LIGHT

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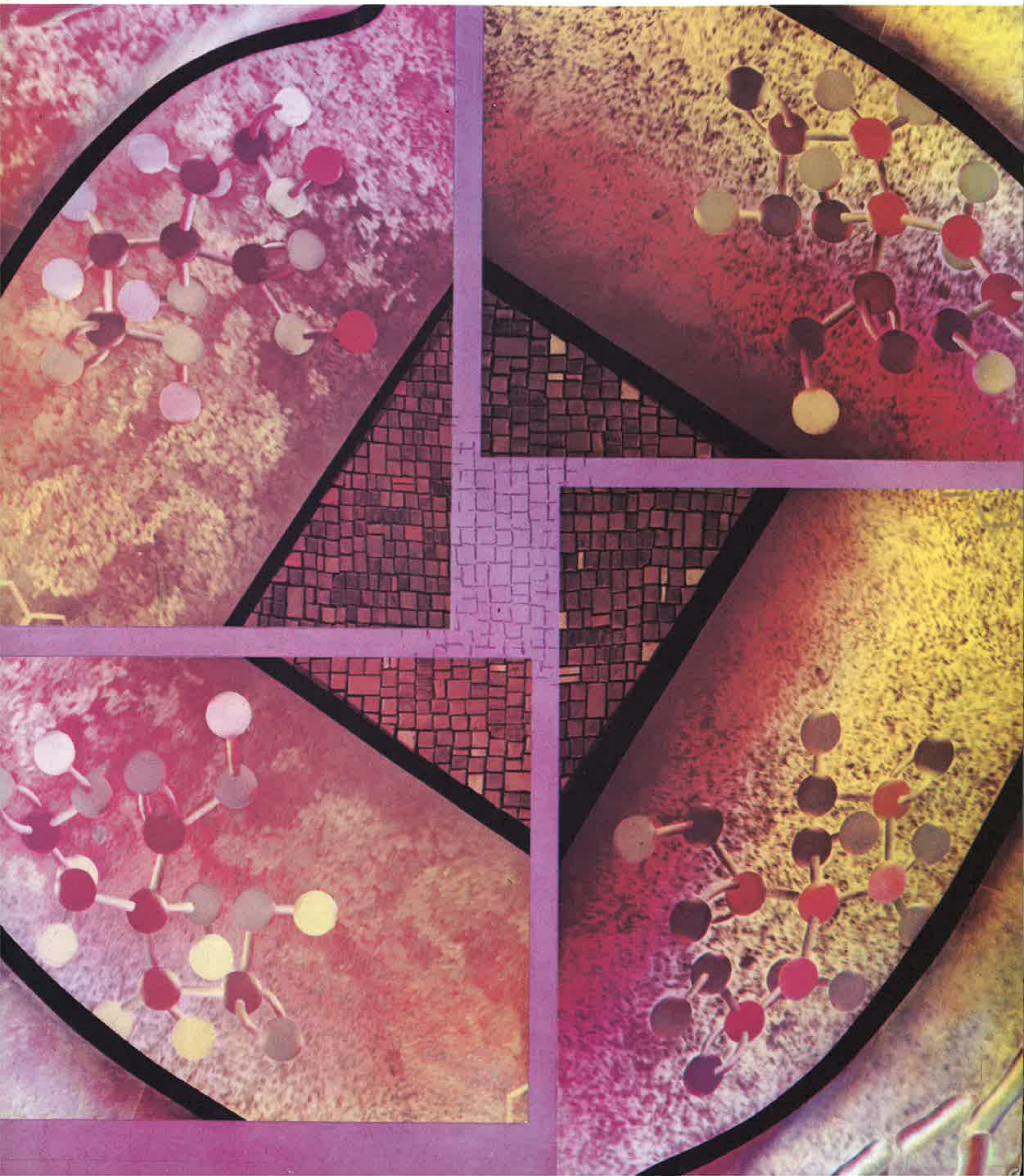

LIGHT

Published in the interest of the progress of sound Lighting Practices

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COVER AND FRONTISPIECE

When you walk past the Bel-Jon mural in the Pfizer lobby in New York, colors of even the smallest elements change. So we photographed one design—moving the camera only a few inches each time—to record the changes, and then arranged several of the "shots" in an over-all design for our cover. Select just one little symbol and see how its color shifts. The mural pictured on this page is quite different in both composition and lighting, and is in the Pan Am building. The photographer in both cases was Dave Ulrich of the Nela Park photographic staff.

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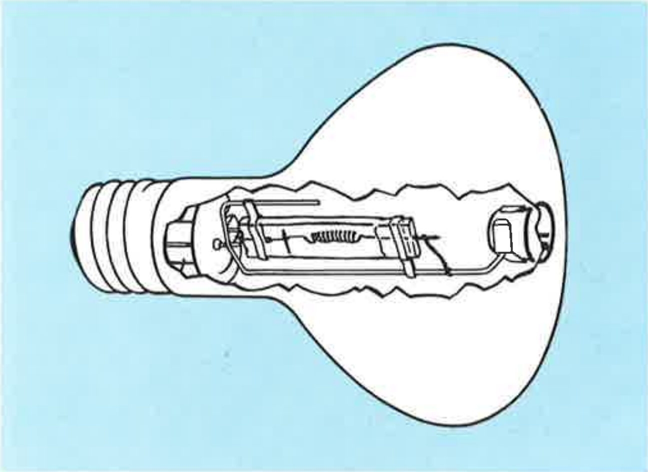
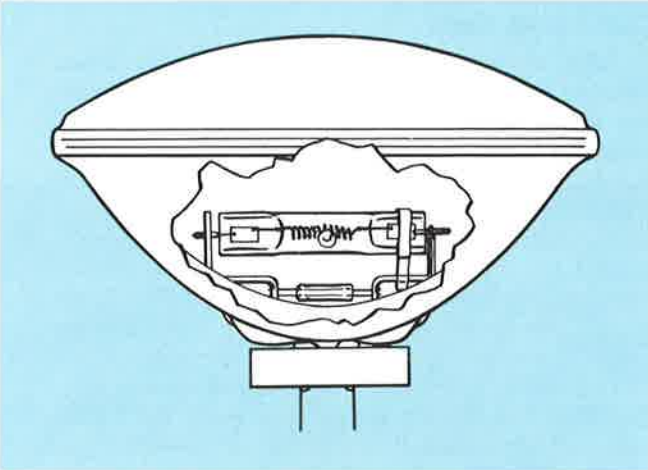




