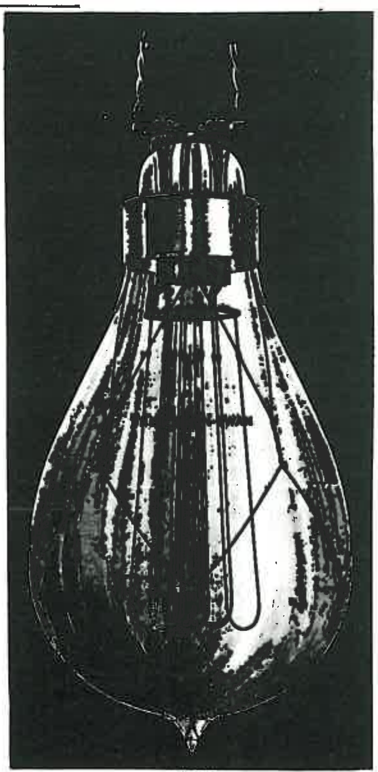

Fig. 13.
ABOUT HALF ACTUAL SIZE.

Lighting Journal 20

Spring 1979

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This issue of LIGHTING JOURNAL coincides with the centenary of the invention of the incandescent lamp on which the whole lamp industry throughout the world was founded. Techniques both of lamp-making and the application of lamps have changed almost out of recognition since those far-off days, but the names of Swan in this country and Edison in America are still remembered as the pioneers of the industry. Today improvements and innovations are more likely to be the work of a team than of a single brilliant individual, but progress both in lamp making and lighting technique still continues, as witnessed by articles dealing with such diverse subjects as the design of the latest type of tungsten halogen lamp for car headlights, office lighting problems and the floodlighting of football and sports clubs and the use of light in dental technology.

One of the oldest art forms to make use of light is that of stained glass. Today this form of decoration is no longer confined to churches, but can be found in large prestige office blocks, in town halls and even occasionally in domestic settings. Martin Harrison, himself a well-known practitioner of the art, describes how it appears in the 20th century, and Robin Aldworth shows how it can be lit.

In this the 20th issue of the Journal, we have made some innovations. We have changed the type-face; we have doubled the number of pages on which coloured illustrations appear and we have added Swedish to the language into which resumés of the principle articles are translated. We would welcome your reactions to the 'new look'. The only time the present editor received any correspondence from readers was when he confused the roses of Lancaster and York. We would like to hear from you, and might even publish your letters, although that might necessitate increasing the number of pages.

The portrait of Sir Joseph Swan, at about the time he developed his incandescent lamp, on our front cover, is used by the courtesy of the Science Museum. Opposite are four pages from an Edison-Swan catalogue of 1892.

Contents

Pioneers

Why is it that the names of Swan and Edison stand out as the major pioneers of the modern electric lamp industry, and what is their connection with Thorn Lighting? They did not demonstrate the first controlled production of light from electricity. Hawksby in 1700 was the first, using frictional electricity to produce light from a glow discharge in an imperfect vacuum.

The demonstration of a carbon arc by Sir Humphrey Davy at the Royal Institution in London in 1810, made possible by building a large chemical battery of cells, first fired the enthusiasm for electric lighting. This battery, the first source of continuous electric current available to experimenters, was expensive and could only operate the arc for a short time, but the blaze of light, with a luminous efficacy probably 100 times that of the flames normally in use, emphasised its potential.

Michael Faraday

The discovery by Michael Faraday, Davy's successor at the Royal Institution, of electro-magnetic induction led to the development of an electric power industry, to supply arc lamps used for street lighting. This led to the establishment of the first power stations and the consequent availability of electricity stimulated the search for a suitable electric lamp to use inside buildings.

Many of the scientific papers were concerned with "The sub-division of the electric arc" which led to a renewed interest in incandescence. Platinum and carbon were the preferred materials with carbon the favourite in view of its high melting temperature and low cost.

Swan, Sprengel and Stearn

Swan and Edison did not submit the first patents on a carbon lamp. Starr in 1845 patented the use of a rod of carbon in a vacuum. It is almost certain that it was this patent that inspired Swan to begin his series of research experiments. He realised that to achieve his objectives of making a small power light source, it was necessary to reduce the size of the carbon from rods to filaments.

Although the development of electric incandescent lamps has come about through the elimination of combustion, as a legacy from the many thousands of years of use of flames as light sources, the lives of lamps, even today, are expressed in terms of burning hours. The term "burning" was still strongly applicable to the early lamps of Swan and other researchers. The weak link in their techniques was the imperfect vacuum, so that incandescence and burning occurred together, the carbon combining with residual oxygen.

The door to the construction of a non-burning lamp was opened in 1865, when Sprengel invented a vacuum pump far superior to any then available. Impressed by the success of Sir William Crookes in using and improving the pump for his experiments on discharges in vacuo, the results of which were published in 1875, Swan redoubled his efforts, being joined by C. H. Stearn, the forerunner of the modern technician, who provided the manipulative techniques.

Meanwhile Edison, in America, had built the first of the great industrial research laboratories. He realised that it needed teams of specialists to perfect an initial invention, and he had already made many important inventions being known as the "Wizard of Menlo Park". Also inspired by Crookes' success, he recruited Ludwig Boehm, a glassblower from Geissler in Germany and in 1877 entered the contest to produce a practical carbon lamp.

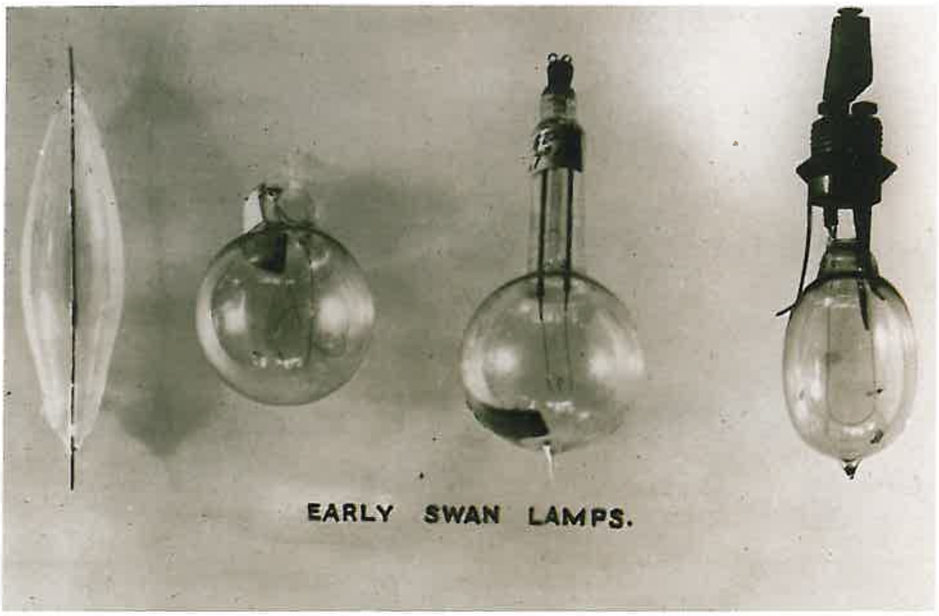
A drawing of Sir Joseph Swan, made by M. Agnes Cohen in 1894. Born in 1828, he was 86 when he died. By permission of the National Portrait Gallery.

Swan's First Lamps

Swan first announced his achievements on the 3rd February 1879, in the theatre of The Literary & Philosophical Institute of Newcastle. In a lecture in Newcastle the following October 70 gas jets were simultaneously extinguished and with truly dramatic effect, 20 Swan lamps transformed darkness into light.

Progress was rapid.Commercial production was started at Benwell near Newcastle, and by the close of 1881 an associated factory was making Swan lamps in France. They were installed in H.M.S. Inflexible, the liner City of Richmond and a railway saloon on the London to Brighton line. This year also witnessed the installation of Swan lamps in the House of Commons, and the following year found them in the

Some early Swan lamps. Swan's original lamp is on the left of the group.



# of Lighting

H. R. Ruff

Mr. Ruff is a Lighting Consultant and formerly Head of AEI Lamp and Lighting Research for AEI Lamp and Lighting Ltd and British Lighting Industries Ltd.

This drawing of Thomas Alva Edison is based on a photograph taken in his laboratory towards the end of his life. He was 32 years old when he produced his incandescent lamp and died in 1931.

Mansion House, the British Museum and the Royal Academy. 1882 also marked the advent of electric theatre lighting using filament lamps; the stage of the Savoy Theatre was lit by 824 Swan lamps, and 370 were used elsewhere in the theatre. Miniature lamps were even attached to the performers themselves during a production of Iolanthe.

Edison Enters the Lists

Meanwhile Edison, too, had made rapid progress, studying not only the making of the lamps but also their system of operation and recommending parallel operation from a constant voltage supply while Swan was still suggesting series operation of lower voltage lamps.

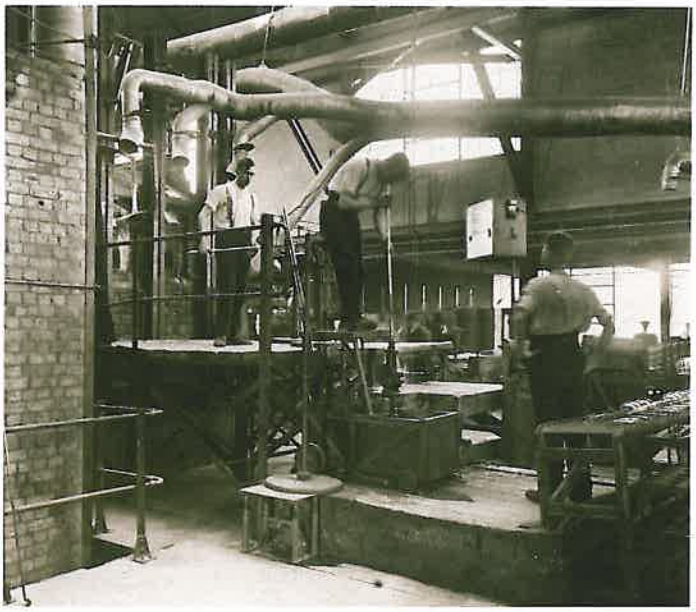
Both had found independently that it was essential to pass current through the filament and heat the glass bulb nearly to softening point while evacuating it to get rid of occluded gas and to ensure a vacuum during life.

In November 1879 Edison took out a British patent for a carbon filament lamp. Swan did not apply for a patent until 1880. As soon as the success of the techniques developed by Swan and Edison was realised, claims were made by many who had worked on aspects of the problem. Many law suits were started for the prize of patent protection and it appeared that the two main contenders would be Swan and Edison. But by a stroke of genius they happily composed their difference in an agreement that was represented in Britain by the Company bearing their joint names, Edison Swan.

Combined Operations

The contributions of Swan and Edison to the continued development of the carbon lamp emphasised their complementary natures. The achievements of the research chemist supplemented the ingenuity of the entrepreneur inventor backed by sound research and engineering. The filaments of early lamps were carbonised natural fibres. Having found by experiment that a bamboo strip fibre made his best experimental lamp, Edison sent expeditions to China, Japan, the Amazon valley, India and other remote places to see if there existed still better materials. A particular type of Japanese bamboo was found to be most satisfactory and for many years was cultivated specially for him by a Japanese farmer. But Swan was a chemist, and his main line of research, undertaken for Courtaulds, was into the production of artificial silk. He decided that a uniform man-made thread would be preferable to the bamboo as a basis for the filament. His invention in 1883 of squirted nitro-cellulose carbon thread, not only formed the basis of later carbon

In 1910, tungsten filament lamps were still assembled by hand and the bulbs blown individually, shown below; a typical industrial installation of the time is shown in the upper right-hand picture.



Blowing the glass tubing for fluorescent lamps was still a craft operation in the forties. The lamps themselves were assembled by hand. The picture shows capping and ageing lamps.

filaments, but also laid the foundation of the modern business of artificial silk manufacture. In 1885 he showed some crocheted examples of these fibres under the description of artificial silk.

A New Industry

The world-wide development of electric lighting stimulated the development of the whole electric power industry because of the economic necessity to use expensive power driven machinery as long as possible. Competing power companies, anxious to absorb each other, over-ordered generating equipment; then strove by selling motors and lamps to build up the use of electricity. Two giants, the General Electric Co. and Westinghouse Electric, emerged at the beginning of this century. Based on the Edison-Swan patents, General Electric dominated the lamp industry in America and indeed the world. Under agreement with the General Electric Co. Schenectady, the British Thomson Houston Company (BTH) of Rugby, then mainly interested in manufacturing heavy industrial machinery, had the right to use all lamp patents and trade names. To balance their power equipment factory, they built a lamp factory and started carbon filament lamp manufacture. In 1910 they marketed one of the first tungsten filament lamps under the trade name of Mazda.

Gas Filled Lamps and Fluorescent Tubes

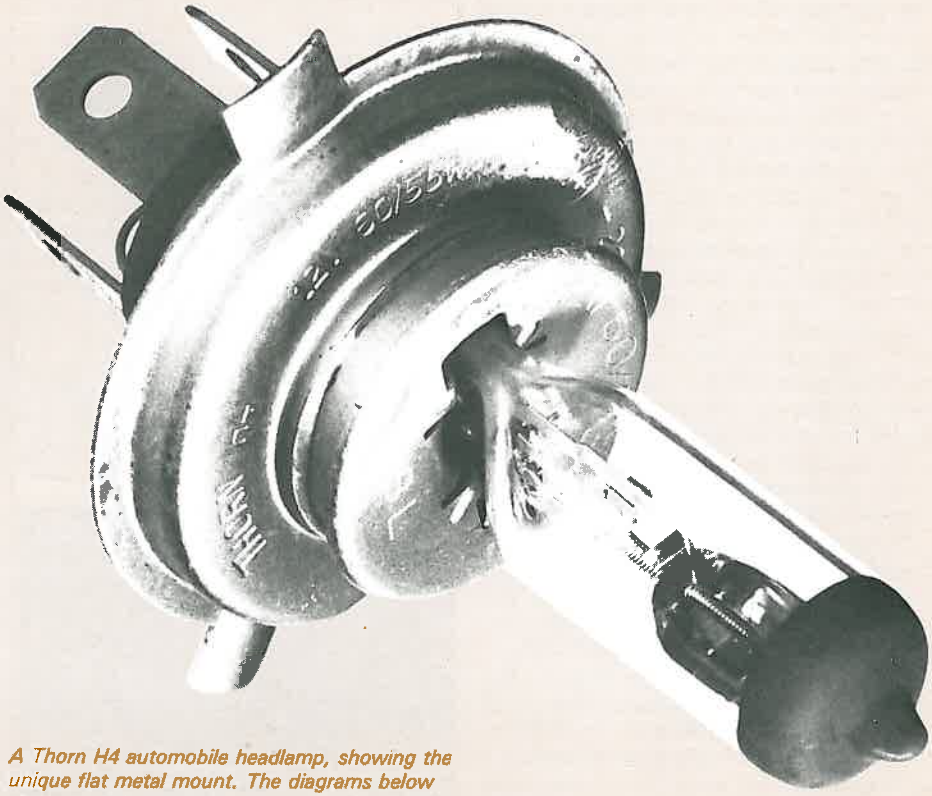
Gas filling of the lamp bulb followed in the middle 'twenties and in the 'thirties the research laboratories of the BTH, Metropolitan Vickers and Ediswan at Rugby were concerned in the development of mercury and sodium discharge lamps. Used mainly for street lighting their colour was less than satisfactory for other purposes and this led to research into the tubular fluorescent lamp.

The threat of war and blackout resulted in a concentration of effort to develop the largest practical unit for factory operation and a 5ft 80W tube was introduced in March 1940. While many special lamps were developed to assist the war effort, this was probably the outstanding contribution of the industry, since it was installed for most production factories.

The postwar surge of activity saw the rapid extension in the range of sizes and colours of fluorescent tubes. Investment of large amounts of capital were needed for the production of tubing, requiring a large manufacturing unit which could supply a major proportion of the demand. Thorn installed such a system in Atlas Lighting and to make this move economic the joint company British Lighting Industries was formed amalgamating the resources of the AEI Lamp & Lighting Company and Thorn. Thus the lamp laboratories at Leicester and the lighting laboratories at Enfield are descended directly from Swan and Edison the pioneers of the industry.

During the war years, localised fluorescent lighting was often used to highlight intricate industrial processes.

H4 Automobile Lamp Technology



A Thorn H4 automobile headlamp, showing the unique flat metal mount. The diagrams below show how the filaments are located in relation to the headlight reflector.

K. R. Wolfe

Manager Tungsten Halogen Lamp Engineering Department, Leicester

Introduction

Perhaps the most important development in headlamp design since the twenties is the introduction of the tungsten halogen, or as it is called in the motor trade, the quartz iodine lamp. Twin filament headlamp bulbs to produce a dipping beam have been with us for a number of years; the standard H4 tungsten halogen version has made it possible to combine good visibility with very low glare levels when used in the appropriate reflector.

The ratification of ECE Regulation 20 requires that the manufacturers of tungsten halogen lamps should tighten the specification of their product, thereby achieving a higher performance from the headlamp unit. The ability to achieve this precision, together with high production rates, presented a difficult proposition when applied to welded components in the form of round wire materials. The unique flat material mount construction evolved by Thorn has solved many of these difficulties and resulted in a more robust and reliable lamp for the consumer.

General Design Concept

The H4 lamp employs the tungsten halogen principle, ensuring constant light output throughout the life of the lamp and an increase in source brightness compared to a conventional headlamp bulb which substantially improves the range of the headlight, both on driving and passing beam. It has two filaments, positioned axially with respect to the headlamp reflector. The focal point of the reflector falls between the filaments but is biased towards the end turn of the filament used to produce the driving beam, that nearest to the lamp cap. This filament, positioned off axis, gives the required angular lift to the hot spot (Fig. 1a). The passing beam filament is positioned in front of the focal point of the reflector and is within a shield, placed so as to produce the asymmetric passing beam by occluding the lower half of the reflector, thus minimising upward light (Fig. 1b).

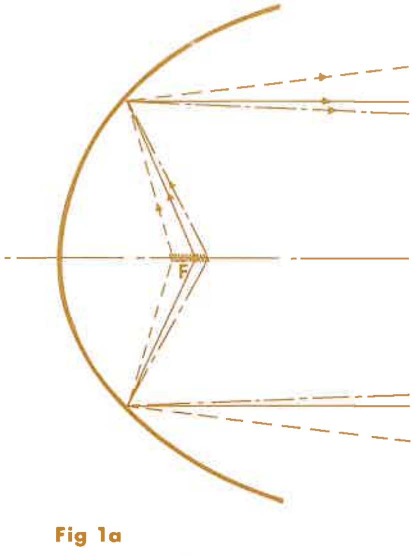


Fig 1a

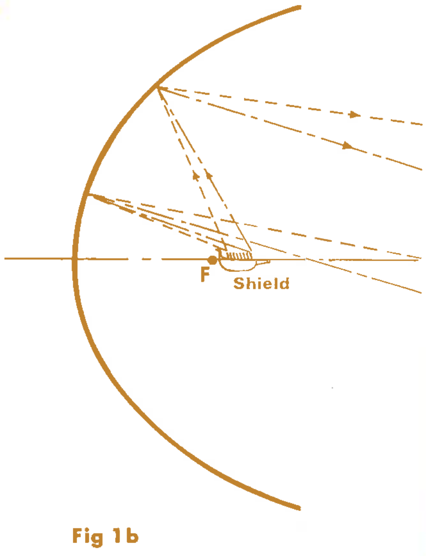


Fig 1b

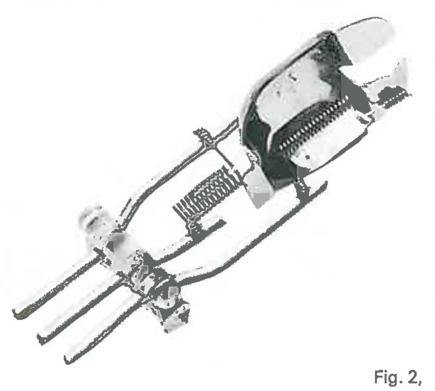


Fig. 2,

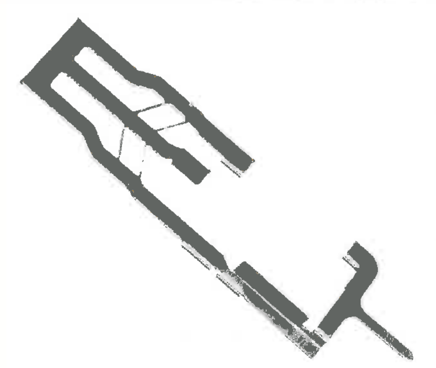


Fig. 3,

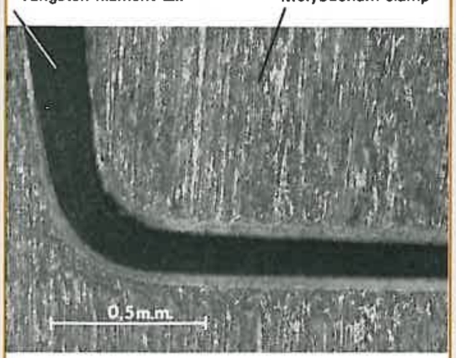


Fig. 5a,

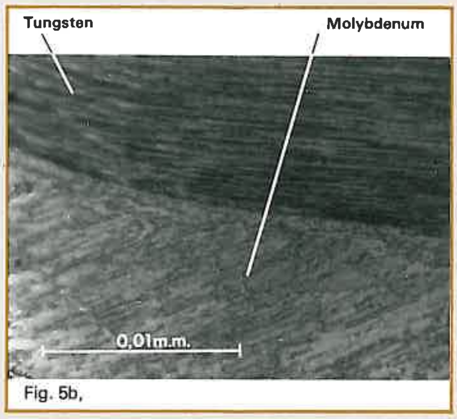


Fig. 5b,

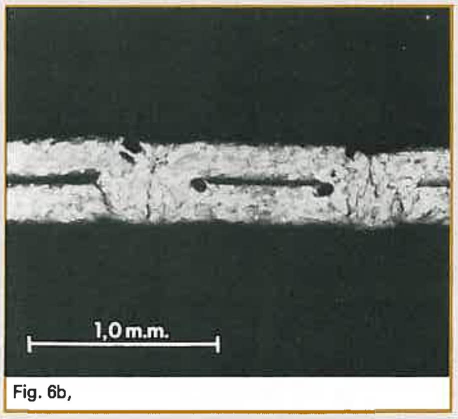


Fig. 6b,

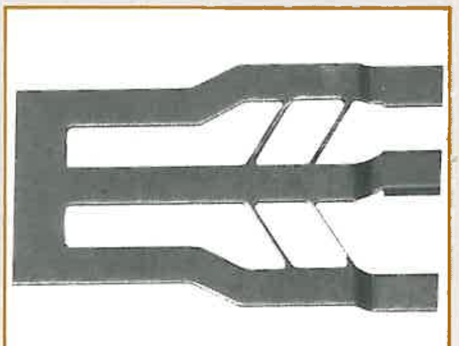


Fig. 7,

The Filament Support Frame

The use of sheet metal as the filament support enables internal reference planes to be established more easily and accurately than when round wire supports are used (Fig. 2). This results in a more economical production process with demands on the inspection criteria reduced to a minimum. It has several other advantages. The filament tails can be clamped instead of being welded, thus increasing the positional accuracy of the filament, minimising re-handling due to faulty welding and avoiding the use of intermediate rare metal fluxes such as platinum. Thin metal bridges between each leg of the frame eliminate the costly quartz bridge, which was previously required to maintain the rigidity of the wire mount during the sealing-in process. Finally, the use of a fabricated 'sheet' frame has greatly simplified the problem of attaching the dipped filament shield. The introduction of laser welding has again reduced shrinkage rates and avoided the use of platinum based fluxes.

Construction

The basic mount frame is stamped from molybdenum strip, a refractory metal with a fibrous crystalline structure. The grain formation is directionally controlled to assist the work involved in subsequent clamping or bending operations. As the mount is formed, the base is bent at right angles to form a positive reference plane for the axial location of the components (Fig. 3) this also ensures rigidity of the mounting surface, which, because it is flat, obscures the light from the driving filament less than would a round wire. The two filaments and the shield are automatically located and assembled to the mount structure, the filaments by clamping and the shield by welding, while still maintaining the established reference planes (Fig. 4). Each mechanical operation is thus simplified and automated, reducing the time spent on assembly and assuring accurate positioning of the components.

Filament Support Material

The types of materials that can be used in halogen lamps are very limited because of the highly reactive nature of the compounds formed in the halogen cycle. Extensive testing has established that a molybdenum framework with tungsten filaments can be used within a quartz bulb, providing the bulb has a relatively low power volume loading.

Molybdenum and tungsten are brittle metals. This is because their crystalline structure is granular; but when the first is rolled and the second drawn into a filament the arrangement of the crystals is changed to a much stronger fibrous form. Heating molybdenum to over 1300°C or tungsten to over 2300°C makes them revert to their original state, which may lead to fracture in service conditions. Consequently, clamping the filament tails to the frame eliminates the problem of embrittlement posed by the conventional welding technique.

Filament Clamping

The degree of contact obtained with a clamped joint can be seen in Fig. 5. The fibrous crystalline structure of the molybdenum is readily visible in the photomicrographs. Fig. 5a shows how the contact area within the clamp is increased by the cranked filament tail, while Fig. 5b shows an enlargement of the clamped area, revealing the intimate contact of the filament tail and frame.

Shield Welding

Both filament clamping and shield welding are carried out together on a rotary mount machine. The shield is located under pressure on to the appropriate frame 'tab' and is welded directly to the frame at two points. A neodymium-glass pulsed laser, together with a suitable optical system, is used for the welding operation. The laser beam is focussed on to the back of the frame 'tab' and penetrates through the molybdenum frame and into the shield. The power required to achieve this is

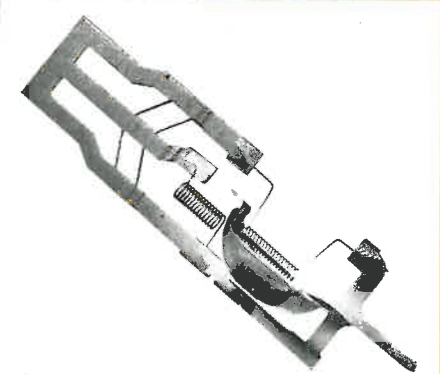


Fig. 4,

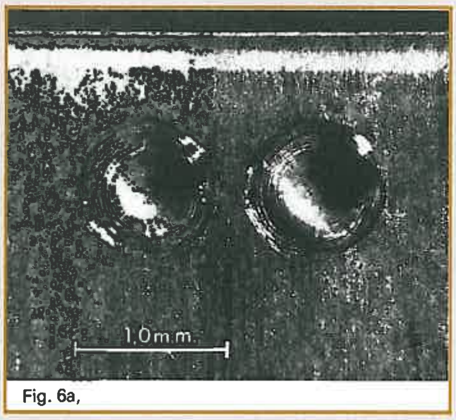


Fig. 6a,

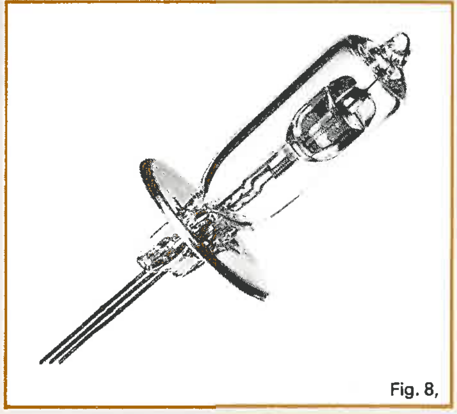


Fig. 8,

approximately twenty joules and this is spread over a pulse duration of several milliseconds. Argon is flushed around the weld area to eliminate oxide and nitride formation, which could seriously degrade the weld quality. The laser welds are illustrated in Figures 6a and 6b.

Bridge Fusing

As stated previously, a bridge piece is needed during the assembly of the filaments to maintain the rigidity of the frame. In lamps using wire filament supports, this takes the form of a comparatively heavy quartz bridge which remains in situ in the finished lamp, but in the flat metal frame, this support is formed from the structure, and must be removed after the assembly is completed. The bridge area of the frame is shown in Fig. 7. Before the lamp can be lighted, these bridges must be removed by controlled fusing using a low voltage current source.

To avoid current damage occurring to the pinch seal assembly by the low resistance circuit, the dimensional control of the bridge and pinch foil cross-section is critical. In the cold state, the effective circuit resistance offered by the foils is very similar to that of the bridge, so that pinch damage can occur. Preheating of the bridge area-serves a useful purpose by increasing the resistivity of the bridge structure so that the resistive heating effect of the low voltage fusing current is concentrated in the bridges themselves. The localised preheating also has the effect of reducing the violence of the fusing process. The molybdenum simply forms a ball structure on the ends of the fused bridges, effectively containing the molten molybdenum and preventing contamination.

Localised Preheating

A conventional industrial radio frequency oscillator is used to produce the localised preheating. The bridge structure is specially designed for inducing radio frequency circulating currents, providing that the axis of the r.f. field is at right angles to both the plane of the frame and the lamp axis. If the r.f. field is confined to pass through the area defined by the bridge structure, a high degree of flux linkage can be achieved, thus ensuring rapid and economical heating of the bridges.

In order to achieve a sufficiently concentrated and localised field, an r.f. susceptor coil is used, together with a ferrite core. Using this arrangement, approximately one and a half seconds are required to heat the bridges to dull red heat. The two sets of bridges are then fused sequentially to prevent over-volting of the filaments.

Capping and Focussing

The method of capping this design involves the use of a three lug cap known as the G16t. A mechanical location of the cap on the pinch, while difficult to obtain, has been found possible. A specially shaped metal lid is pushed over the base of the lamp capsule so that it locks in position (Fig. 8). The lid is then crimped to the cap barrel.

As with all lamps used on projection systems, the positioning of a flange to be soldered at a precise distance from a specified point on the filament (called the "light centre length"), and the specified orientation of the shield, are among the finishing operations. The effectiveness and indeed the practicality of this operation depends upon the characteristics of the mount prior to the capping operation. While visual techniques are at present the most acceptable means of control, albeit limited on final speed, some success is being achieved with automatic focussing.

Requirements of Process Control

The established reference planes, inherent in the flat frame construction, can all be related to the external flange which forms the location and seating plane of the finished lamp. The planes thus produced form the basis of component location for automatic production. The accurately formed frame can be adequately positioned and secured by means of the available flat surfaces, the area and width of which give sufficient tolerance of the filament tail position to allow automatic clamping. The automatic welding of the reflector also gives greater strength and accuracy compared to welding on to a round wire frame, which has to rely on welding electrode location for positional accuracy. Control of the machine setting is possible during manufacture, ensuring a very high degree of product uniformity and simplifying sampling procedures. A much less complicated inspection routine is required to ensure the essential dimensional control needed to make full use of the optical characteristics of lamp and reflector than would be the case of the round wire design, made up on hand operated jigs.

Conclusion

The Thorn version of the H4 tungsten halogen headlamp bulb, by virtue of its unique construction, meets the most stringent requirements of the ECE regulations and is unusually robust as well. The sweep curve over the range of frequencies encountered in automobile applications shows that no serious resonant peaks occur in the operating frequency band in either plane of the lamp.

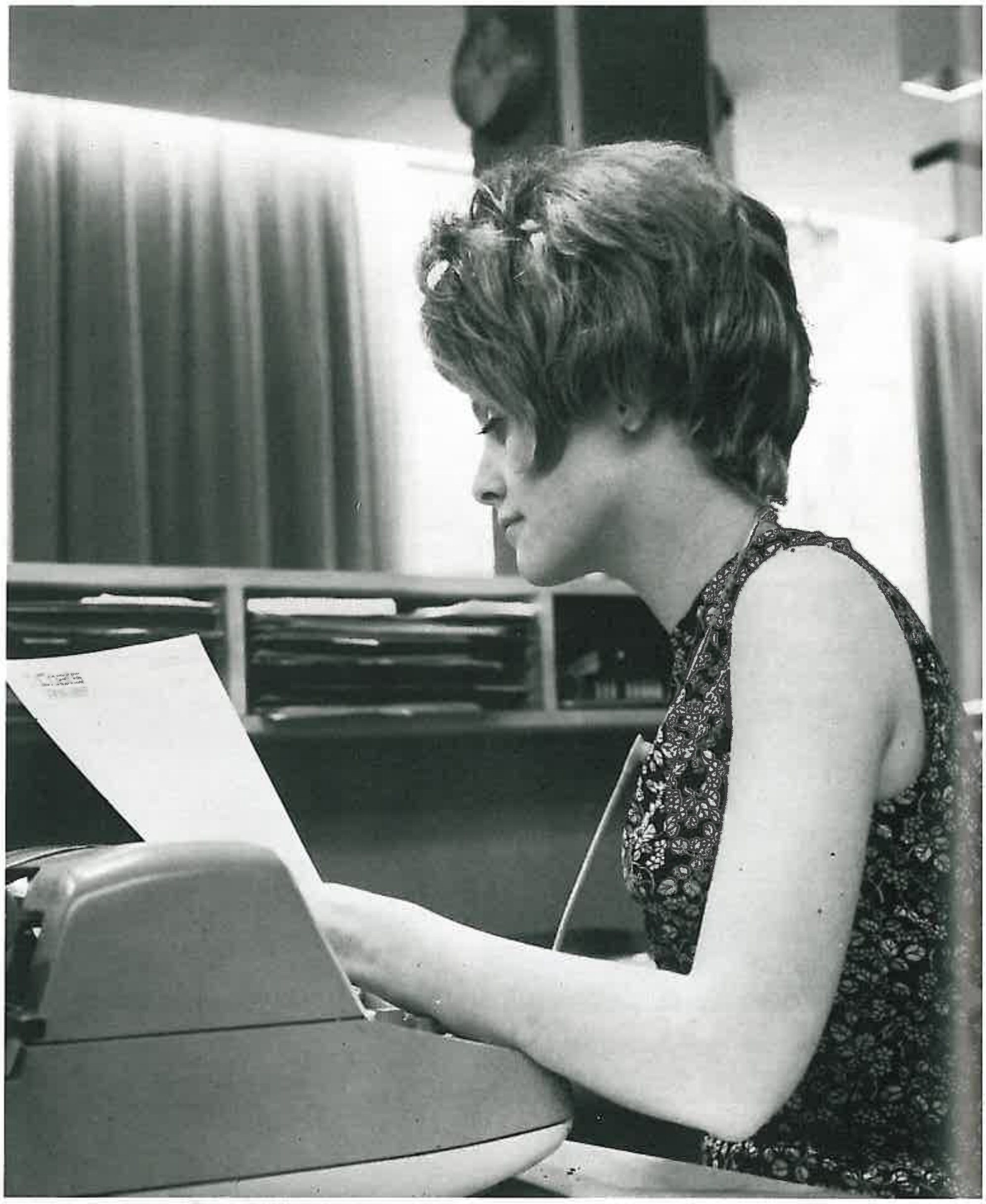
Lamps have also survived the specified duration of the Michigan Impact test device (see Lighting Journal No. 15). This is known to be a particularly severe test condition not normally applicable to this type of lamp. The characteristics of the machine are exposure of the lamps to peaks of 400g, by allowing the drop to occur from a rotating drum having 4 steps and revolving at 200 r.p.m.

Considered in relation with the extreme accuracy of the positioning of the filaments, all this adds up to a lamp technology definitely in advance of that of any other European manufacturer.

New Trends in Office Lighting

W. K. Lumsden

During the past twenty-five years office lighting practice has evolved in accordance with changes in general working conditions, the amount of money a user was willing to spend on creating a "Prestige" environment and variations in the recommendations of the Illuminating Engineering Society. In this article, Mr. Lumsden looks at past methods and points the way forward to possible developments in lighting techniques resulting from changed conditions of work and new light sources.



Work stations, such as this, may rely on the general lighting in a room or, as in this case, be given individual treatment.

A glance into the past

Twenty-five years ago it was still common practice to produce a general lighting installation for offices using a regular array of incandescent lamp luminaires. Illuminance levels were much lower than today, about 15 lumens per square foot (161 lux), and there was no simple method for predetermining the degree of discomfort glare that would be experienced. Long practice in design of incandescent luminaires had, however, led to the adoption of simple rules for limiting discomfort glare. In the case of an opaque reflector there was a minimum cut off to the horizontal of 30° increasing to 45° for schools, while for diffusing fittings, often made of opal glass, the surface area was chosen to reduce the luminance of the lamp to a reasonable value. On the whole these installations were quite successful in visual terms and were generally acceptable to the staff. Part of the reason for their success was undoubtedly due to the fact that the colour appearance of the lighting duplicated that of the lighting in domestic situations, and the colour rendering while not objectively good was nevertheless completely acceptable. Because the lighting was being produced by small bright sources, shadows tended to be defined and hard, again duplicating the domestic situation, and distribution of light on the room surfaces was, subjectively acceptable.

The application of fluorescent tubes

With the advent of fluorescent lighting in the office no significant changes were made to the lighting specification in terms of illuminance or glare, but because of their high efficacy, illuminance levels tended to increase since electricity charges were equated to those for the incandescent installation that was being replaced. It was not thought necessary to change either the design approach for installations using fluorescent lamps, or the calculation method in use. It became apparent fairly quickly that the quality of lighting produced by fluorescent tubes was not as acceptable as that produced by incandescent lamps. This was mainly because of differences in colour appearance and colour rendering of the lamps, but also because of the diffuse nature of the light source. Shadows were softened and contrasts were reduced and room surfaces tended to be more uniformly illuminated because of the high proportion of diffusely reflected light. The visual scene thus produced was totally unfamiliar to many and appraisal of installations which had given rise to complaints led to the conclusion that a different design approach with different lighting objectives was needed.

The Lumen method of design

The lumen method of calculation for general lighting did not, however, need any amendment, as the fluorescent tube, because of its diffusing nature and size, gave a better distribution of light than the same number of incandescent fittings. This was partly due to the fact that the theoretical determination of spacing/mounting height ratios was based on the incandescent lamp. IES Technical Report No. 2 which is still in existence also incorporates the same assumption so that calculations involving data produced in accordance with this Report are valid only for point sources and not for linear sources. Other assumptions in Technical Report No. 2 are that working space should be unobstructed between the desk top and the ceiling and that there should be uniform reflectances on all the walls. An understanding of these points is vital if any installation is to be designed to give satisfactory lighting in every task position, as clearly a simple calculation for average illumination can be valid only for a relatively small part of the area. Particularly around the perimeter the actual illumination on the task can be very much lower than the average value, even in an unobstructed room. Where there are obstructions, as for instance filing cabinets, coat cupboards or isolating partitions, the lumen method of calculation by itself is not sufficient and additional design work needs to be carried out. Considerable experience is necessary as there is no simple calculation or approach that will give the designer a clear idea of the illuminance that will be received on each task position. The lumen method of calculation for average illuminance is, however, of considerable use in those interiors with no obstructions or where the average illuminance designed for is sufficiently high to allow for losses of this kind and still produce a reasonable illuminance on the task.

Is a new Design Approach Necessary?

This is an appropriate time to question whether the lighting objectives, design approach and calculations in common use will satisfy future needs for offices. Appropriate because of new legislation, in particular the Health and Safety at Work Act, which could be expected to have some influence on the lighting conditions in each worker's task area, and the EEC low voltage Directive, which imposes obligations on manufacturers with regard to the safety of their products in use. In addition the Lighting Division of CIBS is aware of visual and lighting problems that will need resolution before specifying lighting objectives for the future, and of course, the user is very much concerned with costs of lighting, particularly costs in use, and is socially concerned with the need to conserve energy. Changes in light sources commonly used will also affect design and calculation methods, particularly the increasing use of high intensity discharge lamps in place of fluorescent tubes. The metal halide lamp has been used in many office installations to provide the sole lighting, while the Kolorlux (MBF) mercury lamp has been used extensively in ancillary areas. We are now seeing a slowly increasing use of high pressure sodium lamps in offices to take advantage of their very high efficacy although the colour is not universally acceptable.

The use of localised Lighting

Another, quite different consideration is the control of the lighting. In the majority of offices all

Thirty years ago, most general offices looked like this. The pictures below show a remarkable change. In the offices of Foster Wheeler at Glasgow, continuous rows of Thorn 'Clipper' fittings mounted on trunking provide an average illuminance of 750 lux on the vertical and 500 lux on the horizontal plane. They are used both to light an ordinary office and an area where scale models of petro-chemical machinery can be examined.

The specially designed MBF luminaires in the coffered ceiling at the Metal Box offices at Reading are located to provide the maximum illuminance at work stations.