More New Lamps

by **Al Makulec**
Product Planning and Application, Nela Park

Increasing the line of PAR and R Quartzline® lamps from three to fourteen has provoked much interest. It is possible to get sizes from 250 watts to 1500 watts; lamps that have a design life of 4000 hours; high maintained light output; the over-all efficiency of Quartzline lamps; and the efficient beam control of PAR and R lines. Both lighting designers and users appreciate these features of the new lamps.

How It Happened

It all started with the familiar lines of PAR and R lamps. Their characteristics are familiar to most people because they are so popular and are used in so many places. Their greatest advantages, of course, are: built-in reflectors that never need maintenance; choice of wattages and beam spreads suited to most applications; and low initial cost for fixtures, because most of the light control is built into the lamps.

Then came the Quartzline lamps — first introduced in the 500-watt size by General Electric in 1959 — now available in many wattages. The quartz lamps are tubular and filled with an iodine atmosphere. The iodine cycle meant longer life for the tungsten filament without sacrificing luminous efficiency and with nearly perfect lumen maintenance throughout life. Today, these lamps are still called Quartzline, although special glass, rather than quartz, is used in some types, and other halogens produce the same effect as the iodine gas.

But the gains in efficiency, life, maintenance, and bulb-size reduction came at a price. Linear Quartzline lamps must be operated at or near horizontal position to keep the iodine evenly distributed in the tube; otherwise, severe blackening and bulb failure are likely to occur at the upper end. And the pinched seals at the ends of the lamps must be kept cool enough to prevent oxidation of the lead-wires that would crack the seals and cause lamp failure. In fact, this need to control seal temperatures accounts for the fact that many fixtures for linear Quartzline lamps cannot be made more compact. There is one other drawback. These linear lamps in the higher wattages are more effective when designed for longer length and for operation on higher-voltage circuits. This eliminates some of the interchangeability of sizes that has always been one of the great advantages of incandescent lamps.

Design Changes

Use of the coiled-coil filament has resulted in shorter, fatter tubes. Lamps will operate in any position, and a wide range of wattages can be produced for operation on 120-volt circuits. This design does not eliminate the seal-temperature problem, however. In fact, this may be more serious, because more lamp wattage is produced in less volume. So these tubes were put in PAR and R bulbs where they operate in an inert atmosphere which protects the seals from oxidation.

Now they can be operated in any position, and the beam spreads are similar to those already widely accepted in practice. In some cases, the Quartzline construction permits a smaller bulb to accommodate a given wattage. Cost of fixtures may be lower. Cost of light is often much lower.

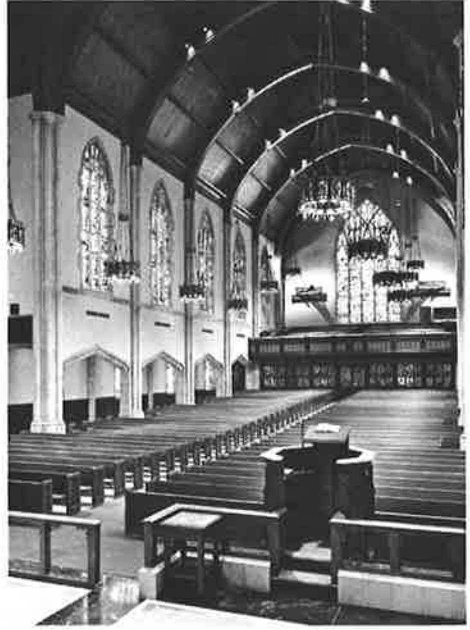
Looking at Costs

Take, as an example, a fairly large-scale downlighting installation. Such an installation might use downlights with baffles or a polished aluminum cone for shielding, with 150-watt PAR-38 flood lamps. Because the new 250-watt PAR-38 Quartzline flood has almost exactly twice the mean lumen output, the number of fixtures needed for a given footcandle level is halved, and wattage is reduced by one-sixth (about 17 per cent). The lamps last twice as long; half as many lamps are needed; and maintenance labor is cut to one-fourth. At typical commercial energy rates for 4000 hours of operation per year, the resultant cost for equal illumination is about 19 per cent less for the PAR-38 Quartzline installation than for the conventional PAR-38 system. If 300-watt R-40 lamps are used in the conventional system, the savings are only slightly less in the case of "spun-cone" downlight which can use the light from R-40 flood lamps efficiently. Baffled types of units absorb about half the light of R-40 floods, so relative costs soar.

Applications

The larger PAR and R Quartzline lamps will be used outdoors for floodlighting buildings, signs, parking lots, and both amateur and professional sports areas. The 250-watt and 500-watt sizes will be used outdoors, too, of course, but they will have greatest popularity indoors. In stores they can be used in show windows, above counters, and for highlighting featured displays. In office buildings they'll be used for wall-washing, for lobby lighting, and for decorative spotlighting. Industrial inspection lighting, which often requires high footcandles, will also benefit.

In time, we shall probably look back on this extension of the Quartzline lamp family as only one phase in the introduction of many types of lamps in outer bulbs. From today's point of view, however, the improvements in performance are major ones. We are satisfied that a new direction has been taken in the development of incandescents with these PAR and R Quartzline lamps.



Downlighting is provided by dimmer-controlled PAR-56 Quartzline medium floods. Three circuits triple the relamping interval.

The exterior facade is lighted by 500-watt PAR-56 Quartzline lamps in units that incorporate protective cover glass.

From six poles, a total of thirty 500-watt PAR-56 narrow spots are aimed at the steeple near downtown Dayton, Ohio.

THE PRESENT LINE

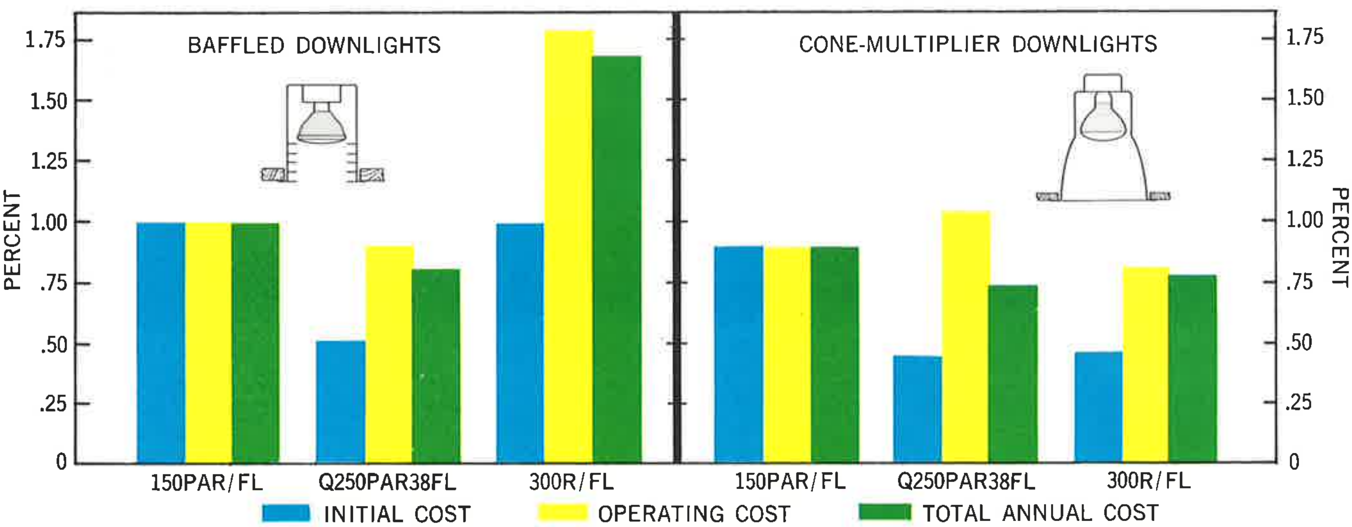
REFLECTOR QUARTZLINE LAMPS	PAR QUARTZLINE LAMPS
500-watt R-40 spot, flood	250-watt PAR-38 spot, flood
1000-watt R-60 spot, flood	500-watt PAR-56 narrow spot, medium flood, wide flood
1500-watt R-60 spot, flood	1000-watt PAR-64 narrow spot, medium flood, wide flood

In this show window (close-up, left) are seven 250-watt PAR-38 Quartz-line floodlamps. These accent the merchandise — direct attention to it.

Three 250-watt PAR-38 Quartzline spots produce twice the illumination on mannequins—compared to regular 150-watt R-40's used previously.

This painted bulletin measures about 20 feet by 60 feet. It is lighted by nine 1000-watt R-60 Quartzline floods. Lighting level is about 100 footcandles.

RELATIVE COSTS FOR EQUAL FOOTCANDLES—TWO TYPICAL SYSTEMS



BASED ON 2.5 RR, LIGHT REFLECTANCES, 4000 HOUR PER YEAR OPERATION, 2½¢ PER KWH, 50¢ LAMP REPLACEMENT LABOR COST.

Useable... Visible... Lobbies

by **F. A. Dickey**
Product Planning and Application, Nela Park

The Seagram Building: classic example of interior vertical surface lighting and its relationship to over-all building design and lighting. An almost continuous row of 300-watt R-40 flood lamps creates the high brightness necessary. By placing these lamps about 12 inches from the wall, the designer was able to obtain rich highlight and shadow patterns on the rather rough-surfaced travertine.

In their quest for useful space which can create favorable impressions, owners of commercial buildings are often limited to lobbies and other circulation areas. For this reason, these spaces are often important components of a corporate advertising or public relations program. Success depends upon an understanding of the major volumes of the spaces under consideration. This means not only an understanding of how the space can be handled architecturally, but upon an understanding of the visual process and how it relates to the lighting of such areas.