Note that the fluorescent desk lamp in the right-hand picture is positioned so that reflections from shiny surfaces on the desk are directed outside the field of view of the user.

the lighting points are switched from the same place and individuals have no control over the lighting at their point of work. A new school of thought suggests that, although a level of general lighting is necessary for safety and visual comfort, it should be supplemented by local lighting, under the control of the people actually using it. So we are seeing an increasing number of installations using luminaires fixed adjacent to the work positions, in some cases on the ceiling immediately above them, but more often fixed to the work station itself. In these situations it is usual and necessary to provide some general overhead lighting to cater for tasks carried out away from the work stations and to improve seeing conditions.

Local lighting alone is unsatisfactory because it can give rise to heavy shadows between and under desks, if badly adjusted can cause glare to people at other work stations, and because muscular strain can be caused by working at a brightly lighted task in otherwise dark surroundings. This is because the eye becomes adapted to the area of high brightness and if the worker looks up, the pupil must dilate. When the worker's attention is again drawn to the work he or she is temporarily dazzled, with a consequent sense of strain. So a measure of general illumination is required, but the fact that the local lighting can be controlled by the individual worker has considerable psychological value.

The benefits to the user may not be easily expressed in financial terms, but those to the staff may prove considerable. For instance, local lighting, if properly designed, can increase task visibility and reduce both mental and visual strain. Furthermore, because the lighting is completely under the worker's control and people differ considerably in their lighting needs, there will be a higher proportion of satisfied people. Many individuals rebel against the tyrrany of the benign environmental conditions imposed on them by designers imbued with the ideals of the battery hen.

Some important aspects of lighting Design

The most important aspects of lighting can be summed up under four main headings, quality, quantity, cost and safety. I am taking each in turn to show how present practice needs to be changed to suit future needs.

Quantity: The Importance of Task Illuminance

Quantity is currently expressed as a value of illuminance — often taken from the current (1977) IES Code. The code quite clearly states that the recommended illuminance is required on the task but in many instances the recommended value is taken as the design objective for average illuminance over the entire area concerned. With this latter approach individual tasks may not receive the IES recommended illuminance but the simplicity of the design approach and installation of a regular layout of lighting fittings is ample justification for the adoption of this convention. It should be recognised, however, that a general lighting design based on calculation of the average illuminance will not necessarily satisfy the lighting needs of all the workers even in an ideal room. It may be necessary to accept that occasionally working positions with unusual difficulties may require local lighting if experience shows that the general lighting system will not produce acceptable task lighting. This is a small price to pay for the simplicity and convenience of the lumen method of design. Nevertheless, in larger areas or those with obstructions a definite specification for quantity of light should be considered. This could take the form of illuminance received on the task itself and this means, of course, every task in the room but it should be born in mind that illuminance received does not equate directly to task visibility and other factors must be considered in addition to numerical illuminance.

Reflected glare

The most important of these other factors is glare reflected from the task, which in an extreme situation can reduce the effectiveness of the incident light to nothing, as it can completely obscure detail to be seen on the task. It is clear, therefore, that an illuminance value with no qualification has little real meaning in visibility terms and one must distinguish between illuminance that will help vision and illuminance that will hinder vision by producing reflected glare. Where the task is flat and on a horizontal working surface reflected glare can be simply avoided by suitable positioning of the lighting fittings to ensure that light is incident on the task from the sides and not from ahead. This approach is well documented (see Lighting Journal No. 9) and the bat-wing distribution was evolved to suit this situation. But the same simplistic approach cannot be adopted in those situations where the task is on an inclined or vertical plane, as the geometrical derivation of danger areas on the ceiling is much more difficult and in the case of three dimensional tasks completely impossible for the practical designer.

Light and Stained Glass

Martin Harrison and Robin Aldworth

Most people associate stained glass with figurative designs such as these. The angel was designed by Harrington Mann, (1864-1937), "Thomas" was made by Anton Wendling in 1958 and "Messdiener" by Georg Meistermann in 1947.

Mr Harrison, who is curator of the Museum of Stained Glass at Ely organised the international exhibition of stained glass, 'Glass/Light', sponsored by Thorn and held in the Royal Exchange, London, in July and August 1978 as part of the Festival of the City of London. It drew an attendance of just under 20,000 and was the most extensive exhibition of its kind held in this century, with exhibits brought from all over Europe ranging in date from the eighth to the twentieth century. In this article he discusses the function and recent developments of stained glass, while Robin Aldworth, Chief Lighting Engineer of Thorn Lighting writes about the lighting.

The Glass/Light exhibition came at a time when stained glass is rapidly regaining a place in the public's imagination and returning to a level of popularity it has not enjoyed since the 1920s. Ironically though, while this renewed interest in the medium has had considerable repercussions at the 'Craft your own Tiffany Lamp' end of the market, it has still to make itself felt with the potential patronage which might bring about a secular revival of stained glass at the highest level.

The history of stained glass in the 20th century is an uneven one: only in Germany has there been an 'avant garde' which has paralleled contemporary ideas in art and architecture with anything approaching consistency. In France artists of the highest stature such as Leger, Manessier, Cocteau, Braque, Chagall and Matisse have designed for stained glass, but the resulting windows have almost invariably been of a very painterly kind, with few concessions made to the inherent differences between painting and stained glass. Works such as Leger's series of windows in the apse of the Church of the Sacred Heart, Audincourt, (1950-52) or Braque's set at the Chapel of St. Dominique, Varangeville, (1953/4) show a bold and self-assured handling of the material, but are surely destined to remain isolated examples of strongly personal and idiosyncratic styles.

The British Arts and Crafts Movement

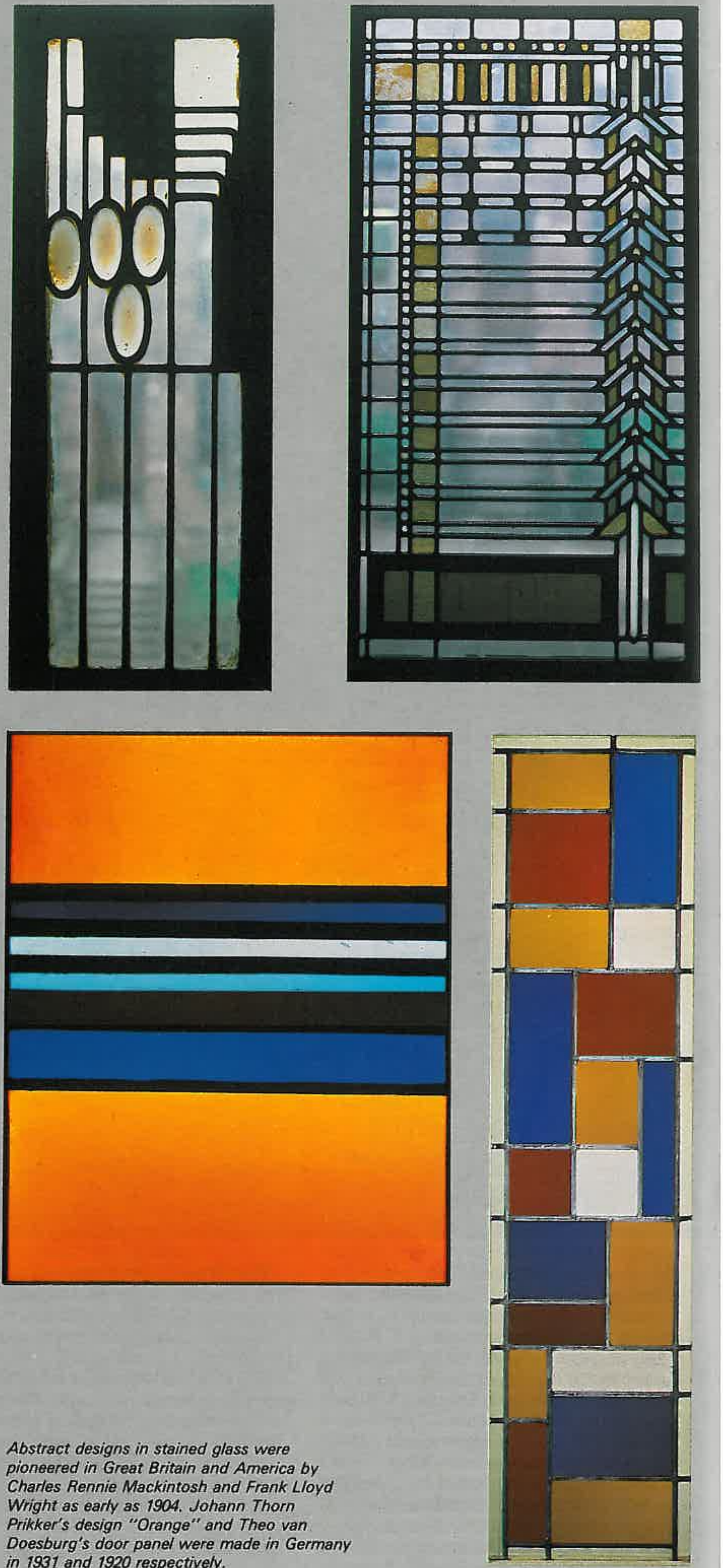
At the very beginning of the 20th century British stained glass of the Arts and Crafts School seemed to be leading the world, as indeed was the work of our most 'advanced' architects. The vernacular-based but freely adapted architectural styles of men such as C. F. A Voysey, M. H. Baillie-Scott and C. R. Mackintosh were widely admired and the books of Hermann Muthesius, such as 'Das Englische Haus' of 1904-5, were most influential in broadcasting their message throughout Europe. But while the modernistic aspects of British work became the roots of a new International Style of modern architecture, stripped of historical references, after about 1905 such advanced ideas found little favour in Britain itself. The same was true of stained glass.

An Isolated Example

There was a single isolated and early example of abstract stained glass made in England in 1915 (designed by the painter Alfred Wolmark for the west windows of St. Mary's Church, Slough, Bucks.) and after that seemingly a total rejection of all the new ideas the 20th century artistic avant-garde was exploring. There was not the least hint in British stained glass before 1950 that Cubism, Abstraction or Constructivism had ever happened. Even Wolmark's window became the subject of a law suit and, though clearly quite abstract in conception (it is close to the work of the Vorticist group, with whom Wolmark exhibited, in manner) it was interpreted in the courts as representing the Expulsion of Adam & Eve from the Garden of Eden! Not until John Piper's first stained glass in the 1950s was the courage to experiment with real artists found in England again.

Contemporary Trends in Design

In Germany however the Dutch artist and designer Jan Thorn Prikker was, from the beginning of the century, involved in the current preoccupations of concerned artists. The development of his stained glass encompassed Symbolism, then Expressionism. Ultimately, in the early 1920s, he abandoned figurative art completely to begin a large body of abstract works of great stature, culminating in the startlingly uncompromising and economical panel 'Orange', now owned by the Kaiser Wilhelm Museum at Krefeld and shown at 'Glass/Light'. At the Bauhaus, the widely influential art school which was founded at Weimar and moved to new buildings by its director Walter Gropius at Dessau in



Abstract designs in stained glass were pioneered in Great Britain and America by Charles Rennie Mackintosh and Frank Lloyd Wright as early as 1904. Johann Thorn Prikker's design "Orange" and Theo van Doesburg's door panel were made in Germany in 1931 and 1920 respectively.

1925, many of the most prominent artists connected with the school were involved at various times with the stained glass department, which was of course unwaveringly committed to abstract work. They included Paul Klee, Josef Albers and Theo Van Doesburg (an early Van Doesburg made at the Weimar Bauhaus was shown in 'Glass/Light'). With such a solid and distinguished background in Germany it is perhaps not surprising that, even though 1932 saw both the death of Thorn Prikker and Hitler's closure of the Bauhaus there was sufficient impetus to carry stained glass as a viable creative medium on and through the second world war. With the extensive rebuilding of West Germany after the war came unparalleled opportunities for designers of stained glass and a new school arose led by the painter Georg Meistermann, who was followed in the 1950s by a new generation spearheaded by Ludwig Schaffrath and Johannes Schreiter, both totally committed to stained glass as an architectural art. Schaffrath's work was strongly graphic and linear and clearly developed from the Bauhaus tradition, while Schreiter was concerned to emphasise geometric and architectural qualities by the introduction of subtly opposed organic elements.

An entirely abstract treatment is seen in the two windows illustrated above. They were designed by Brian Clarke and Johannes Schreiter, both in 1975. Ludwig Schaffrath uses very little colour in his glass, but relies on patterns made by the leading and by areas of dark glass. These windows were placed in the nave of St. Joseph's Church, Aachen in 1972.

The Function of Stained Glass

In its natural environment stained glass is of course almost always lit by daylight. Its chief function in the great gothic cathedrals of Britain and Europe was to modulate and subdue the transmission of light to a level which would result in an atmosphere conducive to worship — to create an environment removed from the material world outside, where it would be more possible to contemplate spiritual matters. Stained glass would take its part in articulating the architectural symbolism by, for example, using more and darker glass in the choir — the most 'holy' and mystical part of the cathedral. Fashions, even in liturgy, change of course, and by the 14th and 15th centuries glass of lighter tones became the order of the day as the dimly-lit and mystical interior was no longer de rigeur. 'God' was making way for 'Man' and the Renaissance was just around the corner.

Under exhibition conditions it is impractical to rely on daylight for lighting stained glass, and inevitably it is not possible to reproduce the kinetic qualities of ever-changing natural light. For 'Glass/Light' the answer was to build up a high level of diffused fluorescent light of daylight colour temperature. This resulted in an even, bright light which satisfactorily retained a lot of the 'glassiness' of the material itself.

The Lighting Problem

Since stained glass is usually designed to be seen in daylight, variations in sunlight and shadow, the shapes of trees seen dimly through it and the shadows of buttresses or of other buildings produce a 'liveliness' which cannot easily be imitated by the designer of artificial lighting. Indeed, the artificial lighting of stained glass in a normal setting is seldom achieved successfully, as has often been remarked by people standing inside a floodlit church or cathedral.

By day the stained glass is viewed against the sky but at night the light from the exterior floodlights is directed upwards, reflecting a high proportion from the external surface of the glass so that little or no light is transmitted through the window. The viewer inside the building sees only a black aperture surrounded by stonework. For the same reason stained glass windows look black when viewed from outside in daylight.

The basic principle that must be employed by the lighting engineer, therefore, is to simulate the large fairly bright area provided by the sky, in other words, he must provide an area of diffused light behind the glass. Where, as in a few museums, the glass is exhibited in windows specially designed for the purpose, even if they normally admit daylight, it may be possible to arrange for the artificial lighting to be reflected from white external shutters or blinds which can be closed or drawn at night and lit by fluorescent tubes recessed in the window embrasure behind the stained glass panel. This technique is obviously impossible in an existing building where the architectural appearance must not be disturbed.

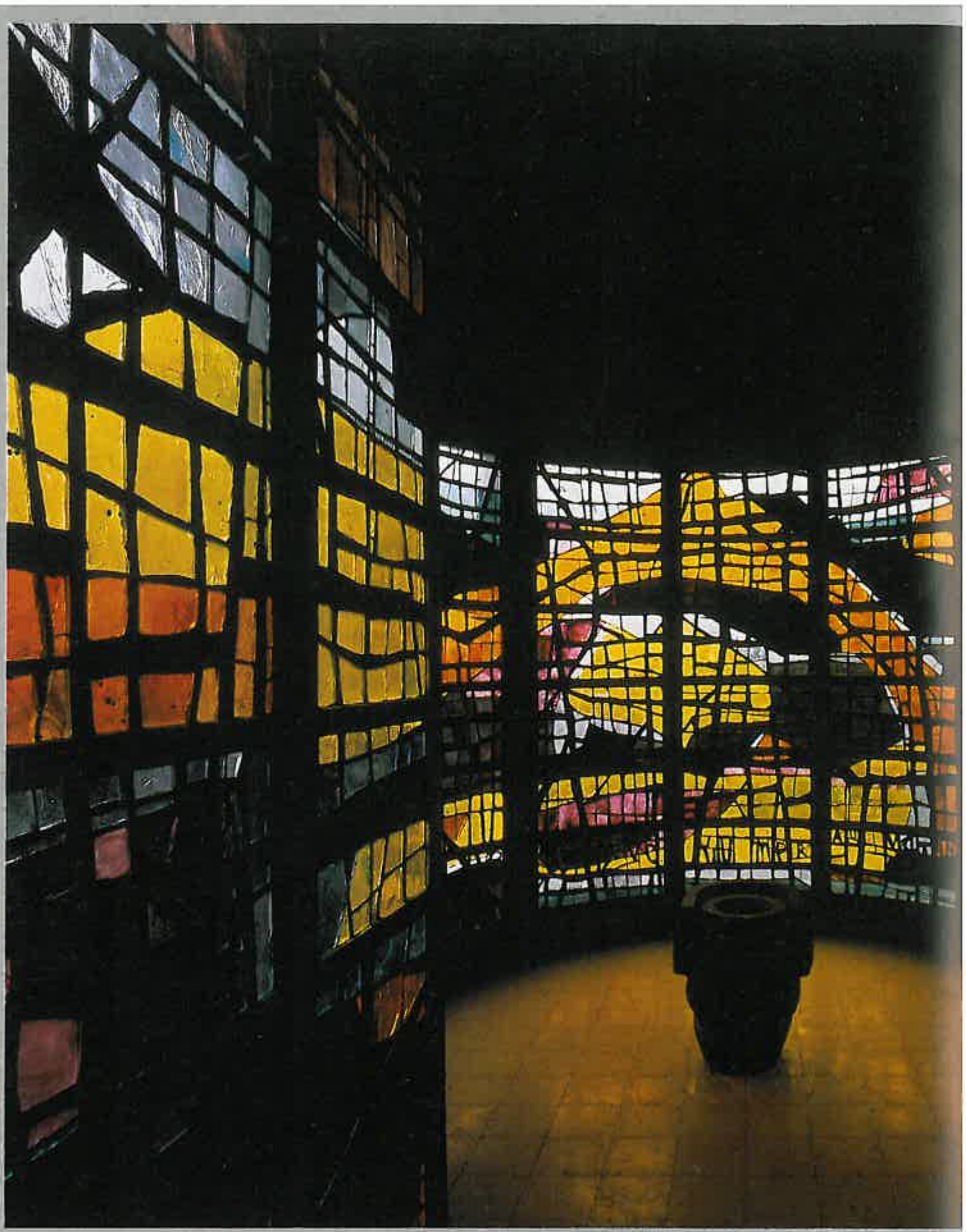
In the case of an indoor exhibition, such as that at the Royal Exchange, the problem is easier to solve. All that is needed is to show the stained glass panels in front of 'light boxes' containing fluorescent tubes. The spacing of the tubes in the white-painted interior of the box must be such that they do not appear as bright lines traversing the panels; this can be achieved by mounting the stained glass in front of opal acrylic sheets and spacing the tubes in the white-painted box at a 1:1 spacing; mounting-height ratio.

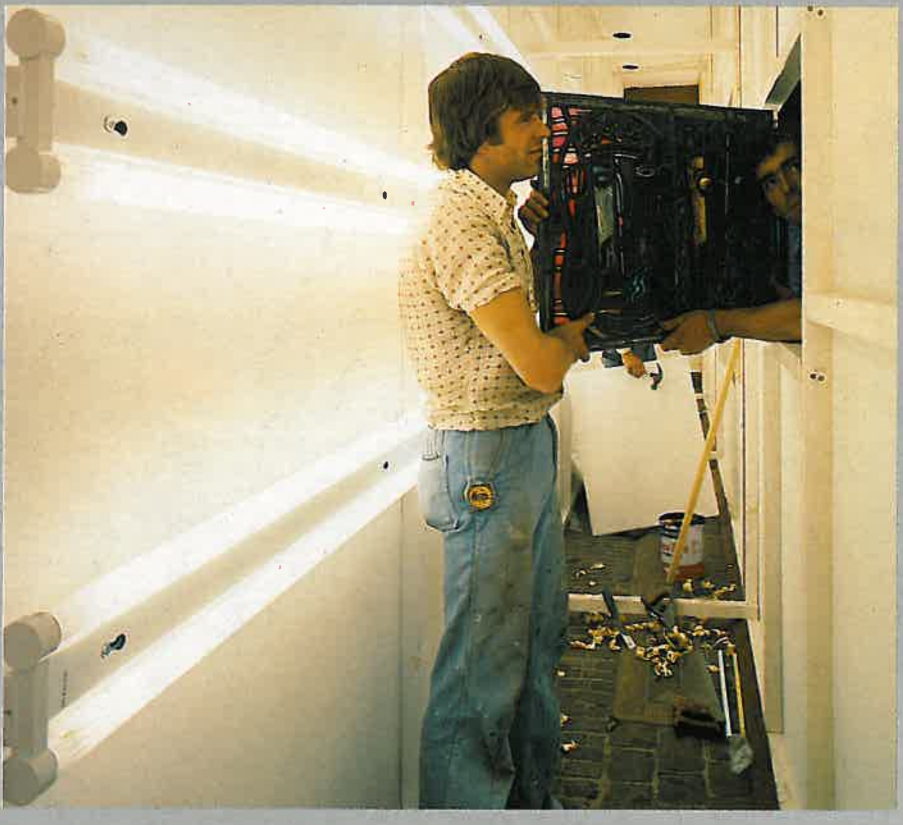
Size of Light Boxes and Colour of Tubes

At the Royal Exchange, there was plenty of room available, so that it was possible to make the light boxes big enough to allow maintenance staff to go right inside them to change lamps etc,. but in most cases they must be considerably smaller and access to the tubes must be from the front, the stained glass panels being hinged to allow this.