Traditionally, we have treated public areas in terms of footcandle recommendations for horizontal surfaces. There may be some problem with this approach, however, especially for areas in which people are moving around. Then, because the eye is oriented horizontally, the primary visual surface may be a wall. This may well be opposite an outer glass wall through which passersby may look into the lobby. The rear wall then becomes the most important vertical surface.

The undulating, sculptured rear wall in this Pan Am office in the Pan Am building in New York depicts the size and scope of a service. It advertises and provides visual cues for circulation of traffic within the area. To provide the brightness necessary to see this wall from the outside during the day, the designer used floodlamps on 10-inch centers, 12 inches from the wall. Color is confined to the furnishings, and lamps are concealed by louvers.

The brightness of reflected images on window glass usually averages 100 footlamberts—can sometimes be more. Therefore, the brightness of the rear wall of the lobby should be 100 ftL or more to compete effectively.

Day and Night

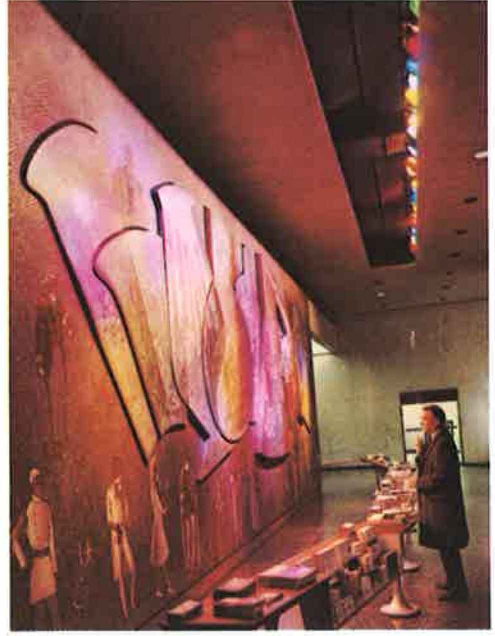
A lobby, no matter how attractive, serves no purpose unless it can be seen . . . . and seen from the outside first of all. To a lighting man this means examining the brightness relationships. During the day, the outer glass wall may reflect buildings and images from across or even in the street. These reflections may be so bright that they completely or at least partially and irritatingly mask the view of the interior and of a beautifully articulated lobby wall.

At night, a street-lighting unit may be reflected from the interior wall itself — if this is highly polished. This is particularly noticeable when the general lighting in the lobby, and the wall lighting, too, are dimmed. Dimming, incidentally, is often used at night when the brightness of the interior does not have to balance with daytime brightnesses. For this purpose, many large buildings may have a lobby lighting system that is controlled by an adjustable clock or timer mechanism or, even more elaborately, by a photo-sensitive cell and control system.

Vertical Surfaces

Great care must be taken in selecting materials for these most important vertical surfaces. Very often a matte surface will be superior to a polished or specular surface, especially if the wall is to be lighted. Consideration must be given also to another important factor — lobby lighting is usually an integral part of any building floodlighting composition. It is important, then, that both lobby lighting patterns and color be planned

Polished stone walls may give status to building lobbies, but can pose problems to a lighting designer. Such walls reflect distracting, small areas of light—here, light from bright sources outside the building, and apparent only at night.



Here, the colored light comes from the front of the mural. PAR lamps with colored filters are closely spaced behind the dropped ceiling and aimed at Jon Bel-Jon's stainless steel creation. Designs are made with engraver's tools, and reflect different colors when they are viewed from different locations in the lobby.

The Georgy Kepes' mural for K.L.M. Airlines in New York is reminiscent of a lighted city seen from the air at night. It actually incorporates many types of light sources which are mounted behind the wall. In spite of its unusual design, it does conform to a basic principle — it contrasts in brightness with other elements in the space to attract attention.

from the very beginning to harmonize with the floodlighting of the building.

Because there is emphasis on the rear wall in lobbies, it becomes a tempting location for works of art — typically, wall murals. Variables such as composition, reflectance and specularity of pigments, shadow patterns, and color influence the lighting design. The most successful murals are usually large in scale so that elements within the composition may be understandable from the outside of the building. This is true whether the mural is painted on a flat surface or uses some variation of bas relief. Lighting may or may not be integrated with the mural, but lighted it should be, and the artist and designer should be aware of what light can do for and to the element.

The Importance of Scale

Sometimes it is possible to over-emphasize the importance of vertical surfaces. In large rooms, such as bank lobbies, auditoriums, and sports arenas, designers try to establish a feeling of scale. It is important that the person experiencing the space should be aware of its tremendous size. Lighting the walls helps to define the limits of the room, and to aid circulation of traffic. But a sense of scale is enhanced when the room is treated as a volume. Then, treating the ceiling as an architectural element can help. This is especially true if the ceiling consists of a large element composed of smaller elements. Perspective lines appear, and the individual is able to relate the smaller elements to the size of the whole.

In older buildings, where large suspended luminous ceilings, for example, may be out of place, it is possible, usually, to emphasize with lighting the decorative ceiling elements. These may be frescoes, murals, or rich plaster or masonry detailing. Both direct and indirect lighting techniques have been used . . . . depending upon available rceessing depth, presence of fresco work on the ceiling, and the floor reflectance. In such areas, higher wattage sources such as the new Quartzline PAR and R lamps are useful.

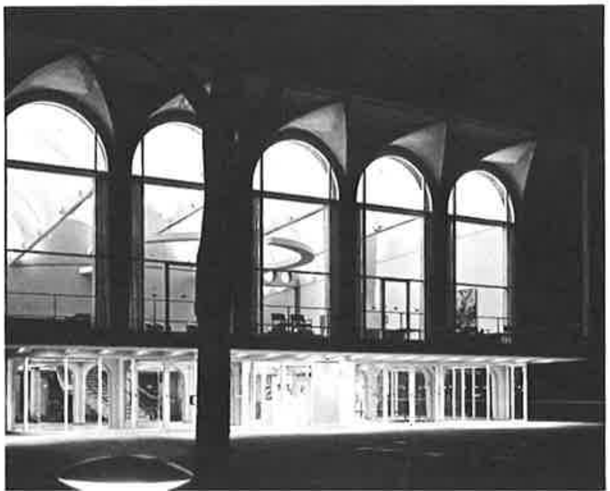
In the newer structural types such as thin-shell concrete buildings, it is usually impossible to recess a lighting fixture. Surface-mounted units usually inhibit the form of the structure, which is one of its most important attributes. Therefore, indirect lighting may be the answer — using the inner surfaces of the shell as reflectors.

It is apparent that both vertical and horizontal surfaces should be considered carefully when the lighting system is planned, and that this planning should take place during — not after — the designing phase of a new building.

A large coffered ceiling enables a viewer to gain an impression of the size of a room — especially if he relates size of individual coffers to the size of the entire space. Lines of perspective are obvious. The edges of this lighted ceiling also tend to define the limits of the large space.

Decorative ceiling details are revealed when lighted. Here, lamps were mounted in the chandeliers and aimed toward the ceiling. Floor surfaces were sufficiently high in reflectance to "bounce" light back to the ceiling from the Quartzline lamps recessed in the smaller medallions in it.

The size of the light source can be a real factor where form and structure should be emphasized, and the lighting equipment must be unobtrusive. Here, Quartzline lamps fit neatly into column-mounted units; require little space.



Light helps to emphasize form and structure in which the architect is, of course, interested. Incandescent lamps were used here to provide indirect lighting which reveals the nature of the space and the volume of the building.

On the Dot

by **F. W. Meers**
Iowa-Illinois Sales District, Large Lamp Dept.

Sheaffer Pen throughout the years has made highest quality writing instruments. This striving for quality is now reflected in their lighting systems. After John Mansheim, the Plant Engineer, attended an industrial lighting course at Nela Park, he decided to eliminate all supplementary lighting by bringing the general lighting up to an adequate level for the fine visual tasks.

John investigated many types of lighting systems and finally settled on the use of General Electric Power Groove lamps. He achieved general lighting of 175 footcandles and eliminated supplementary lighting — even in the area where girls work with the Sheaffer White Dot — part size .060 inch. Management easily justified the cost of the lighting changeover when it became apparent that efficiency, productivity, and employee morale were higher, too.

Next Step

Employees in other areas saw the new lighting system and asked for more light. To achieve this, power capacity is being increased, and soon the higher lighting level will be common to all of the production areas in the plant.

In the meantime, other types of areas have not been neglected. Only recently the packaging department was given 125 footcandles. Here, Sheaffer's low-end merchandise is packaged. In today's market, packaging frequently sells the product, and efficiency and speed are most important factors. Management has noticed that these factors have improved with the higher lighting level — and so has employee morale.

Other Areas — Other Lighting Systems

Sheaffer Pen — like other pen companies — has to safeguard the plant. To do this they employ closed-circuit television at entrances, and security lighting at loading docks and around the buildings. The types of lighting used are shown in the illustrations on the last page of this article.

Power Groove® lamps replaced a 40-watt fluorescent lamp lighting system. Lighting level increased from about 30 fc to 175 fc. Now, no supplementary lighting equipment is needed, productivity has increased (this is piece work) while scrap has been reduced. The women like working here.

Sheaffer Pen is a classic example of an industry faced with keen competition while maintaining current expenditures for plant improvement and modernization that will enable them to meet future demands. Improved lighting is a real tool to help them do this — and they know it!

Ink cartridges are imprinted and the imprints dried quickly. Space is at a premium. By replacing PAR heat lamps with 1500-watt quartz infrared lamps time and space were reduced.

Power Groove lamps were installed in this packaging department, also. Lighting level is about 125 fc. Lamps have been in since 1962. The system is cleaned twice a year — during inventory shut-down.

Lacquer on pen barrels must be dried quickly, also. Six units, each containing one 2500-watt quartz infrared lamp, operate under voltage; replaced PAR heat lamps for more efficiency.

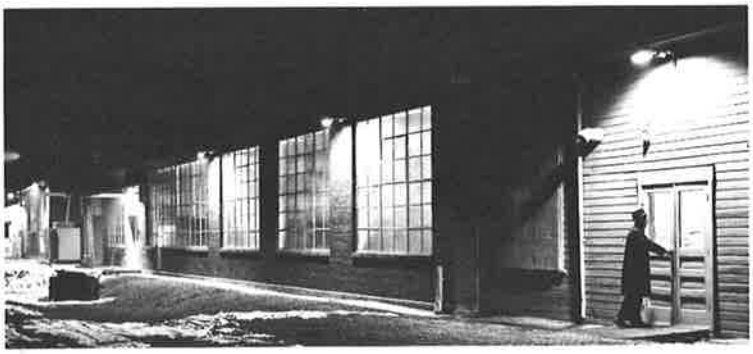
The new Panel F lamp interests John Mansheim, and he is trying it in several locations. In both cafeteria and stairwells it has replaced 200-watt incandescent lamps. It represents less maintenance.