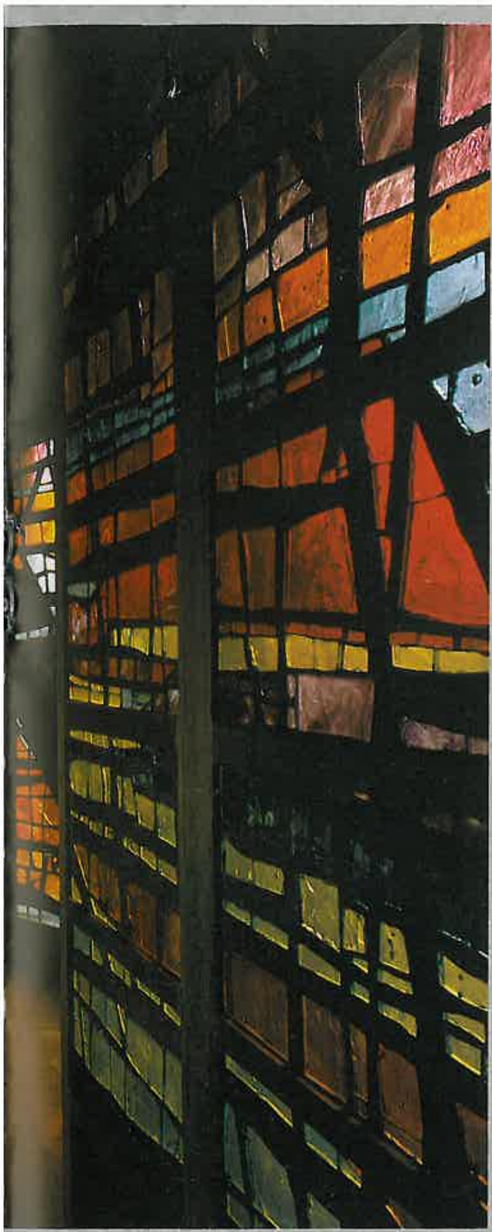
The main practical design problem raised by this exhibition was to know how much lighting equipment to install, as although the sizes and arrangement of the windows was known in advance, the designer had no information on the density or transmission of the windows until the exhibits had been assembled. This was two days before the official opening. All that was known was that some of the large designs were constructed of high-transmission white glass and that they might be close to smaller windows of dense coloured glass and consequently lower transmission. This could have resulted in glare from the larger windows obliterating the detail in their neighbours. In addition there was the possibility that the darker glass could reflect an image of a brighter window on a facing wall.

In the absence of information, the basic installation of 2400mm twin Popular Packs was arrived at, based on the results of an earlier exhibition of glass by Brian Clarke. Only when the exhibition was fully assembled





The size of the lighting cavity and the arrangement of fluorescent tubes can clearly be seen in this picture of a workman inserting a panel of stained glass at the "Glass/Light" exhibition.

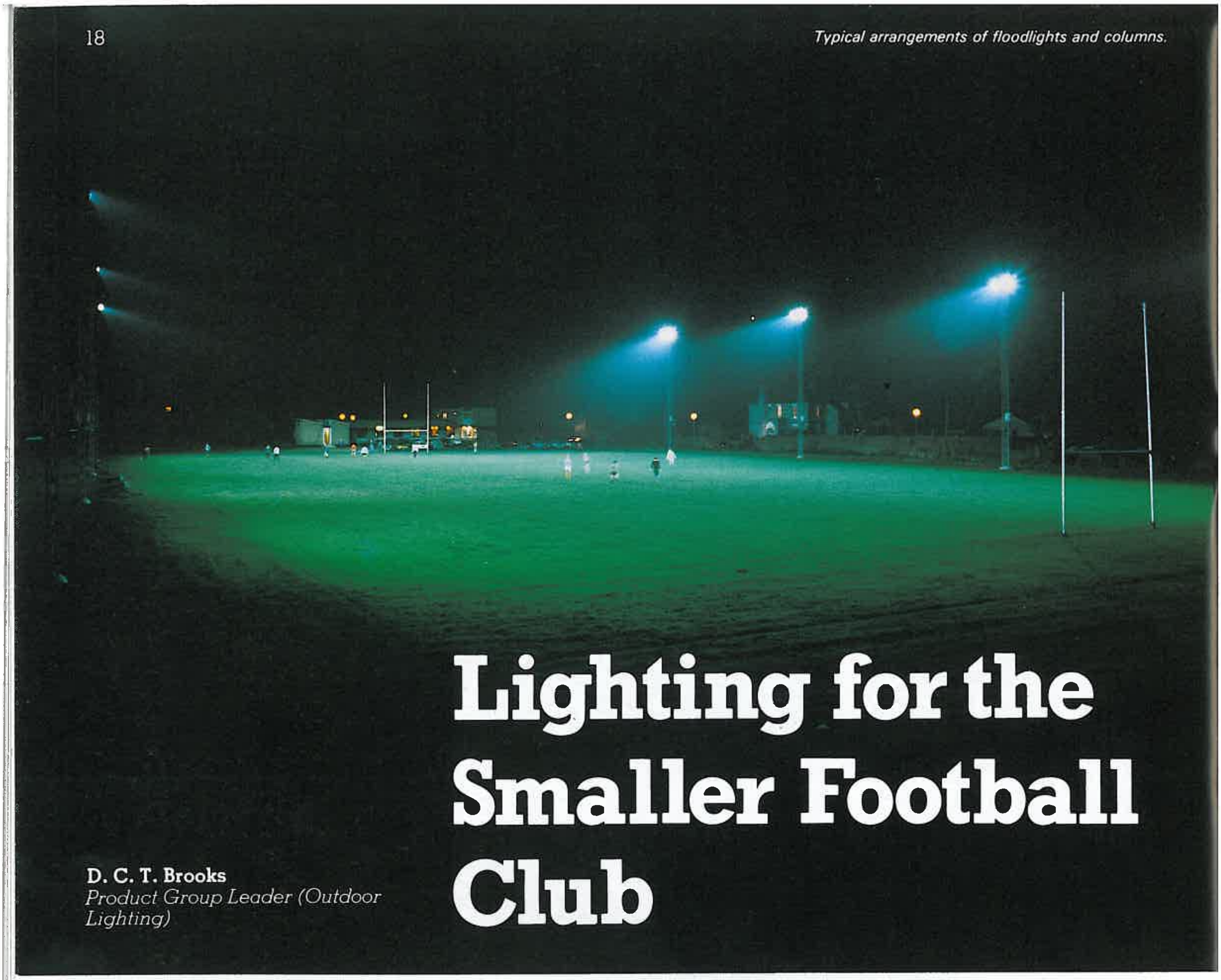


was it possible to 'tune' the installation by removing tubes or, in the case of the darker windows, installing additional equipment. The generous proportions of the light boxes made this relatively simple to do. Tests at the earlier exhibition had also shown that the colour rendering properties of the 'Natural' tube gave acceptable rendering of the wide range of coloured glasses contained in the exhibition. The choice of the 2400mm tube at 100W rating was partly influenced by the modular design of the light boxes and partly by the need to provide as much light as possible within the limits imposed by the electrical load available at the Royal Exchange.

The Future of Stained Glass

If, as seems essential if it is to thrive, the future of stained glass rests with the public and industrial sector, it may not be an idle wish to hope that the artificial lighting of stained glass might be further developed, for many new and exciting opportunities for permanent windows in ill-lit or unlit locations would open up. The large attendance at 'Glass/Light' was extremely gratifying for those involved in its organisation; it would appear to be another sign that in this increasingly secular age stained glass is no longer thought of as a dinosaur-like anachronism and that there is cause for some optimism for the future of the medium.

Walls of stained glass by Jean Bazaine enclose the Baptistry of the Church of the Sacré-Coeur at Audincourt, built in 1952. The rather heavy abstract treatment contrasts strongly with Patrick Reyntiens' "The Cross" made in 1966. A possible return to figurative design is hinted at by this design by Marc Chagall for a parish church in Kent.



Typical arrangements of floodlights and columns.

Lighting for the Smaller Football Club

D. C. T. Brooks
Product Group Leader (Outdoor Lighting)

Several articles in previous editions of LIGHTING JOURNAL have described the planning and installation of floodlighting at the stadia of well-known football clubs. Indeed, from the introduction of the 1 kW CSI system at West Ham and MBIL at Arsenal in 1971, much emphasis has rightly been placed on providing illuminance and colour rendering to the high standards imposed by colour television transmissions and this has been done without substantially increasing, and sometimes even reducing the electrical load and windage on existing towers. What, perhaps, has been neglected is the valuable contribution the 1500W MBIL system can make to sports clubs of more modest means, by providing floodlighting of good quality at a reasonable cost to meet their particular needs.

In recent years, we have seen the development of new sports centres together with the formation of new leagues for various field games such as rugby and association football, many of which involve mid-week competitions at which spectators are present. The use of such facilities makes floodlighting essential.

Improving Existing Schemes

Existing schemes may be improved to make this possible. Many small football clubs have used tungsten halogen floodlighting with success, but now many of these schemes are inadequate and, in any case, they are ripe for renewal. The efficient use of energy is an important consideration. The change to a 1500W MBIL scheme can not only provide an improvement in illuminance, but also effect savings in operation. Already there are many football clubs, rugby clubs, local authorities, colleges and universities which have installed floodlighting of this type, and discovered that it need not be a complicated business at all. It is not necessary to call in computer-aided design. It does not — in comparative terms — cost a fortune and the installation can be achieved with relative simplicity. In fact, it is often possible for the club's members to carry out some of the work themselves. In the rest of this article, some of the steps in planning and installing a 1500W MBIL system are considered.

Planning and Preparation

The starting point should be to define what precisely is to be lit. Most sports fields can be considered as rectangular areas which are to be illuminated to a certain standard of uniformity and illuminance. Some further consideration will be required to suit the particular sport. For example, with rugby, some light is called for behind the posts, unlike association football where play is restricted to between the goals, but this only means a slight re-positioning of the towers or columns.

A very suitable arrangement is to use four 16m columns on each side of the pitch with two ON 1600 luminaires on each. The calculation of aiming angles will be dealt with by the lighting engineer. An electrical contractor should be chosen to carry out cabling and the installation of control gear and switch gear. It is quite within the realm of the club members to carry out much of the manual labour, but it is essential that the schedule of trench digging, installing columns and, perhaps, a switch gear room is co-ordinated with the electrical contractor, so that work can proceed smoothly. It is also

important to clear any legal points, such as whether planning permission or way-leaves for electricity supply are required before work can go ahead. Normally, it will be necessary for plans to be submitted with details of the installation and equipment, so at this stage, it is, perhaps, worthwhile looking at the hardware involved.

Basic Design of Lamps and Floodlight

The first items to consider are the lamp and luminaire. In the 1500W metal halide lamp, the halides are chosen to give a high light output of good colour rendering and with colour appearance approximating to daylight. The lamp is mounted in a compact luminaire which effectively acts as a jacket. The luminaire has a contoured asymmetric reflector, polished and anodised, located between end-plates cast in aluminium alloy. Cool chambers in the castings provide accommodation for special lampholders. At the rear of the reflector a cast chamber with a gasketed lid provides wiring facilities.

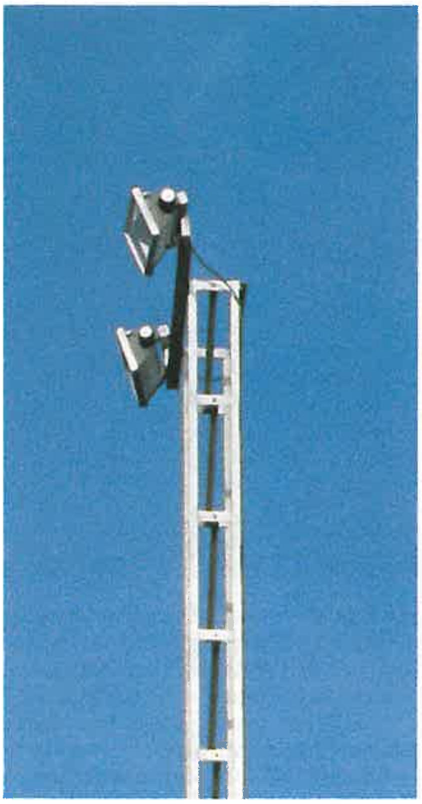
The baffle reflector in the luminaire provides sharp run back above the peak intensity and light at low angles to provide coverage near the base of the column or tower. In the standard luminaire the reflector is designed to provide coverage with the peak intensity aimed at 65°-70° above the downward vertical. An insert reflector may be used at lower aiming angles to give a wider beam distribution. The luminaire complies with BS 4533:2.5 and carries the Safety Mark. This 'symbol of safety' demonstrates to the purchaser that the luminaire complies with the British Electrical Equipment (Safety) Regulations 1975. The lamp and luminaire have been designed and tested together to ensure that a compatible floodlighting unit is produced.

Mounting the Floodlights

Luminaires are normally mounted at 15 to 16m and the choice of support will, to some degree, be influenced by site conditions and access for maintenance. Columns which can be lowered to the ground for maintenance by means of a hydraulic jack have proved very popular with 1500W MBIL schemes. They are often designed with an enclosure in the base which can accommodate up to four sets of control-gear. A top bracket is provided, to which the mounting stirrup of the luminaire can be bolted. All installation work and even approximate aiming can be carried out at ground level. These columns are usually supplied in sections and can easily be assembled on site, the base section being secured by bolts set in a concrete foundation. Much of the work of assembling and erecting this type of column can be carried out by club members under supervision, thus reducing labour costs, but the use of a hydraulic jack is essential.

Mounting on Lattice Towers

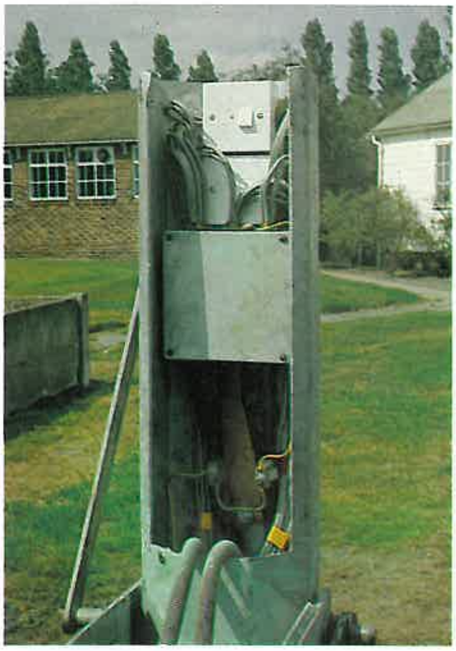
Small lattice towers offer an alternative approach. These are usually of tubular construction with cross-bracing and incorporate welded step rungs to obtain access to the cross arms where the luminaires are mounted. Where space does not permit the raising and lowering of columns, as for example where a small stand has been built beside the pitch, such towers provide a suitable solution. In some circumstances, if the structure is sound, a convenient stand can be utilised, and it may be possible to dispense with towers altogether by mounting luminaires on the stand roof itself. But most smaller clubs without such facilities will usually be left to choose between the use of columns or small towers, and given adequate space and access, price, availability and convenience will probably be the deciding factors.



The top of one of the lattice towers used at Hereford compared with a hinged hexagonal aluminium column, in which the control-gear is mounted internally. In the lattice tower it has to be placed high enough to avoid vandalism.

Electrical Installation

The Lighting Engineer will be able to specify the electrical characteristics of the lamp and control gear, but the Electrical Contractor will be responsible for the specification and installation of suitable cables and switchgear, which will include the provision of a three-phase supply to each column and for the installation and fusing of main feeder cables. A data book (Ref. T39/T) is available from Thorn Lighting engineers, giving comprehensive information on the operation and performance of lamps and gear; the rest of the



Stages in the erection of a hinged aluminium column.
(1) The base of the column is fitted to the "root" and electrical connections made.
(2) The floodlights are fitted on the cross-piece.
(3) The column is erected by means of the hydraulic jack.

installation must, of course, comply with the IEE Wiring Regulations in the U.K., or National Regulations elsewhere.

Three-Phase Supply

The 1500W lamp has a volt drop of 250 volts and operates from a three-phase supply, using a single open-core and coil choke. Cross-phase operation allows the choke to be smaller than would be the case in a phase to neutral installation and it is, therefore, more convenient to install in the base of a suitable column. There is normally no difficulty in providing a three-phase supply but an auto transformer (240/415 volts) is available for use where a three-phase supply is unobtainable.

Choice of Cable

Electrical characteristics are given in table 1. There are some general points for the electrical contractor to bear in mind. For example, the pulse generated by the 1500W circuit is progressively attenuated as longer lengths of cable are used to connect the lamp to the main choke. The degree of attenuation for a given length of cable is dependant upon the capacitance of the particular cable being used and table 2 lists common types. It is evident that control gear mounted at the base of a 16m column is well within the limits of these typical cables.

It is important to remember that, as ignitor pulses are involved, MICC cables should not be used between the choke and lamp. This avoids the danger of the insulation breaking down under the influence of the pulse. Suitable PVC insulated cable to BS 6004 should be used. This is explained in the LIF Technical Guidance Note No. 3 "The Use of High-Pressure Sodium and Metal Halide Lamps".

Points to Note

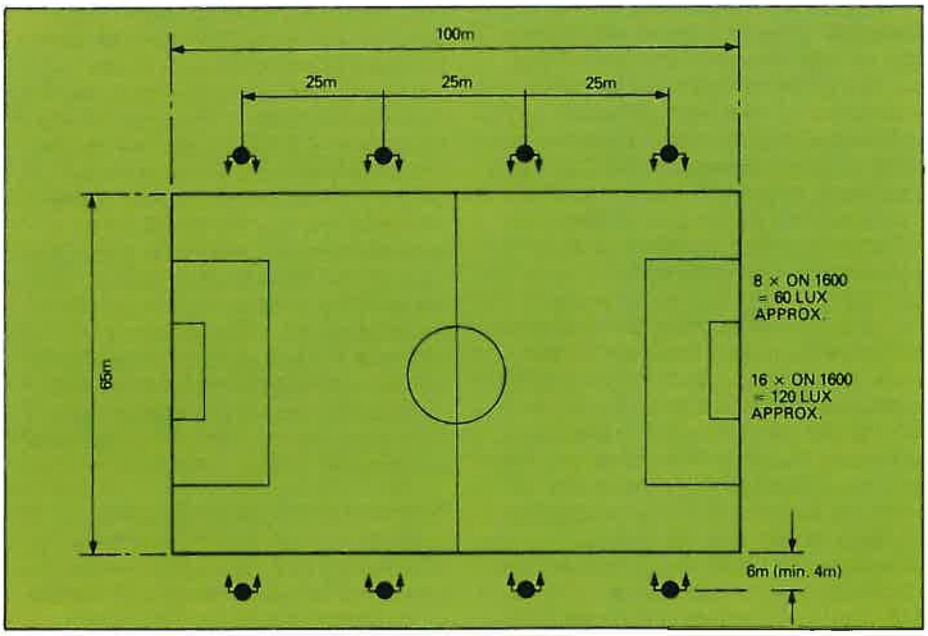
The lamp and circuit are designed to be Delta connected between phases of a 3 wire, 3 phase 415V AC 50Hz supply. Lamp circuits are grouped to form a balanced load across the 3 phases. The following points should be noted.

1. Each supply wire to each lamp circuit should be fused and allowance made for the high starting current of the lamp.
2. The incoming supply lines must be fused.
3. To minimise the risk of power-factor capacitors becoming open circuit or disconnected, it is recommended that each separate 30μF capacitor should be connected via the fuses in each lamp circuit.
4. To reduce the risk of failure arising from the loss of one phase conductor within the installation, it is necessary to pay particular attention to:—
    a. The excess current protection (fusing)
    b. The correct cable size and rating
    c. Correct and proper installation and connections.

Location of Control Gear

The control gear itself can usually be located at the base of column or tower in a rainproof housing or enclosure which should be kept locked to avoid unauthorised access. It is important to mount chokes away from equipment sensitive to heat such as capacitors and ignitors. Ventilation for these schemes is not usually a problem in temperate climates, but if the ambient temperature is likely to exceed 50°C, then special provisions will be necessary.

The siting of switch controls, etc., will need to be discussed with the Electrical Contractor at an early stage — usually the club house provides a suitable location.



A typical layout for an Association Football pitch. For a Rugby ground the columns would be spaced a little wider, say at 30m.

compared to the Pantheon at Rome, was added to the design of Peddie and Vinnear of Edinburgh.

This hall, refitted and redecorated in 1972 is in daily use as the Royal Bank's St. Andrew's Square office, and the building also houses the Head Office of the National and Commercial Banking Group, the Holding Company that controls the capital of the Royal Bank of Scotland Limited and of William and Glyn's Bank Ltd.

The principal architectural feature is the shallow dome, pierced with star-shaped openings. This is lighted by 1600W linear metal halide lamps mounted in pairs in the four hollow corner brackets, and by fluorescent tubes mounted in the cornices. Some extra lighting is provided at floor level by fluorescent tubes concealed under the desks.

This scheme was designed by Mr. MacDonald-Smith, Architect, working in close collaboration with Thorn lighting engineers at Glasgow, and installed by Sturrock Power Installations Ltd of Edinburgh.

The total lighting load is 18kW and the average illuminance at desk level is 100 lux.

Floodlighting Two Insurance Offices

The Standard Life and Guardian Royal Insurance offices face one another on opposite sides of the end of George Street, where it debouches on St. Andrew's Square. The Guardian is a light grey building designed in the neo-Georgian style of the middle 'thirties. When it was built, floodlighting was provided from 13 1000 Watt filament lamps mounted in decorative glass and metal lanterns bracketted out from the walls at first storey level. These have been relamped with 400W Thorn 'Kolorlux' mercury fluorescent reflector lamps, the control gear being mounted on adjacent balconies.

Lighting the Standard Life building presented a more difficult problem. It is a late Georgian building with an elaborately carved frieze below the deep cornice and heavy cornices and architraves over the doors and windows. To light it from the area between the railings and the façade, as was originally proposed, would have resulted in very heavy reversed shadows from these features, so it was proposed to light it from the roof of the Guardian building on the opposite side of the street, a solution which has seldom been attempted in the United Kingdom.

A row of 9 OHS floodlights housing SON TD lamps was mounted on a part of the roof of the Guardian building that is lower than the rest, so that the floodlights were screened from view from the square by the bulk of the main building. The floodlights are mounted on a heavy steel 'railway' and are fed from a separately metered supply. The scheme was designed by Mitchell, Dey and Norton and Partners, consulting engineers of Edinburgh, in close collaboration with Thorn Lighting. The permanent steelwork is secured to the roof structure and the design of this part of the installation was carried out by Blythe and Blythe, consulting engineers of Edinburgh.

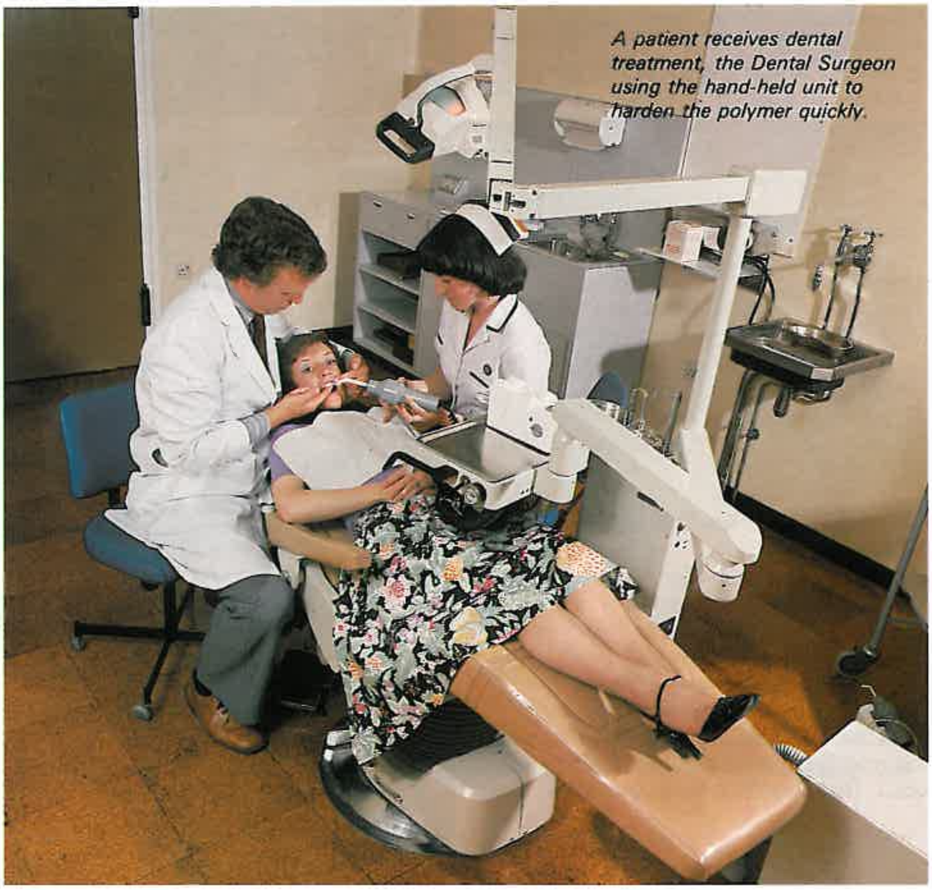
Because the light strikes the Standard Life building at an angle, the figures on the frieze stand out well, and the shadows of cornices and architraves are where one would expect them to be. The installation is considered completely successful by the owners of both properties, Standard Life being very grateful for the help given them by Guardian Royal Assurance.

The distal end of the quartz rod being aimed at the tooth. The intense blue light emitted from it is clearly visible.

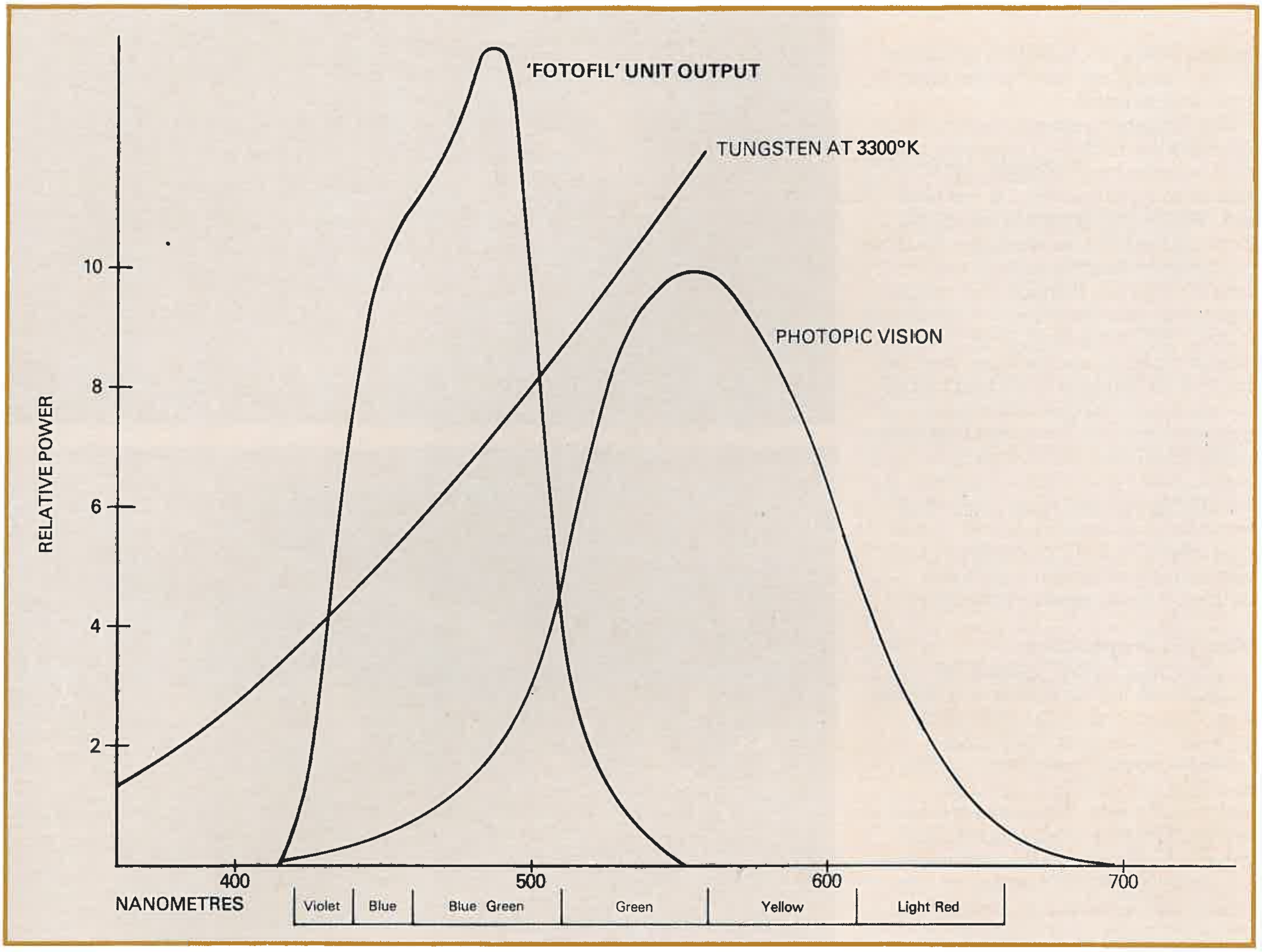
Dental Technology with Light

G. L. Adams and E. J. G. Beeson
Mr. Adams is a Special Applications Executive in Zone 1, Thorn Lighting Ltd, and Mr. Beeson Manager of Special Lamp Projects at Leicester.

Many readers of *Lighting Journal* will be familiar with the latest extremely compact forms of operating lamp which have found their way into dental surgeries. These operating lamps are, in effect, profile spotlights offering a sharply defined patch of illumination which may be trained on the working area without discomfort to the patient. They are used for the conventional purpose of illumination but another dental lamp provides visible light for a very different purpose. It is not a visual aid but one in which the light causes a photochemical change in a material used in dental surgery; the photopolymerisation of a restorative composition used in dental treatment. This is a new material called 'Fotofil' the trade mark of Johnson & Johnson Dental Products Company. The lamp is used in a hand-held activator unit designed by the Medical Aids Unit of



A patient receives dental treatment, the Dental Surgeon using the hand-held unit to harden the polymer quickly.



the ICI Pharmaceuticals Division at Macclesfield, Cheshire.

Photopolymerisable Systems

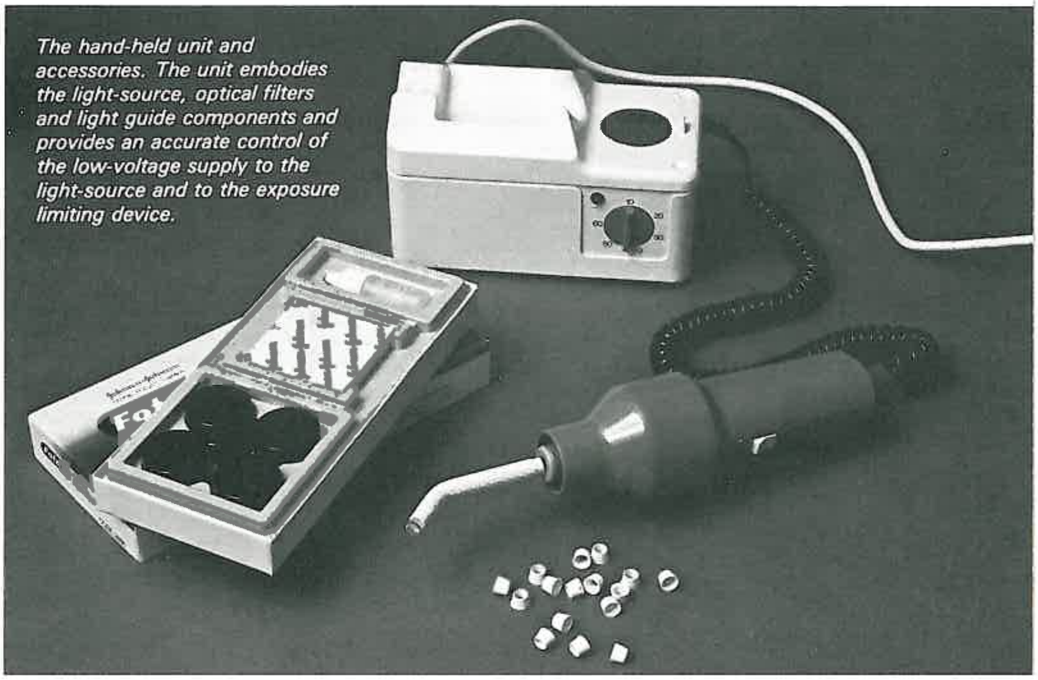
Many other photochemical processes and photopolymerisable materials are used in industry where radiant energy in the shortwave, longwave, ultra violet and blue regions of the spectrum are used to effect a chemical change, causing fixing or hardening of a substrate. While the long wavelength radiations have less energy per photon, they are generally able to penetrate thicker layers than the shorter wavelengths which have their principal effect at the surface of a polymer layer. Most of these materials have a high absorption in this region, so that the radiation is not transmitted through the material and only surface hardening occurs.

Small Areas of Irradiation

In dentistry only small areas of several square millimetres are irradiated but the radiation is required in some depth so that a small but intense source is needed and this is more readily obtained in the visible region of the spectrum than in the ultra violet. The use of UV even in the long wavebands is undesirable because of the biological effects on the human body and although these effects can be adequately safeguarded by the use of suitable filters and shields, a system using the harmless visible radiations is to be preferred. The dental composite can be handled readily in normal room-lighting conditions but in this latest development it can rapidly be hardened by exposure to an intense band of light in the visible area of the spectrum.

'Photofil' Activator Light

The unique quality of the 'Fotofil' photopolymerisable material is that it is not sufficiently sensitive to visible light to be hardened by it but utilises a narrow band of radiation near the ultra violet region. This is shown in the graph where a comparison is made with the photopic response of the average human eye. In other words, radiation to which the eye responds in normal day to day seeing



The hand-held unit and accessories. The unit embodies the light-source, optical filters and light guide components and provides an accurate control of the low-voltage supply to the light-source and to the exposure limiting device.

encompasses the radiation produced by the 'Fotofil' unit so that the latter is in no way harmful.

The tungsten halogen filament that provides the radiation operates at a high temperature, around 3300°K to maximise light emission at the blue end. While only a part of the curve showing the relative energy output of the tungsten lamp is shown, this extends not only through the visible region but into the infra red, peaking at about 800 nm with energy extending as far as 3000 nm. Beyond this any radiation is absorbed by the fused silica envelope raising its temperature. It will be seen that only a very small part of the energy is transmitted by the 'Fotofil' system, the remaining energy being dissipated principally as heat. This energy has to be effectively suppressed as any heat concentration on a patient's tooth will cause severe discomfort.

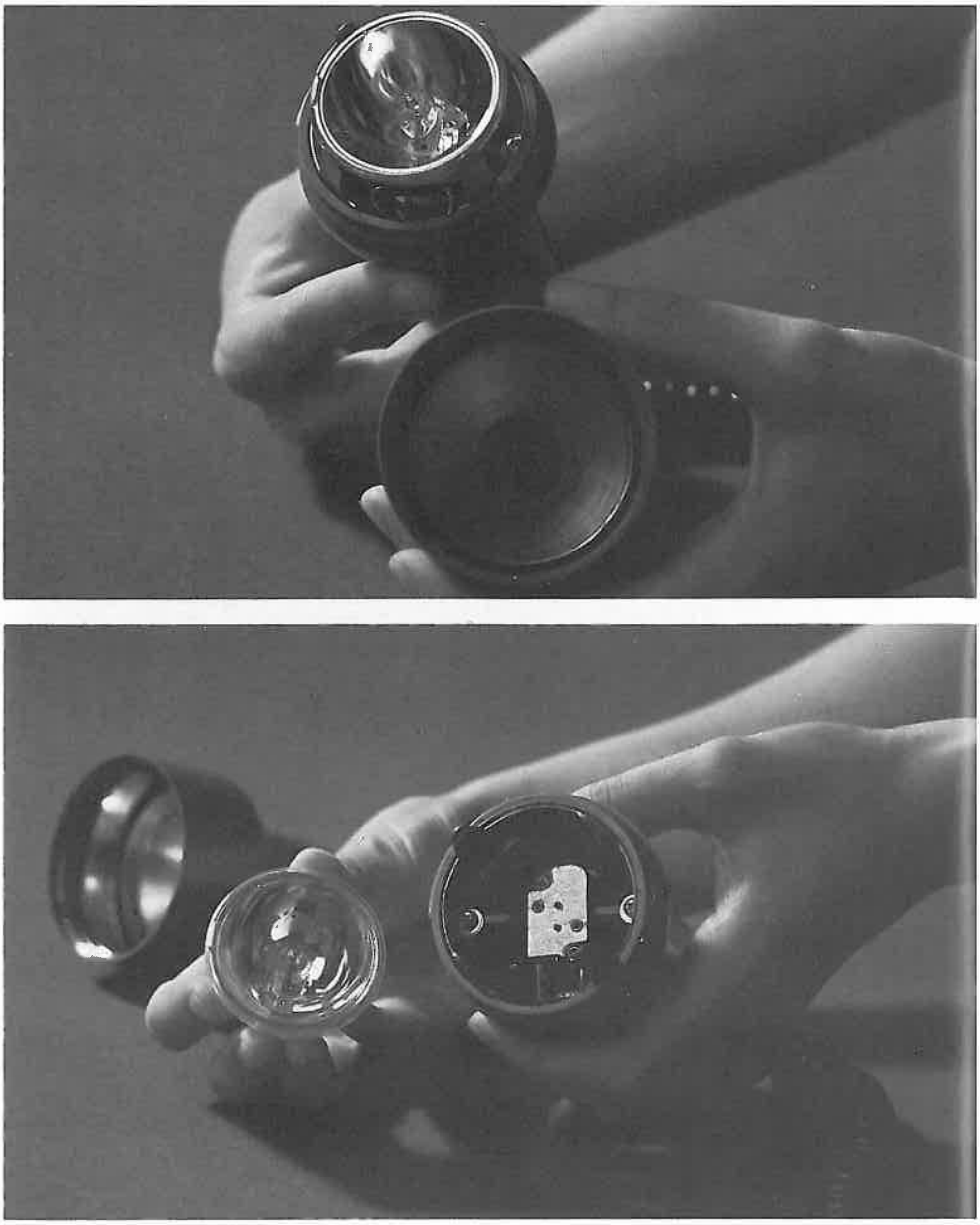
Principle of operation

In the new 'Fotofil' system the composition is provided in a selection of shades, enabling the dentist to achieve a good match with the patient's normal tooth colouring by blending as necessary with the 'Universal' paste. These shades can be used alone or in any proportion with the 'Universal' paste since it is a one paste system. When the restoration is complete, visible light primarily at the blue end of the spectrum (between 420 and 520 nm) is projected by means of a quartz rod forming part of the activator unit on to the tooth that has been restored. An automatic timer of up to 60 seconds is provided on the activator unit and this is set up by the dentist to control the exposure according to the class of restoration involved.

The hand-held lighting unit

The hand-held lighting unit contains a small tungsten halogen lamp in a focussing integral dichroic mirror which allows almost 60% of the infra red radiation to pass through it, where it is removed by a small electric fan.

The reflected visible light is focussed into a concentrated beam and is further filtered by a heat absorbing glass with additional filters to remove not only the visible content which would cause glare to the dentist but also to filter any radiation below the violet region, suppressing any U.V. output, small though it is, from the quartz tungsten halogen lamp. This focussed beam is then imaged on to an optical flat at the end of a fused silica rod, the rod acting as an optical light-guide providing a concentrated output of energy at its distal point where it is estimated that the energy transmitted is around 0.5 watts.