Different lighting systems for closed-circuit TV

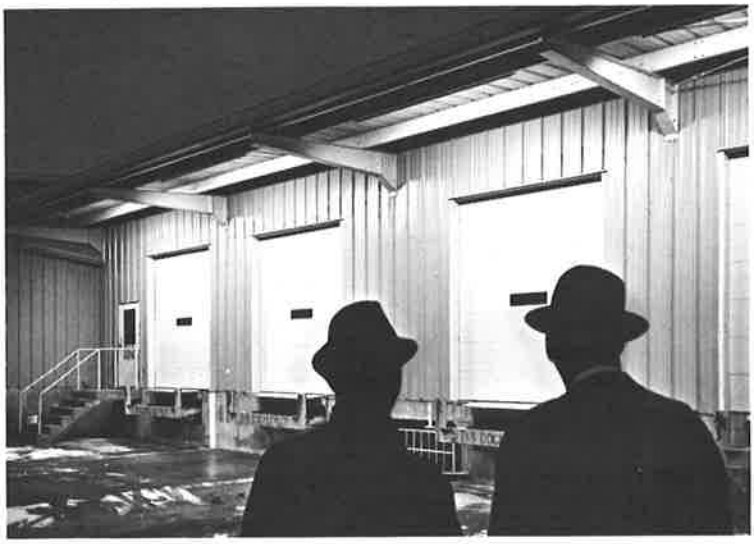
One 1000-watt color-improved mercury lamp

Two 400-watt color-improved mercury lamps

Four Power Groove lamps in two-lamp units

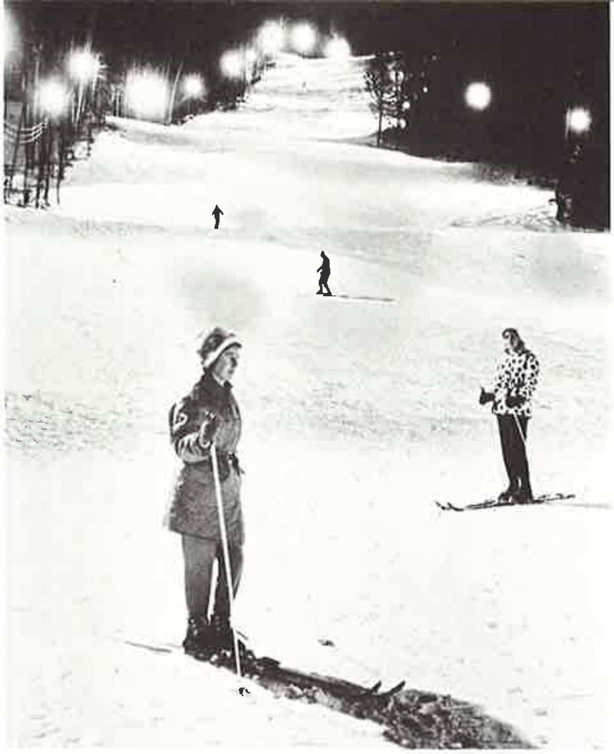


Lamps (175-watt mercury) on the outside perimeter of the plant are placed to utilize reflecting surfaces of the building walls — not the windows.



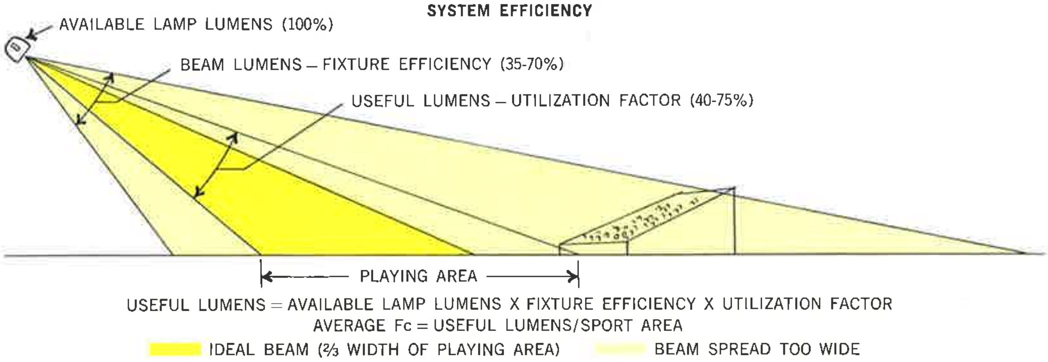
Loading docks have eight-foot Power Groove lamps in single-lamp units mounted close to the edge of the roof overhang in front of each door. Units are partly concealed by a section of the cornice.

Do You Light All Outdoors?



Long hours of operation and need for uniform lighting at relatively low lighting levels resulted in use of wide beam fixtures using color-improved mercury lamps. Cool visual appearance is an added benefit of mercury lighting for this ski slope.

by **R L. Paugh and D. A. Toenjes**
Product Planning and Application, Nela Park



The design of a lighting system for an outdoor sports area is complicated by many choices and even compromises. But it is possible to have a rule-of-thumb procedure that may simplify things a bit. Basically, it starts with this – *the characteristics of the light source determine the major characteristics of the entire lighting system.*

Lamp efficiency, life, and cost are considered in relation to these factors: optical control needed, the total amount of light that the area requires, the convenience and need of fixture maintenance, importance of color, and any effects upon the total original cost of the lighting system – including poles and fixtures.