Avoiding Glare to the Dentist

A quantity of safety tips in the form of short protective sleeves is provided and one of these is placed on the distal end of the quartz rod in order to confine the light to the area of the restorative paste. These safety tips also reduce the likelihood of the dentist accidentally observing the bright end of the rod and suffering from the effect of an 'after image' on his retina. The tungsten halogen lamp can be switched on and off as required and is only energised when curing is taking place. Very little radiation reduction occurs through average lamp life of 50 hours and the system is always returned to its original level on lamp renewal as the principal reflecting optic is replaced being an integral part of the lamp.

High technology

Although the overall efficiency of the light system is just under 1% it enables a new technology in dental treatment to advance. It is interesting to note the combination of technological expertise that has contributed to the design of this activator light in a convenient and practical form. Some of these are listed as follows:

Details of the lighting equipment of the hand-held unit.

a) A compact high efficacy tungsten halogen lamp.
b) Accurate profile mirror to concentrate light flux.
c) Selective reflection coatings on mirror to give a cool light beam.
d) Optical light guide.
e) Glass filter to remove unwanted heat.
f) Glass filter to remove unwanted visible light.
g) Glass filter to cut off radiation in the near ultra violet.
h) Solid state control unit to provide constant voltage to the lamp.

Conclusion

Apart from shortening the treatment time involved in any given dental restorative procedure, this light-cure system allows the dentist to control the working time. With experience, the dentist will be able to shape and smooth the restorative to its desired contour prior to curing it, thus reducing to a minimum the post-cure finishing. The system has the further advantage of eliminating the waste which would otherwise result from the premature curing of unused restorative of the conventional type.

Dans cette édition.

LES PIONNIERS DE L'ÉCLAIRAGE ÉLECTRIQUE 2

H. R. Ruff

Bien que Swan et Edison soient généralement considérés comme étant les pionniers de l'éclairage moderne, ce n'est pas à eux que revient l'honneur d'avoir démontré les premières sources de lumière alimentées par l'électricité. Hawksby en 1700, Sir Humphrey Davy en 1810, Starr en 1845, et d'autres savants avaient déjà souligné diverses méthodes possibles, et c'est sans aucun doute l'invention, par Sprengel, d'une pompe à vide appropriée qui permit enfin à ce mode d'èclairage de réussir.

En collaboration avec G. H. Stearn, qui avait fourni des ampoules en verre soufflé et y avait créé le vide, Swan anonça pour la première fois sa découverte en 1878, démontra le bon fonctionnement d'une ampoule au début de 1879, et lança la production d'ampoules à l'echelle commerciale en 1881. De son côté, Edison, qui travaillait avec de nombreuses équipes en Amérique, découvrait en même temps que Swan la nécessité de chauffer le filament durant la mise sous vide de l'ampoule afin de débarraser cette dernière des gaz: il réussit sa première ampoule et la breveta en 1879. Vers la fin de 1879, il obtint un brevet britannique quelques mois avant que Swan ait déposé sa propre demande. Et en 1880, il produisait et commercialisait déjà des ampoules électriques.

Swan et Edison semblaient donc destinés à rivaliser; en fait, ils décidèrent de s'associer, avec d'excellents résultats. Par la suite, Swan mit à profit sa découverte de la soie artificielle pour la réalisation d'un filament en cellulose carbonisée qui remplaça le bambou carbonisé utilisé par Edison.

Les premières ampoules à filament en tungstène furent mises sur le marché par la General Electric Company of America en 1910 et furent suivies, vers le milieu des années Vingt, par des ampoules à atmosphère gazeuse. Les lampes à vapeur de mercure et de sodium furent mises au point et commercialisées au début des années Trente et furent suivies, en 1940, par le tube fluorescent qui, durant le black-out de la guerre, assura l'éclairage des usines d'Angleterre.

Depuis lors, les progrès ont été spectaculaires, et nos deux inventeurs auraient été grandement enthousiasmés par les éclairages contemporains, qui démontrent une fois de plus que la nouvelle technique d'aujourd'hui deviendra banale demain.

LA TECHNOLOGIE DES PHARES D'AUTOMOBILE 5

K. R. Wolfe

Les ampoules au tungstène-halogène constituent probablement le progrès le plus important dans le secteur des phares d'automobile survenu depuis 1920; elles ont considérablement amélioré la visibilité, tout en réduisant les risques d'éblouissement. Le réglement No. 20 (2) de la CEE exige des constructeurs qu'ils resserrent leurs spécifications. En ce qui concerne l'ampoule de phare H4 (à double filament), la construction à monture plate exclusive de Thorn a résolu bon nombre des problèmes inhérents à la fabrication. Elle permet en effet d'établir plus aisément les plans de référence intérieurs que ne le permettent les supports de filament à fil rond.

Cette nouvelle technique permet par ailleurs la fixation par serrage des extrémités du filament sur la monture, ce qui évite les manques de précision et les risques de surchauffe durant le soudage. On évite ainsi également d'avoir à utiliser un lourd pont de verre de quartz afin de maintenir la rigidité nécessaire de l'ensemble de support durant cette opération. Les fils de faible diamètre sont éliminés par fusion contrôlée après scellement du filament dans l'ampoule au moyen d'un champ à haute fréquence localisé.

Le réflecteur qui contrôle l'éclairage du filament "code" est soudé au laser sur le support. Cette méthode, associée à un positionnement ultra-précis des filaments obtenu grâce à la technique du "métal plat", produit une ampoule H4 exceptionnellement robuste et très avancée, au point de vue technique, par rapport à la majorité des ampoules H4.

TENDANCES DES ÉCLAIRAGES DE BUREAU 8

W. K. Lumsden

Les tâches de nature administrative ne se limitent pas à celles qui s'effectuent dans des bureaux; néanmoins, la conception des éclairages demeure la même quelle que soit la fonction du bâtiment qu'ils équipent.

A l'époque de l'éclairage incandescent, les bureaux étaient décorés d'une véritable forêt de luminaires suspendus, ces éclairages étant le plus souvent positionnées de manière à éclairer des plans de travail donnés. On évitait alors tout éblouissement par rayonnement direct en prévoyant une découpe de 30° pour montage de réflecteurs, ou en utilisant des verres de type opale largement dimensionnés pour entourer les lampes. Ces diverses solutions fournissaient un plage d'éclairement située entre 75 et 160 lux.

Bien que l'on ait continué à produire des ensembles d'éclairage de bureaux basés sur les lampes à incandescence jusqu'au début des années 60, l'éclairage fluorescent commença être utilisé dans la plupart des bureaux vers la fin des années 60. Les tubes fluorescents assuraient un éclairement moyen de 160 lux pratiquement sans zones d'ombre mais, comme les murs et les plafonds étaient éclairés plus brillamment, et que les tubes produisaient une lumière froide par rapport aux éclairages à incandescence, bien des gens les trouvaient déplaisants.

Au fur et à mesure que les valeurs d'éclairement recommandées augmentaient, l'éblouissement causé par les luminaires présentait un problème de plus en plus grave. On commença donc à produire des luminaires à basse luminance, mais ces derniers donnaient parfois l'impression que les pièces étaient insuffisamment éclairées, ceci étant dû à la diminution de la lumière réfléchie par les murs et plafonds. Vers le milieu de 1960, la S.I.E. (Société des Ingénieurs Eclairagistes) mit au point le système des indices d'éblouissement. Les niveaux d'éclairement recommandés continuèrent à augmenter, mais sans l'amélioration de l'éblouissement que l'on attendait — même à des valeurs atteignant 1000 lux.

Le code S.I.E. actuel recommande des coefficients d'éclairement correspondant à diverses tâches, mais sans tenter d'évaluer l'éblouissement. Il n'existe en fait aucun moyen de spécifier cette dernière, et il semblerait donc impératif d'entreprendre des recherches dans ce secteur puisque, même si une installation donnée est conforme en tous points aux stipulations du code S.I.E. le plus récent, l'éblouissement inhérent à chaque tâche dépendra de l'expérience et des talents du concepteur de l'éclairage concerné.

LE VERRE ET LA LUMIÈRE 13

Martin Harrison et R. C. Aldworth

L'exposition "Verre et Lumière" patronnée par Thorn en juillet dernier et présentée au Royal Exchange de Londres, coïncida avec un regain de popularité du vitrail. Il est néanmoins difficile de savour si l'avenir nous réserve une renaissance du vitrail.

Au début du XXème siècle, les oeuvres abstraites des maîtres-verriers Voysey, Bailley, Scott et Mackintosh étaient grandement admirés en Europe; néanmoins, après 1905 ou vers cette date, les artistes britanniques revinrent au figuratif et ce n'est que durant la décade 1950 que John Piper remit en vogue ce que l'on pourrait dénommer l'Art Moderne du vitrail.

Simultanément, en Allemagne, Prikker, Klee, Albers et Van Doesburg mettaient en oeuvre une tradition d'esprit plus contemporain, très proche de celui du Bauhaus détruit par Hitler. Durant les années 50, une nouvelle école inspirée par Georg Meistermann comptait parmi ses principaux disciples Schaffrach et Schreiter, tous deux pionniers du vitrail abstrait et de style "architectural".

Les vitraux, normalement éclairés par la lumière du jour, présentent certains problèmes en ce qui concerne la présentation à la lumière artificielle mais, dans le cadre d'une exposition telle que "Verre et Lumière", les divers vitraux ont été montés dans des "boîtes à lumière" contenant des tubes fluorescents. Comme l'on disposait, au Royal Exchange, de toute la place nécessaire, ces "boîtes" furent réalisées dans des dimensions suffisantes pour permettre à un homme debout de changer les tubes en question. Le plus difficile était de pouvoir régler la luminosité de surface des divers vitraux exposés de manière à ce qu'un grand vitrail en verre relativement peu teinté ne risque pas d'éteindre, par contraste, un vitrail adjacent plus petit et doté de couleurs plus denses. On fit donc appel à des tubes fluorescents "Natural", leur excellent rendu des couleurs couvrant de manière adéquate la vaste gamme de vitraux exposés, tandis que l'apparence de couleur froide qu'ils émettent, simulait bien celle du jour.

Le succès de cette exposition aboutira peut-être — nous l'espérons du moins — à une réapparition du vitrail dans la vie de tous les jours.

ECLAIRAGE DE TERRAINS DE JEUX DE CLUBS SPORTIFS 18

D. C. T. Brooks

Bien que l'eclairage par projecteurs de divers stades au niveau d'éclairement requis par la télévision en couleur ait déjà fait l'objet de descriptifs dans plusieurs éditions du *Lighting Journal,* ce n'est que récemment que l'éclairage de clubs de moindre importance a commencé à recevoir une plus grande attention. La combinaison des exigences portant sur les économies d'énergie et le nombre toujours croissant de spectateurs désirant assister à des matches disputés en soirée a abouti à la mise en oeuvre des systèmes 1500W MBIL, dont l'apport en ce domaine est significatif.

Ces systèmes peuvent être installés à titre de matériel entièrement nouveau, ou encore servir de remplacement à un système au tungstène-halogène analogue, mais moins efficace. Dans l'un ou l'autre cas, la planification et la préparation d'un éclairage par lampes aux iodures métalliques peuvent se faire sans difficulté. La solution la plus fréquemment adoptée est de prévoir quatre pylônes de 16 m à monter de chaque côté du terrain, ces pylônes portant chacun deux luminaires ON1600. Les "gros travaux", creusement de tranchées et préparation de fondations en béton par exemple, peuvent en de nombreux cas être menés à bien par des membres du club, les travaux plus spécialisés étant confiés à une entreprise d'électricité. Au Royaume Uni, il est nécessaire d'obtenir en premier lieu un permis de construire, et l'on doit également parfois négocier les droits de passage requis pour l'installation des câbles d'alimentation.

Le choix entre des pylônes articulés pouvant être abaissés et relevés au moyen de vérins hydrauliques, ou de pulônes en treillis métallique munis d'échelles solidaires dépendra en grande partie des conditions locales. La présence d'une tribune couverte peut également exercer une certaine influence sur ce choix. Tous les travaux de nature électrique devront être effectués par une entreprise qualifiée, et devront être conformés en tous points aux réglements locaux et nationaux.

La technique de base peut être utilisée, avec les variantes appropriées, pour un grand nombre de sports ainsi que pour l'éclairage de certaines zones industrielles, parcs de camions par exemple. La lampe 1500W MBIL montée dans le projecteur ON1600 est un luminaire polyvalent qui, en règle générale, fournit toujours une solution satisfaisante aux problèmes d'éclairage extérieur par projecteurs.

LUMIÈRE DANS L'ART DENTAIRE 24

G. L. Adams et E. J. G. Beeson

La plupart des gens connaissent bien le scyalitique, cette lampe spéciale qu'utilisent les dentistes pour obtenir un petit faisceau de lumière contrôlé avec précision de manière à éclairer la bouche du patient sans lui causer aucune gêne au niveau des yeux. Le type de lampe décrit dans cet article ne constitue pas un mode d'éclairage, mais sert à produire une modification d'ordre photochimique de la matière utilisée par les dentistes pour la remise en état ou la reconstitution des dents.

L'industrie en général fait appel à de nombreuses formes d'irradiation dans le but d'apporter des modifications chimiques aux polymères, de les durcir ou de les fixer. La majeure partie de ces procédés concerne l'irradiation de grandes surfaces tandis que le dentiste doit traiter des surfaces minuscules, mais travailler en profondeur. Il doit donc disposer d'une source de rayons produisant un faisceau de faibles dimensions mais intense, avec irradiation dans la partie visible du spectre. Cette solution est préférable à l'emploi des ultra-violets, puisque cette partie du spectre ne présente aucun danger.

Le polymère "Photofil" utilisé pour les interventions dentaires n'est pas suffisamment sensible à la plupart du spectre visible pour durcir en cours d'application, mais durcira rapidement lorsqu'exposé à une lumière ultra-violette très intense. La source initiale est fournie par une lampe au tungstène-halogène montée dans un réflecteur dichroïque. Le faisceau ainsi produit traverse des filtres regroupés dans une enceinte que tient le dentiste, puis est dirigé sur la dent au moyen d'une tige de focalisation en silice munie d'un embout spécialement conçu pour éviter tout éblouissement du dentiste durant l'application.

Ce système présente un grand avantage, en ce qu'il réduit considérablement tant la durée de l'intervention que les pertes de matière associées à l'emploi des méthodes classiques.

In dieser Ausgabe.

PIONIERE AUF DEM GEBIET DER BELEUCHTUNG

2

H. R. Ruff

Swan und Edison werden zwar allgemein als die Pioniere der modernen Beleuchtung angesehen, aber waren nicht die ersten, die eine elektrisch betriebene Lichtquelle demonstrierten. 1700 war es Hawksby, 1810 Sir Humphrey Davy und 1845 Starr — und andere Personen, die mögliche Methoden aufzeigten, und es ist zweifellos der Erfindung einer zufriedenstellenden Vakuumpumpe durch Sprengel zuzuschreiben, daß diese Versuche schließlich zum Erfolg führten.

Swan, der mit G. H. Stearn zusammenarbeitete, der aus Glas geblasene Glühbirnen bereitstellte und diese evakuierte, gab seinen Erfolg im Jahre 1878 bekannt, demonstrierte eine erfolgreiche Lampe zu Beginn des Jahres 1879 und nahm 1881 die kommerzielle Herstellung von Lampen auf. Edison, der mit einem großen Team von Assistenten in Amerika arbeitete, duplizierte Swans Entdeckung, daß der Glühfaden während der Evakuierung der Glühbirne erhitzt werden muß, um die eingeschlossenen Gase auszuscheiden, und demonstrierte und patentierte seine erste erfolgreiche Lampe im Oktober 1879. 1880 war er bereits mit der Herstellung und Absetzung von Lampen beschäftigt, nachdem er gegen Ende 1879 einige Monate vor Swan das britische Patent angemeldet hatte.

Anfänglich sah es so aus, als ob die beiden Pioniere zu Rivalen werden würden, doch taten sie sich schließlich in einer Partnerschaft — mit äußerst positiven Resultaten — zusammen. Swan wendete seine Erfindung von Kunstseide später auf den wolframkarbidumkleideten Glühdraht an, der den von Edison verwendeten geschwärzten Bambus ersetzte.

Die ersten Wolframfadenlampen wurden von der americanischen General Electric Company im Jahre 1910 auf den Markt gebracht. In den mittleren 20er Jahren folgten mit Gas gefüllte Glühbirnen. Quecksilber- und Natriumdampflampen wurden dann zu Anfang der 30er Jahre entwickelt und auf den Markt gebracht, gefolgt von der Leuchtstoffröhre zur Beleuchtung der kriegsverdunkelten Fabriken Großbritanniens im Jahre 1940.

Seitdem ist der Fortschritt spektakulär, und die zwei Erfinder wären von den heutigen Lichtquellen stark beeindruckt! Dies beweist wieder einmal, daß eine Technik, die heutzutage neu ist, schon morgen zum Alltag gehört.

KFZ-LAMPENTECHNIK

5

K. Wolfe

Wolframhalogen-Scheinwerferlampen sind auf dem Kfz-Sektor die wichtigste Entwicklung seit den 20er Jahren unseres Jahrhunderts und haben die Visibilität stark verbessert und gleichzeitig die Blendwirkung herabgesetzt. Die ECE-Vorschrift Nr. 20 (2) stellt an die Hersteller die Forderung, die technische Konzeption weiter zu verbessern. Die H4-Scheinwerferlampe (mit Doppelfaden), in ihrer einzigartigen Flachbauweise von Thorn, hat viele Probleme der Herstellung gelöst. Interne Bezugsebenen sind wesentlich einfacher zu ermitteln, als dies bei Runddraht-Glühfadenträgern der Fall war.

Die neue Methode gestattet außerdem die Anklemmung der Glühfadenenden an das Gehäuse, wodurch Ungenauigkeiten vermieden und die Möglichkeit einer schweißbedingten Überhitzung ausgeschaltet werden. Außerdem entfällt die Notwendigkeit einer starken Quarzglasbrücke zur Erhaltung der Festigkeit der Trägerbaugruppe während dieses Verfahrens. Die feinen Brückendrähte werden durch kontrolliertes Fusionieren entfernt,. nachdem der Glühfaden mit Hilfe eines lokalisierten Hochfrequenzfeldes in die Glühbirne eingeschlossen wurde.

Der Reflektor, der das Licht vom Abblendlicht-Glühfaden lenkt, wird mit einem Laser am Gehäuse angeschweißt, was zusammen mit der überaus genauen Anordnung der Glühfäden, möglich durch die Flachmetallmethode, zu einer außergewöhnlich robusten Lampe führte, die technologisch den meisten H4-Lampen überlegen ist.

TRENDS IN DER BÜROBELEUCHTUNG

8

W. K. Lumsden

Sogenannte 'Büroarbeit' beschränkt sich zwar nicht nur auf Bürogebäude, aber die Beleuchtungsart ist die gleiche — unabhängig von der Funktion des Gebäudes, in dem die Arbeit ausgeführt wird.

In den Tagen der Wolframbeleuchtung kam ein Wald von Hängelampen zur Anwendung, und doch wurden die Leuchtkörper häufig nur für die Beleuchtung spezifischer Arbeitsgebiete eingesetzt. Eine direkte Blendwirkung wurde durch eine 30-Grad- Abschirmung bei Reflektorleuchten oder durch Verwendung großer Opalglaskästen für die Lampen reduziert. Die Werte für die zu erreichende Beleuchtungsstärke lagen zwischen 75 und 160 Lux.

Leuchtstoffröhren für Büros wurden gegen Ende der 50er Jahre sehr beliebt, obwohl auch noch zu Anfang der 60er Jahre Büros mit Glühlampenbeleuchtung ausgestattet wurden. Eine durchschnittliche Beleuchtungsstärke von 160 Lux mit nahezu schattenlosem Licht wurde erreicht, aber weil die Wände und Decken heller erleuchtet waren und das Licht im Vergleich zu Glühfadenlampen kälter, hatten viele Leute Einwände gegen 'Neonbeleuchtung'.

Mit dem Zunehmen von Beleuchtungsstärkewerten wurde die direkte Blendwirkung von Leuchten zu einem größeren Problem. Leuchten mit niedriger Helligkeit wurden eingeführt, die zuweilen den Eindruck erweckten, daß die Räume unzureichend erleuchtet waren, weil weniger Licht auf Wände und Decken fiel. In den mittleren 60er Jahren wurden von der IES (Beleuchtungstechnische Gesellschaft) Blendwirkungswerte eingeführt. Die empfohlenen Beleuchtungsstärkewerte stiegen weiterhin an, ohne eine erwartungsgemäße Verbesserung der Sicht zu bringen — nicht einmal bei Werten bis zu 1000 Lux.

Der zur Zeit geltende IES-Code empfiehlt Beleuchtungsstärkewerte für verschiedene Arbeiten, ohne gleichzeitig die Sicht zu bewerten. Es gibt auch tatsächlich keine Maßgabe, nach der Sicht vorgeschrieben werden kann. Es hat den Anschein, daß dieser Aspekt des Beleuchtungswesens noch weiter erforscht werden muß, denn, selbst wenn eine Installation allen Anforderungen des laufenden IES-Codes entspricht, hängt die Sicht noch immer von Erfahrungen und Fähigkeiten des einzelnen Beleuchtungsplaners ab.

GLAS UND LICHT

13

Martin Harrison und R. C. Aldworth

Die von Thorn unterstützte Glas/Licht-Ausstellung in der Royal Exchange in London im vergangenen Juli ergab sich zu einem Zeitpunkt, zu dem Farbglas seine frühere Beliebtheit zurückzuerhalten beginnt. Eine Vorhersage, ob dieses Wiederaufleben von Buntglas auch im Säkularbau eintreten wird, ist allerdings noch verfrüht.

Am Anfang des 20. Jahrhunderts wurden abstrakte Dessins aus Glas von Voysey, Bailley-Scott und Mackintosh weit und breit in ganz Europa bewundert, aber ungefähr nach 1905 kehrten britische Künstler wieder zu figurativen Dessins zurück, und erst in den 50er Jahren kam ein modernerer Stil in der Verwendung von Buntglas mit John Piper wieder auf.

In Deutschland entwickelten unterdessen Prikker, Klee, Albers und Van Doesburg eine modernere Tradition, die sich eng an den von Hitler zerstörten Bauhaus-Stil anlehnte. In den 50er Jahren wirkte eine neue Schule unter der Führung von George Meistermann und Teilnahme von Schaffrach und Schreiter sowohl in der abstrakten als auch architektonischen Behandlung von Buntglas bahnbrechend.

Buntglas, gewöhnlich von Tageslicht durchleuchtet, läßt sich nicht leicht in künstlicher Beleuchtung ausstellen, und die Glas/Licht-Ausstellung überwand das Problem dadurch, daß das Buntglas in Lichtkästen mit Leuchtstoffröhren montiert wurde. Dank der Großräumigkeit der Royal Exchange (Königl. Börse) konnten diese Lichtkästen so groß ausgeführt werden, daß die Lampen von einem in den Kästen stehenden Mann ausgewechselt werden können. Die größte Schwierigkeit bestand darin, die Helligkeit der Oberflächen der Exponate zu regeln, damit ein großes Fenster mit verhältnismäßig hellem Buntglas ein kleineres, möglicherweise dunkler gehaltenes daneben nicht vollkommen 'erdückt'. Es wurden Leuchtstoffröhren mit natürlichen Lichtfarben verwendet, da ihre Farbwiedergabe den mannigfachen Bereich der Buntglasexponate am besten zur Geltung brachte, während ihre 'kühle Wirkung' Tageslichtbeleuchtung simulierte.

Es besteht die Hoffnung, daß der Erfolg dieser Ausstellung zu einem Wiederaufleben der Verwendung von Buntglas führen wird.

BELEUCHTUNG FÜR SPORTPLÄTZE

18

D. C.T. Brooks

Obwohl Flutlicht für verschiedene Stadien bis zu dem Maß, das für die Fernseh-Verfilmung erforderlich ist, bereits in mehreren Ausgaben dieses Beleuchtungsjournals behandelt wurde, gewinnt die Beleuchtung kleinerer Sportplätze seit kurzem weiter an Bedeutung. Die Kombination von energiesparenden Anforderungen mit dem wachsenden Interesse des Publikums an Abend-Matchen hat zu der Verwendung von 1500-W-MBIL-Systemen geführt, die einen wertvollen Beitrag geleistet haben.

Die Installation eines solchen Beleuchtungssystems kann entweder von Grund auf neu sein. Es ist aber auch möglich, daß die Halogen-Metalldampflampen ein zwar ähnliches, aber weniger leistungsfähiges Wolfram-Halogen-System ersetzen sollen. In beiden Fällen brauchen Planung und Vorbereitung nicht mit Problemen verbunden zu sein. Die üblichste Lösung besteht darin, vier 16-m-Maste an jeder Seite eines Sportfeldes aufzustellen und mit zwei ON1600-Scheinwerfern je Maste zu bestücken. Schwere Hilfsarbeit, wie das Ausheben von Gräben und Legen von Betonfundamenten kann häufig von Klubmitgliedern verrichtet werden, so daß das Elektro-Installationsunternehmen nur für die Facharbeit verantwortlich ist. In Großbritannien muß eine Planungsbewilligung eingeholt werden, und zuweilen ist auch die Erhandlung von Wegerechten für die Elektrizitätsversorgung notwendig.

Die Wahl zwischen kippbaren Masten, die mit Hilfe eines Hydraulikheber angehoben und abgesenkt werden können, und stahlmasten mit steigsprossen hängt weitgehend von den örtlichen Bedingungen ab. Auch das Vorhandensein einer abgedeckten Tribüne kann ein mitbestimmender Faktor sein. Die elektrische Arbeit muß von einem Fachunternehmen ausgeführt werden und den örtlichen und für das ganze Land geltenden Bestimmungen entsprechen.

Diese grundlegende Methode kann mit örtlichen Variationen auf viele Sportarten und sogar industrielle Anlagen, wie z.B. Lkw-Parkplätze, angewendet werden. Die 1500-W-MBIL-Lamp in einem ON1600-Scheinwerfer ist ein vielseitiges Werkzeug, das eine ausgezeichnete Lösung für verschiedenartige Flutlicht-Beleuchtungszwecke im Freien darstellt.

DENTALTECHNIK UND-BELEUCHTUNG

24

G. L. Adams und E. J. G. Beeson

Die kompakte Form der Operationslampe, wie sie von Dentisten verwendet wird, ist allgemein bekannt. Sie liefert einen streng umgrenzten Lichtpunkt auf dem Mund des Patienten, ohne ihn schmerzhaft zu blenden. Die in diesem Artikel beschriebene Lampe wird nicht zur Beleuchtung verwendet, sondern zur Bewirkung eines photochemischen Wandels in dem vom Dentisten verwendeten Material, um Zähne zu plombieren und wieder aufzubauen.

Viele Strahlungsformen werden in der Industrie verwendet, um chemische Änderungen in Polymeren zu bewirken, z.B. um sie zu erhärten oder zu fixieren. In den meisten Fällen werden große Gebiete bestrahlt, doch in der Zahnheilkunde müssen nur sehr kleine Zonen und diese allerdings bis zu einer bestimmten Tiefe erfaßt werden, was eine kleine, intensive Strahlungsquelle im sichtbaren Teil des Spektrums notwendig macht, das dem UV-Spektrum vorgezogen wird, weil es keine schädlichen Wirkungen hat.

Das 'Photofil'-Polymer, das für die Instandsetzung von Zähnen verwendet wird, ist gegenüber dem Großteil des sichtbaren Spektrums nicht empfindlich genug, um zu erhärten, während es auf dem Zahn des Patienten aufgetragen wird, erhärtet aber schnell unter der Einwirkung eines intensiven Violettlichtes. Eine Wolfram-Halogen-Lampe in einem Zweifarbenreflektor stellt die ursprüngliche Lichtquelle, die durch Filter in einem handgehaltenen Gehäuse geleitet und schließlich mit Hilfe eines fokussierten Quarzstabs, der zur Vermeidung der Blendgefahr für den Dentisten mit einer Schutzspitze versehen ist, auf den Zahn gelenkt wird.

Das System bietet den Vorteil, daß die Operationszeit wesentlich verkürzt, und die Abfallmenge, die bei Anwendung von üblichen Methoden anfallen würde, verringert werden.

En esta edición.

PIONEROS DE LA ILUMINACIÓN 2

H. R. Ruff

A pesar de que Swan y Edison son generalmente considerados los pioneros de la iluminación moderna, no fueron ellos los primeros a demostrar una fuente de luz accionada eléctricamente. Hawksby en 1700, Sir Humphrey Davy en 1810, Starr en 1845 y otros, indicaron posibles métodos y fue sin duda la invención de una bomba de vacío satisfactoria de Spengel lo que les llevo al éxito final.

Swan, trabajando con G. H. Stearn, quien suministró y evacuó las bombillas de vidrio, anunció su éxito por la primera vez en 1878, demostró con éxito una lámpara en 1879 y empezó a fabricar lámparas comercialmente en 1881. Edison, trabajando con un gran equipo de ayudantes en Norteamérica, duplicó el descubrimiento de Swan sobre la necesidad de calentar el filamento durante la evacuación de la bombilla a fin de eliminar los gases ocluídos, y demostró y patentó con éxito la primera lámpera en 1879. En 1880 ya se encontraba produciendo y comercializando lámparas, y obtuvo una patente británica a finales de 1879 unos meses antes de que Swan hiciera una solicitud para lo mismo.

Al principio parecía que serían rivales, sin embargo, más tarde, establecieron una sociedad con resultados muy fructuosos. Swan, más tarde, aplicó su invención de seda artificial al filamento de celulosa que reemplazó el bambú carbonizado usado por Edison.

Las primeras lámparas con filamento de tungsteno fueron comercializadas por la General Electric Company de los EE.UU. en 1910, seguidas de bombillas rellenas de gas a mediados de la década del veinte. Las lámparas de descarga de mercurio y sodio se desarrollaron y comercializaron a principios de la década del treinta, seguidas en 1940 por la introducción del tubo fluorescente para iluminar los oscurecidas fábricas del Reino Unido en la época de la guerra mondial.

Desde entonces, el progreso ha sido extraordinario y los dos inventores estarían impresionadísimos con las actuales fuentes de luz, considerando siempre que la nueva técnica de hoy se toma común en el futuro.

TECNOLOGÍA DE LÁMPARAS PARA AUTOMOVILES 5

K. R. Wolfe

Las bombillas tungsteno-halogenos para faroles son tal vez el desarrollo más importante en este campo desde la década de los veinte y han mejorado la visibilidad sobremanera reduciendo el brillo. El reglamento Num.20(2) del MCE exije que los fabricantes sean más estrictos con sus especificaciones. En el caso de la bombilla para faroles tipo H4 (filamento doble), la extraordinaria montura plana Thorn ha resuelto muchos de los problemas de fabricación. Los planos de referencia interna se establecen con más facilidad que con el usa de soportes de filamento de alambre redondo.

La nueva técnica también permite que los extremos del filamento se fijen a la armazón suminstrando exactitud y evitando el sobrecalentamiento del soldeo. Tambiém elimina la necesidad de un puente de vidrio de cuarzo pesado de soporte durante este proceso. Los finos alambres de puenteo se retiran por medio de fusión controlada por medio de un campo local de alta frecuencia después que se ha encerrado el filamento en la bombilla.

El reflector que controla la luz del filamento de la luz baja, es soldado por medio de un laser a la armazón, y esto, junto con la exacta localización de los filamentos posibilitada por la técnica del metal plano, trae como resultado una lámpara de excepcional robustez, tecnológicamente más avanzada que la mayoría de las lámparas H4.

TENDENCIAS EN LA ILUMINACIÓN DE OFICINAS 8

W. K. Lumsden

Los trabajos del tipo oficina no están restringidos a las oficinas, pero el enfoque del diseno de su iluminación es el mismo a despecho de la función del edificio en que se encuentran.

En los días de la iluminación incandescente, se usaba un bosque de fijaciones colgantes, sin embargo el equipo de iluminación se usaba a menudo para iluminar áreas específicas. El brillo directo estaba limitado por la disposición de un corte de 30° para reflectores o usando pantallas grandes de ópalo para las lámparas. Se suministraban valores de iluminación de 75-160 lux.

La iluminación fluorescente para oficinas se generalizó a finales de la década del cincuenta a pesar de que todavía se usaban esquemas incandescentes a principio de la década del sesenta. Se producía una iluminación promedio de 160 lux casi libre de sombras, sin embargo como las paredes y techos estaban brillantemente iluminados y la luz era fría comparada con la de las lámparas de filamento, mucha gente la encontraba poco satisfactoria.

Conforme aumentaban las valores recomendadas para la iluminación, el brillo directo de las luminaries se formaba un problema más y más serio. Las luminarias de baja brillo fueron introducidas dando a veces la impresión de que los cuartos no estaban suficientemente iluminados debido a la disminuición de la luz en las paredes y techos. A mediados de la década del sesenta el sistema de valores de brillo fue introducido por IES. Las recomendaciones continuaron aumentando, pero sin la mejoría esperada en la visibilidad, aun con valores de 1000 lux.

El código actual del IES recomienda valores para varios trabajos pero no evalúa la visibilidad; en realidad, no hay forma de especificar la visibilidad. Parece ser que se hace necesario una investigación sobre este aspecto del diseno de la iluminación ya que, aunque una instalación esté de acuerdo totalmente con el código actual de IES, la visibilidad para un trabajo dependerá de la experiencia y habilidad de cada diseñador de iluminación.

VIDRIO Y LUZ 13

Martin Harrison y R. C. Aldworth

La exposición de vidrio y luz, patrocinada por Thorn, en el Royal Exchange, Londres, el pasado mes de julio llegó en el momento en que el vidrio de color está alcanzando nueva popularidad. Sin embargo, todavía es pronto para decir si estamos a punto de presenciar una nueva época en el sentido secular de su uso.

A principios del siglo XX, los diseños abstractos en vidrio de Voysey, Bailley-Scott y Mackintosh, eran muy admirados en Europa, sin embargo a partir de alrededor de 1905, los diseñadores británicos volvieron a los diseños figurativos y fue solamente en 1950 cuando John Piper resucitó el enfoque más moderno del vidrio de colores.

Mientras tanto, en Alemania, Prikker, Klee Albers y Van Doesburg desarrollaron una tradición más moderna estrechamente relacionada con la Weimar Bauhaus destruida por Hitler. En 1950 una nueva escuela dirigida por Georg Meistermann incluía Schaffrach y Schreiter, ambos pioneros del abstracto y el tratamiento arquitectónico de este vidrio.

El vidrio de colores, iluminado normalmente por la luz del día, presenta problemas de exposición bajo la luz artificial, pero en una exposición a cubierto como la de vidrio y luz, aquel se puede exponer montado en "cajas de luz" con tubos fluorescentes. Como había suficiente espacio en el Royal Exchange, estas cajas eran lo suficientemente grandes para que un hombre cambiase las lámparas trabajando desde dentro de las cajas. El problema principal fue regular el brillo de la superficie del material expuesto de forma que una ventana grande de vidrio con cierta transparencia no ofuscase una más pequeña y menos transparente que se encontrase junto a ella. Se usaron tubos fluorescentes "Naturales" ya que su emisión de luz cubre de forma adecuada la gran gama de vidrios de colores estimulando con su aparencia el simulacro de un cielo diurno.

Se espera que el éxito de esta exposición nos lleve a un renacimiento del uso del vidrio de colores.

LA ILUMINACIÓN DE LOS CAMPOS DE LOS CLUBES DEPORTIVOS 18

D. C. T. Brooks

A pesar de que la iluminación nocturna para los varios estadios de acuerdo al nivel requerido por la televisión en colores ha sido descrita en varias ediciones del *Lighting Journal*, la iluminación de los clubes más pequeños ha crecido en importancia últimamente. La combinación de los requisitos de conservación de energía y el creciente número de espectadores en los juegos nocturnos ha llevado al uso de sistemas 1500W MBIL que han tenido una contribución magnífica a este arte.

Este esquema de iluminación puede ser nuevo, o las lámparas de mercurio-haloide pueden reemplazar un esquema de cuarzo-iodo similar, pero menos eficiente. De todas formas el planeamiento y la preparación no son difíciles. La solución más común es suministrar cuatro columnas de 16 m a cada lado del campo con dos luminarias ON1600 en cada una. El trabajo básico, como la excavación de trincheras y preparar los cimientos de hormigón podrá ser hecho a menudo por los socios del club, dejando el trabajo especializado en las manos del contratista de trabajos eléctricos. En el Reino Unido se debe obtener un permiso oficial y e veces se deben negociar vías para el suministro de electricidad.

La alternativa entre columnas embisagradas que se pueden levantar o bajar por medio de un gato hidráulico y torres de celosía con escaleras incorporadas,. quedará determinada por las condiciones locales. La presencia de una tribuna cubierta podrá afectar esta decisión. Todo el trabajo eléctrico deberá ser hecho por un contratista calificado y estará de acuerdo con reglamentos nacionales y locales.

La técnica básica se puede aplicar con variaciones locales a un número de deportes, y a áreas industriales como parqueamientos de camiones. La lámpara 1500 MBIL en el proyector ON1600 es una herramienta de usos múltiples que puede normalmente suministrar una solución satisfactoria para las necesidades de la iluminación al aire libre.

LUZ PARA LA ODONTOLOGÍA 24

G. L. A. Adams y E. J. G. Beeson

La mayoría de las personas está familiarizada con la forma compacta de la lámpara de operaciones usada por los dentistas para suministrar un foco de luz controlado y de gran definición sobre la boca del paciente sin causarle molestias visuales. El tipo de lámpara descrita en este artículo no se usa para la iluminación sino para causar un cambio fotoquímico en el material usado por los dentistas para conformar y restaurar los dientes.

En la industria se usan muchas formas de radiación para llevar a cabo cambios químicos en polímeros, para endurecerlos o fijarlos. Muchos de estos se dedican a la irradiación de grandes áreas, pero en dentística muchas áreas pequeñas se pueden cubrir muy bien con el auxilio de una fuente de radiación pequeña pero intensa en la parte visible del espectro, lo que es preferible al del UV porque no tiene efectos negativos.

El polímero 'Photofil' usado para los cuidados dentales no es los suficientemente sensible a la mayor parte del espectro visible para que se endurezca durante su aplicación en la boca del paciente, pero se endurece rápidamente bajo una gran intensidad de luz violeta. Una lámpara de cuarzo-iodo en un reflector dicróico suministra la fuente inicial de luz que pasa a través de filtros en un alojamiento manual y se dirije finalmente hacia el diente por medio de una varilla de silicio enfocada y acoplada con una punta de seguridad para evitar el riesgo del brillo al dentista.

El sistema tiene la ventaja de acortar materialmente el tiempo necesario para llevar a cabo la operación y también reduce la cantidad de material desperdiciado que puede ocurrir al aplicarse los métodos tradicionales.

In questa edizione.

PIONIERI DELL'ILLUMINAZIONE 2

H. R. Ruff

Benché Swan e Edison vengano generalmente considerati i pionieri dell'illuminazione moderna, essi non furono i primi ad ottenere una fonte luminosa dall'energia elettrica. Hawksby nel 1700, Sir Humphrey Davy nel 1810, Starr nel 1845 ed altri indicarono ulteriori possibili metodi e fu senza dubbio l'invenzione di una pompa per fare il vuoto da parte di Sprengel che portò al loro successo definitivo.

Lavorando con G. H. Stearn, che forní e svuotò le ampolle di vetro soffiato, Swan annunciò per la prima volta la sua realizzazione nel 1878, espose con successo una lampada agli inizi del 1879 e cominciò a produrle commercialmente nel 1881. Lavorando con un numeroso gruppo di assistenti in America, Edison riprodusse la scoperta di Swan, cioè che occorrev a riscaldare il filamento durante il processo di svuotamento dell'ampolla per eliminare gas occlusi ed espose, brevettandola, la sua prima lampada nell'ottobre 1879. Nell 1880 egli produsse e mise in commercio le lampade e verso la fine del 1879 egli ottenne un brevetto inglese, alcuni mesi prima che anche Swan lo richiedesse.

Inizialmente sembrò che sarebbero divenuti rivali, ma in effetti Swan ed Edison si associarono con ottimi risultati. Successivamente Swan applicò la sua invenzione della seta artificiale al filamento di cellulosa carbonizzata che rimpiazzò il bambù carbinizzato usato da Edison.

Le prime lampade a filamento di tungsteno vennero messe in commercio dalla General Electric Company of America nel 1910, seguite verso la metà degli anni venti da lampade riempite di gas. Le lampade a vapori di mercurio e a vapori di sodio vennero sviluppate e messe in commercio agli inizi degli anni trenta, seguite nel 1940 dall'introduzione del tubo a fluorescenza per illuminare le fabbriche inglesi nell'oscuramento durante la guerra.