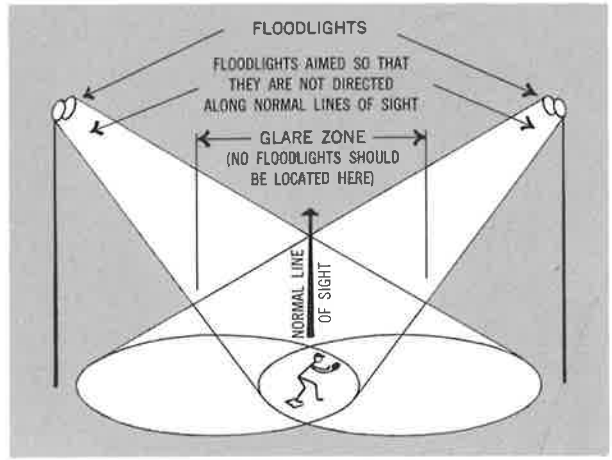
Other considerations might include: cost and compactness of suitable fixture designs for each lamp type; frequency of lamp-and-fixture maintenance (and the relation between intervals for fixture cleaning and for lamp replacement); time required for restarting after power failure; and design voltage of lamps and ballasts in relation to the distribution system's available voltage.

Optical Control of Light Source

The degree of light control is indicated by the dimensions of the light beam and the peak beam candlepower delivered by the fixture. Optical control is a major factor in determining the maximum distance that poles can be placed from the area to be lighted. Usually, the beamspread of individual fixtures (if several are used at each location) should not be greater than about two-thirds of the angle intercepted by the area to be lighted. Floodlights with too great a beamspread, either vertical or horizontal, can result in glare to the spectators and ineffective use of light (see sketch).

The size of the light source determines the beamspread of a lighting fixture. Incandescent, clear mercury, and Multi-Vapor lamps have relatively small light-source dimensions. Typical beamspreads may be as narrow as 20° horizontal and 20° vertical. With special incandescent lamps that have a more concentrated filament construction the same fixture may deliver a beam as narrow as 15°H and 15°V. And in the same fixtures the color-improved (phosphor coated) mercury lamp — a much larger light source — provides an extremely wide beamspread: 110°H by 110°V.

A new dimension in lighting is achieved with the linear Quartzline lamp. The beamshape is rectangular — 100° or more, horizontal, and 10° or more, vertical.



Color Rendering

In spectator sports, particularly, good color rendition is important, because teams are distinguished by the colors in uniforms. Also, spectators like to look normal to other spectators.

Incandescent lamps provide good color rendition for all colors of the spectrum, and this is why they are the most frequently used light sources for spectator-type sports lighting.

However, in many sports areas, discharge-type light sources may be used to advantage economically. The fluorescent lamp provides good color rendition, whereas the color-improved mercury lamp provides only adequate color-rendering light. The new Multi-Vapor lamp combines good optical control and higher luminous efficiency with color rendering similar to that of the color-improved mercury lamp. It may be used widely in the future — even in spectator-type sports lighting.

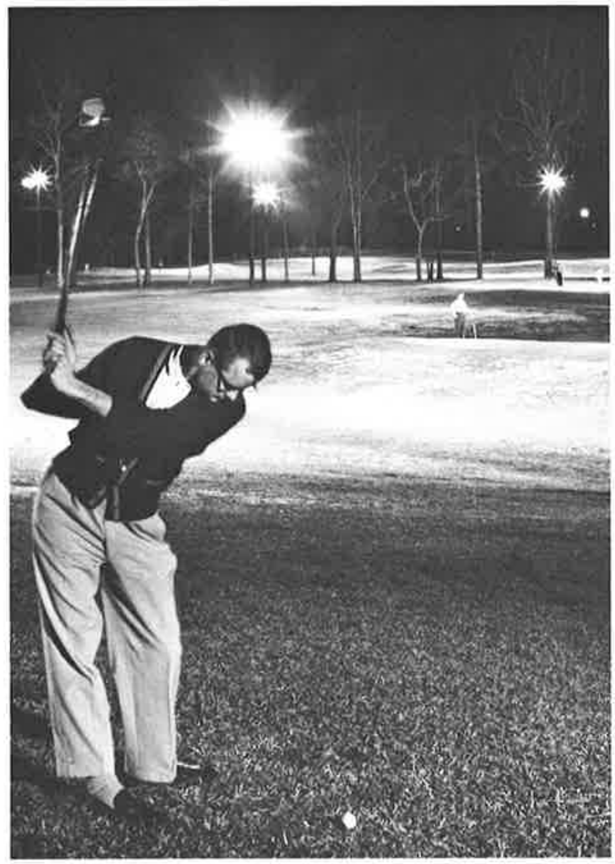
Economics

Owning and operating costs may vary drastically depending upon the light source used, hours of system use per maintenance interval, local power costs, and maintenance costs. Some rules of thumb to observe in designing a lighting system from an economic viewpoint are:

1) Use the highest wattage light source possible — commensurate with desired lighting uniformity. Higher wattage means higher lamp efficiencies and fewer fixtures required per installation.

2) The higher a lighting system is mounted, the more expensive it is to maintain. Therefore, it is economical to match relamping intervals to the hours of system use between realistic fixture maintenance intervals. Over-voltage operation of incandescent lamps, or overwattage operation of mercury lamps is often a way to achieve this match. Such operating conditions increase the light output from these lamps. The result is a reduction in the number of fixtures required to meet a specified lighting level.

3) System efficiency combined with desirable lighting uniformity is dependent primarily upon careful selection of fixtures.