Da quel momento sono stati fatti progressi spettacolari ed i due inventori sarebbero rimasti molto colpiti dalle sorgenti luminose di oggi, che dimostrano la verità dell'affermazione che le nuove tecniche di oggi diventano la norma nel domani.

TECNOLOGIA DELLE LAMPADE PER AUTOMOBILI 5

K. R Wolfe

Le lampade alogene a tungsteno per proiettori rappresentano forse lo sviluppo più importante in questo campo dopo gli anni venti, migliorando notevolmente la visibilità e riducendo l'abbagliamento. La norma ECE n. 20 (2) stabilisce che i fabbricanti si attengano a specifiche più severe. Nella lampada per proiettori H4 (a doppio filamento) molti problemi di fabbricazione sono stati risolti dall'esclusiva caratteristica Thorn della montatura piatta. I piani di riferimento interno possono essere stabiliti più facilmente che non impiegando supporti di filamento in filo rotondo.

La nuova tecnica consente anche di bloccare le code del filamento alla montatura, evitando inesattezze e la possibilità di surriscaldamento dovuto alle operazioni di saldatura. Si elimina anche la necessità di un pesante ponte di vetro di quarzo per mantenere la rigidità del supporto durante questo processo. I sottili fili di collegamento vengono rimossi mediante fusione controllata dopo aver sigillato il filamento nell'ampolla mediante un campo di alta frequenza localizzato.

Il riflettore che comanda l'emissione di luce dal filamento del fascio anabbagliante è saldato a laser sul telaio e tutto ciò, unito alla grande precisione di posizionamento dei filamenti resa possibile dalla tecnica del metallo piatto, dà come risultato una lampada eccezionalmente robusta, tecnologicamente all'avanguardia rispetto alla maggioranza delle lampade H4.

TENDENZE NELL'ILLUMINAZIONE DEGLI UFFICI 8

W. K. Lumsden

Le varie attività svolte negli uffici non sono limitate agli uffici stessi; tuttavia la progettazione per la loro illuminazione è la stessa, indipendentemente dalla funzione dell'edificio in cui si svolgono.

Ai tempi dell'illuminazione a tungsteno veniva impiegata una grande quantità di apparecchi di illuminazione pensili; molto spesso gli apparecchi venivano ubicati in modo da illuminare particolari aree. L'abbagliamento diretto veniva limitato da uno schermo a 30° per i riflettori o usando grandi diffusori in vetro opalino per le lampade. Venivano forniti valori di illuminamento di 75-160 lux.

Verso la fine degli anni cinquanta l'illuminazione a fluorescenza per uffici cominciò a divenire di uso generale, benchè agli inizi degli anni sessanta venissero ancora fatti progetti a incandescenza. Fu prodotta un'illuminazione media di 160 lux quasi completamente priva di ombre, ma poichè le pareti ed i soffitti erano illuminati più brillantemente e la luce era fredda rispetto a quella delle lampade a filamento, molti trovarono questi progetti poco soddisfacenti.

Con l'aumento dei valori di illuminazione consigliati, l'abbagliamento diretto degli apparecchi di illuminazione divenne un problema più serio. Vennero introdotti apparecchi di illuminazione a bassa luminosità che a volte davano l'impressione che le stanze non fossero sufficientemente illuminate a causa della minore luminosità sulle pareti e i soffitti. Verso la metà degli anni sessanta venne introdotto dalla IES il sistema di indice di abbagliamento. I valori di illuminamento consigliati continuarono ad aumentare senza tuttavia ottenere un miglioramento della visibilità, anche a valori di 1000 lux.

L'attuale, Codice IES raccomanda i valori di illuminamento per le diverse applicazioni ma non cerca di valutare la visibilità; anzi, non esiste un modo per poter determinare la visibilità. Un'ampia ricerca è necessaria per quanto riguarda questo aspetto del design dell'illuminazione, perché anche se un'installazione soddisfa sotto ogni punto di vista il Codice IES, la visibilità specifica dipende dall'esperienza e dall'abilità del singolo progettista delle illuminazioni.

VETRO E LUCE 13

Martin Harrison e *R. C. Aldworth*

L'esposizione "Glass/Light" sponsorizzata dalla Thorn ed organizzata nel luglio scorso nella Royal Exchange a Londra, ha avuto luogo in un momento in cui il vetro colorato sta riacquistando la sua popolarità, tuttavia è ancora presto per decidere se una ripresa del suo impiego in applicazioni "laiche" è probabile.

Agli inizi del XX secolo i disegni astratti in vetro di Voisey, Bailley, Scott e Mackintosh furono molto ammirati in Europa, ma, dopo il 1905, i disegnatori inglesi tornarono ai disegni figurativi e fu solo nel 1950 che John Piper rinnovò un'impostazione più moderna dell'impiego del vetro colorato.

Nel frattempo in Germania Prikker, Klee, Albers e Van Doesburg sviluppavano una tradizione più moderna, strettamente collegata con la Weiner Bauhaus distrutta da Hitler. Negli anni cinquanta una nuova scuola di cui fu a capo Georg Meistermann incluse comprese Schaffrach e Schreiter, entrambi pionieri nel trattamento astratto ed architettonico dei vetri istoriati.

I vetri istoriati che vengono normalmente illuminati dalla luce del giorno, presentano problemi con l'illuminazione artificiale, ma in una esposizione quale "Glass/Light", i vetro colorati possono essere montati in "cassette luminose" contenenti tubi fluorescenti. Dato che nella Royal Exchange non mancava lo spazio, queste cassette furono costruite sufficientemente grandi in modo che le lampade potessero essere sostituite da un uomo in piedi all'interno delle stesse. Il problema principale era rappresentato da come regolare la luminosità della superficie degli articoli esposti, in modo che una finestra grande con vetri relativamente trasparenti non offuscasse una finestra più piccola con colori forse più densi che si trovasse accanto. Vennero usati tubi fluorescenti a luce "naturale" che davano risalto ai colori della vasta gamma dei vetri istoriati mentre il loro aspetto fresco simulava il cielo di giorno.

E'auspicabile che il successo ottenuto da questa esposizioni porti a una ripresa nell'impiego dei vetri istoriati.

ILLUMINAZIONE DI CAMPI SPORTIVI DEI CLUB 18

D. C. T. Brooks

Benché l'illuminazione a proiezione di numerosi stadi al livello necessario per la televisione a colori sia già stato descritto in molti numeri del *Lighting Journal,* l'illuminazione di campi sportivi più piccoli ha raggiunto di recente una certa importanza. La necessità di risparmiare energia, unita al crescente numero di spettatori che assistono ad avvenimenti sportivi serali, hanno portato all'impiego dei sistemi MBIL 1500W, i quali hanno apportato un notevole contributo all'arte dell'illuminazione.

Questo sistema di illuminazione può rappresentare un nuovo criterio; oppure le lampade a ioduri metallici possono sostituire un simile, ma forse meno efficiente, sistema con lampade ad alogeno in entrambi i casi la progettazione e la preparazione non dovrebbero presentare problemi. La soluzione più comune è di fornire quattro colonne di m 16 sui lati del campo, ciascuna con due apparecchi di illuminazione ON1600. I lavori più pesanti, quali lo scavo delle trincee e la preparazione delle fondamenta in calcestruzzo, possono spesso essere eseguiti dagli stessi soci del circolo sportivo, lasciando la parte elettrica all'appaltatore specializzato. In Gran Bretagna per questi lavori occorre chiedere l'autorizzazione alle autorità competenti ed a volte bisogna condurre trattative per ottenere il diritto al passaggio dell'alimentazione elettrica.

La scelta tra piloni snodati, che possono essere alzati o abbassati mediante un martinetto idraulico, e piloni a traliccio con scala a pioli incorporata, dipende in larga misura dalle condizioni locali. La presenza di una tribuna coperta potrebbe essere un fattore determinante. Tutti gli impianti elettrici devono essere eseguiti da tecnici qualificati e soddisfare le norme locali e nazionali.

La tecnica di base può essere applicata, con le opportune modifiche dettate dalle condizioni locali, a vari sport e ad aree industriali, come per esempio parcheggi di autotreni. La lampada MBIL 1500W nel proiettore ON1600 è un elemento molto versatile che può offrire una soluzione soddisfacente per le esigenze di illuminazione all'aperto.

TECHNOLOGIA E LUCE PER STUDI DENTISTICI 24

G. L. Adams e *E. J. G. Beeson*

Quasi tutti conoscono il tipo di lampada compatta usata dai dentisti per avere una macchia di luce ben definita e controllata sulla bocca del paziente senza causargli noia agli occhi. Il tipo di lampada descritta nel presente articolo non viene usata per illuminazione, bensí per creare dei cambiamenti fotochimici nel materiale usato dai dentisti per ricostruire e curare i denti.

Molte forme di radiazione vengono utilizzate nell'industria per ottenere cambiamenti chimici nei polimeri, per indurirli o fissarli, e quasi tutte riguardano l'arradiazione di grandi superfici. In odontoiatria, invece, occorre concentrare le radiazioni in profondità su piccole superfici ed è pertanto necessaria una sorgente intensa di radiazioni nella parte visibile dello spettro, che viene preferita a quella nella fascia ultravioletta perchè non è causa di effetti dannosi.

Il polimero "Photofil", che viene impiegato in odontoiatria, non è sufficientemente sensibile alla maggior parte dello spettro visibile per indurirsi mentre viene applicato al dente del paziente, ma indurisce rapidamente sotto una forte intensità di luce violetta. Una lampada ad alogeno in un riflettore dicroico fornisce la sorgente di luce iniziale che viene fatta passare in filtri contenuti in un apparecchio da tenere in mano ed infine diretta sul dente mediante una bacchetta di silice focalizzata e dotata di punta di sicurezza per eliminare il pericolo di abbagliamento del dentista.

Questo sistema presenta il vantaggio di ridurre il tempo necessario per l'operazione, nonché gli sprechi che si avrebbero se venissero applicati i metodi normali.

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BELYSNINGSTEKNIKENS FÖREGÅNGSMÄN 2

H. R. Ruff

Även om Swan och Edison allmänt betraktas som den moderna belysningsteknikens pionjärer, var de inte de första som demonstrerade en elektrisk ljuskälla. Hawksby år 1700, Sir Humphrey Davy 1810, Starr 1845 och flera andra antydde tänkbara metoder. Det var utan tvivel Sprengels uppfinning av en tillfredsställande vakuumpump som slutligen ledde till framgång.

I samarbete med G. H. Stearn, som tillhandahöll och evakuerade de handblåsta glaskolvarna, tillkännagav Swan sitt uppnådda resultat 1878, demonstrerade en framgångsrik lampa i början av 1879 och började tillverka lampor handelsmässigt 1881. Swan upptäckte att det var nödvändigt att värma glödtråden under lampans evakuering för att bli av med inneslutna gaser. Edison och hans medarbetare i Amerika kopierade Swans upptäckt samt demonstrerade och patenterade sin första framgångsrika lampa i oktober 1879. Han tillverkade och marknadsförde lampor år 1880 och tog ut brittiskt patent 1879, några månader innan Swan lade in ansökan.

Det såg först ut som om de skulle bli rivaler, men i stället blev de kompanjoner och nådde mycket lyckade resultat. Swan anpassade senare sin uppfinning. I stället för konstsilke använde han förkolnad cellulosa till glödtråden. Cellulosan efterträdde Edisons förkolnade bambu.

De första glödlamporna med volframtråd marknadsfördes av General Electric Company i Amerika år 1910. Gasfyllda glödlampor kom i mitten på tjugotalet. Urladdningslampor med kvicksilver och natrium utvecklades och marknadsfördes i början på 30-talet och följdes 1940 av lysröret, som gav ljus år mörklagda fabriker i Storbritannien under kriget.

Sedan dess har framåtskridandet varit anmärkningsvärt. De båda uppfinnarna skulle ha blivit synnerligen imponerade av dagens ljuskällor, som bevisar sanningen i talesättet att dagens nya teknik är morgondagens vardagsföreteelse.

BILLAMPANS TEKNOLOGI 5

K. R. Wolfe

Det kanske viktigaste tillskottet bland billampor sedan 20-talet är halogenlampan med glödtråd av volfram. Denna lampa har avsevärt förbättrat sikten i mörker samtidigt som bländningsrisken minskat.

ECE-förordningen nr 20 (2) ålägger fabrikanterna att skärpa sina tillverkninsnormer för billampor. I H4-lampan (med dubbel glödtråd) har Thorns unika konstruktion löst många tillverkningsproblem. Interna referensplan i lampan är mycket lättare att fastställa än när man använder rundtrådsstöd.

Den nya tekniken gör det möjligt att få glödtrådens ändar att fästa vid stommen så att ojämnheter och överhettning undviks vid svetsningen.

Man behöver inte heller som tidigare använda en kraftig brygga av kvartsglas för att upprätthålla styvheten hos stödaggregatet. De fina bryggtrådarna avlägsnas genom reglerad smältning efter det att glödtråden har förslutits i lampkolven genom högfrekvensstrålning. Reflektorn som reglerar ljuset från halvljusträden lasersvetsas på stommen. Detta och den synnerligen noggranna placeringen av glödtråden (som möjliggjorts genom planmetoden) ger en utomordentligt stryktålig lampa, som tekniskt sett ligger steget före de flesta H4-lampor.

TRENDER INOM KONTORSBELYSNING 8

W. K. Lumsden

Under volframlampornas glansdagar hade man ofta en skog av hängande armaturer, som var placerade så att de skulle lysa upp specifika områden. Direkt bländande ljus avskärmades i 30° i reflektorarmaturer. Stora opala glaslampor användes också för att minska bländningen. Man erhöll belysningsstyrkor på 75-160 lux.

Mot slutet av 50-talet började man använda lysrör i kontor. Trots detta utformades glödlampsbelysning av äldre typ fortfarande i början av 60-talet. Man erhöll en genomsnittlig belysningsstyrka på 160 lux med i det närmaste skuggfri belysning. Eftersom väggar och tak blev kraftigt belysta och ljuset var kallt i jämförelse med ljuset från glödlampor, tyckte många att den nya ljustypen var otillfredsställande.

När de rekommenderade värdena för belysningsstyrkan höjdes blev det bländande direkta ljuset från armaturerna ett allvarligt problem. Man introducerade då armaturer med låg ljustäthet. På grund av att en mindre mängd ljus föll på väggar och tak fick man ibland intryck av att rummen var otillräckligt belysta. I mitten av 60-talet introducerade IES ett system med bländningstal. Den rekommenderade belysningsstyrkan höjdes ytterligare, men den förväntade förbättringen i synkomfort uteblev. Synkomforten var inte tillfredsställande ens vid 1000 lux. De nuvarande bestämmelserna från IES rekommenderar belysningsstyrkor för olika uppgifter (typer av anläggningar), men säger ingenting om synkomforten. Det finns egentligen inte någon metod, som på ett adekvat sätt kan mäta synkomforten. Ytterligare forskning behövs inom detta område. Även om en installation görs enligt IES-rekommendationerna, så är resultatet beroende av belysningsarkitektens erfarenhet och kunnighet.

GLAS OCH LJUS 13

Martin Harrison och R. C. Aldworth

Utställningen Glass/Light på Royal Exchange i London i juli kom samtidigt som färgat glas började återvinna sin popularitet. Det är emellertid för tidigt att säga att vi är på väg att återuppliva formgivningen i dylikt glas i ett sekulärt sammanhang.

I början av 1900-talet beundrade man i Europa abstrakta glasmålningar av Voysey, Bailley, Scott och Mackintosh, men efter år 1905 gick de brittiska konstnärerna tillbaka till figurativ formgivning. Det var inte förrän 1950 som John Piper återupplivade den modernare inställningen till glasmålning.

Samtidigt hade Prikker, Klee, Albers och Van Doesburg i Tyskland utvecklat en modernare tradition, intimt förbunden med Wiener Bauhaus, som Hitler lät förstöra. På 1950-talet kom en ny skola som leddes av Georg Meistermann. Schaffrach och Schreiter tillhörde båda denna skola och de var pionjärer i fråga om abstrakt och arkitektonisk behandling av detta glas.

Glasmålningar, som vanligtvis lyses upp av dagsljus, ger problem då de ställs ut i artificiellt ljus. Men på en inomhusutställning som Glass/Light kan glaset visas monterat i "ljuslådor". Eftersom det finns gott om rum på Royal Exchange, kunde man göra ljuslådorna så stora att lamporna kunde bytas ut av en man stående upprätt inuti dem. Huvudproblemet var att reglera ljusstyrkan på utställningsföremålens yta. Ett stort fönster med jämförelsevis klart glas fick inte framhävas mer än ett intillstående mindre fönster, som kanske hade glas i en tätare färg. Man använde "naturfärgade" lysrör eftersom de fullgott återgav nyanserna i de olika glasfärgerna, samtidigt som deras svala utseende simulerade dagsljus.

Man får hoppas att framgången med denna utställning kan leda till nyvaknat intresse för glas i olika färg.

BELYSNING TILL SPORTANLÄGGNINGAR 18

D. C. T. Brooks

Belysning av större sportanläggningar med krav på färgåtergivning enligt TV-bolagens normer har beskrivits i flera nummer av *Lighting Journal*. På sistone har sportanläggningar, som tillhör mindre klubbar kommit i blickpunkten. Behovet att spara energi och det ökade intresset från åskådarna för kvällsmatcher har lett till systemen ON 1600 1500W MBIL, som givit ett värdefullt bidrag inom detta område.

Ett dylikt beslysningsprogram kan utgöra en ny satsning och halogenlamporna kan kanske ersätta liknande men inte så effektiva volframlampor. I vilket fall som helst behöver planeringen och förberedelserna inte vara alltför svåra. Den vanligaste lösningen är att ha fyra 16 m höga stolpar på var sida om planen, med två armaturer ON1600 på varje stolpe. Det grova arbetet, t.ex. att gräva diken och göra iordning betongfundament, kan utföras av klubbmedlemmarna, medan det yrkesmässiga elektriska arbetet överlämnas åt elentreprenören. I en del länder, t.ex. Storbritannien och Sverige, måste man söka byggnadstillstånd, och den elektriska ledningsdragningen kan ibland kräva särskilda överläggningar.

Valet mellan fällbara stolpar, som kan höjas och sänkas med hjälp av en hydralisk domkraft, och fackverkstorn med inbyggda stegar är avhängigt förhållande på orten. Förekomsten av en läktare under tak kan mycket väl inverka på detta beslut. Allt elektriskt arbete måste utföras av en godkänd entreprenör och följa lokal- och riksförordningar.

Den grundläggande tekniken kan med lokala växlingar användas inom olika sporter och områden inom industrin, t.ex. parkeringsplatser och upplagsplatser. Lampan 1500W MBIL i strålkastaren ON1600 är ett allsidigt instrument, som skänker en tillfredsställande lösning när det behövs belysning utomhus.

BELYSNING INOM DET CENTRALA OMRÅDET 24

G. L. Adams och E. J. G. Beeson

De flesta känner till den kompakta lampa, som tandläkarna använder för att få en stark koncentrerad belysning riktad mot patientens mun utan att patienten på något vis störs av ljuset. Den lamptyp som beskrivs i denna artikel används inte i belysningssyfte utan för att åstadkomma en fotokemisk ändring i det material tandläkarna använder för att bygga upp och laga tänder.

Inom industrin används många strålningsformer för att åstadkomma kemiska förändringar i polymerer: för att härda eller fixera dem. Oftast gäller det bestrålning av stora områden, men inom tandläkarkonsten gäller det att täcka mycket små områden till ett avsevärt djup. Detta kräver en liten men intensiv strålningskälla i spektrums synliga del, som föredras framför ultraviolett strålning, eftersom man vill undvika skadliga verkningar.

Polymeren "Photofil" som används vid lagning av tänder är inte tillräckligt känsligt för större delen av det synliga spektrat för att härdas medan den anbringas på tanden. Härdning sker snabbt under högintensiv violett belysning. En halogenlampa i en dikroisk reflektor utgör den ursprungliga ljuskällan. Ljuset passerar genom filter i en handhållare för att till slut riktas mot tanden genom en fokusinställd kvartsstav, som är försedd med säkerhetsspets för att inte bländа tandläkaren.

Systemet har den fördelen att det avsevärt förkortar den tid som behövs för en operation och minskar de materialförsluter som uppstår vid användning av normala metoder.

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