Long burning hours per year and high lamp efficiency make mercury lamps most economical for golf course lighting. Good color rendition on greens and tees demands the use of color-improved mercury lamps. Clear mercury lamps are used on fairways where control of light is of primary importance.

There are times when the initial cost of a lighting system is of greater importance than operating costs. Then, incandescent lamps and fixtures should be used. Of the incandescent lamps, the high-wattage reflector lamps have the lowest initial fixture and lamp costs.

Other Lamp Characteristics

Incandescent, mercury, and Multi-Vapor lamps usually have fixtures of about the same physical size. However, where minimum physical size of the fixture is of primary importance, the Quartzline lamp fixture types can be used with little or no sacrifice in lighting intensity.

Starting characteristics of mercury and Multi-Vapor lamps differ markedly from those of incandescent and fluorescent lamps. The former require three to five minutes to warm up to full light output. If power is interrupted they need a longer period to restart and warm up. To compensate for this starting characteristic an auxiliary safety lighting system should be provided.

High-voltage secondary distribution systems (200 volts or more) can reduce initial system installation costs and also result in an effective lighting system if the proper lamps are used. Discharge lamps with high-voltage ballasts are effective. High-voltage standard incandescent lamps, although available, should be used only as a last resort. They are physically quite fragile, low in initial efficiency, and have poor maintenance characteristics when compared to 120-volt incandescents.

On the other hand, high-wattage Quartzline lamps (also incandescent) are available only in the higher-voltage designs. These lamps are equivalent in physical strength to 120-volt standard lamps and have the high efficiencies and excellent maintenance characteristics typical of all of the Quartzline lamps.

The need for a high degree of light control and good color rendition results in the use of incandescent lamps. The rectangular beam shape provided by Quartzline lamps and fixtures, and very narrow vertical beamspread and sharp cutoff characteristics are well suited to the layout of a race track.

System Quantity and Quality

It is easy to determine, numerically, the *quantity* of light supplied by a system. *Quality,* in terms of spectator and player discomfort and disability glare, is more difficult, if not impossible, to determine numerically.

Numerically, the combination of fixture efficiency, fixture utilization factor, and fixture maintenance factor result in a system efficiency figure. This is the per cent total lumens generated by the light sources that reach the playing area. Reasonable uniformity of illumination throughout the playing area is required for both players and spectators. A maximum uniformity ratio of three to one between maximum and minimum footcandles in the playing area is recommended.

Adequate mounting heights* and proper location of luminaires in respect to player and spectators reduce the possibility of objectionable glare and provide a balance of illumination on both vertical and horizontal surfaces. Where possible, fixtures should be aimed so that their light beams are not in line with the normal viewing directions of the players. (see second sketch)

* *I.E.S. "Current Recommended Practice for Sports Lighting."*

Quartzline lamps and fixtures provided good visibility for spectators, good color rendition, and low initial system costs. The narrow vertical beamspread and sharp cutoff characteristics of these units permits cross-aiming to the opposite side line. Wide horizontal beamspreads of fixtures meant that only six poles instead of eight were needed.

That Residential Influence

by **J. H. Jensen**
Product Planning and Application, Nela Park

Lighting installations should create pleasant, livable environments for people to enjoy; they should not be merely showcases for lighting equipment. People usually respond favorably to a lighting installation that is intimate, individual, and inviting . . . this, the residential lighting designer knows. He believes therefore, that a lighting job should be inviting as opposed to cold and unappealing. A lighting job should be intimate as opposed to vast and overpowering. A lighting job should be individual as opposed to impersonal. And these concepts can be applied to installations other than residential.

With today's emphasis on higher footcandle levels, and with the new tools that are available to the lighting designer to make these higher levels easily obtainable, commercial lighting, quite frequently, takes on characteristics that definitely are not tailored to people, but are, rather, fine examples of engineering.

The three "I's" of lighting mentioned above – intimate, individual, inviting – do not affect footcandle objectives, or even visual comfort, to any degree. If designers would factor these three "I's" more frequently into today's lighting installations, these would be vastly more appealing.

Too often, much of today's commercial lighting is characterized by:

. . . endless rows of lighting fixtures that go on and on without relief

. . . dull, drab color schemes with no excitement or change of pace

. . . acres of luminous ceiling that virtually overpower the individual.

Certainly, such installations have no intimacy, no individuality, and are definitely not inviting. And yet, almost any commercial interior could have some of these attributes if the lighting designer would ask himself some questions like these:

. . . can I cut down the occupant's view of the major lighting equipment?

. . . can I break up the space visually, or even physically?

. . . can I inject some familiar or home-like materials?

. . . can I enliven the space with the judicious use of color without its being distracting?

When some elements like these enter the lighting design, it is possible to draw attention away from the lighting and focus it on the colors, the furnishing, and – most of all – the people. *Making a space more appealing to people should be a major goal of the lighting designer.*

Characteristics of Residential Lighting Design

Residential lighting has been characterized by its minute attention to the three "I's". There are many lighting techniques thought to be residential that can have wide application in commercial lighting. Many commercial spaces can lend themselves to such lighting treatments. These are usually areas where the designer wishes to create a home-like feeling, or where a social atmosphere is desired.

Here are several examples:

private executive office. This often reflects the personality of the occupant. The need for high, uniform lighting levels may be less important than the need for a relaxing atmosphere — one conducive to thought and conversation.

restaurants and dining rooms. Sociability and relaxation are major considerations. The degree of "atmosphere" depends upon the character of the restaurant — type of clientele to be attracted.

conference rooms. These usually require great flexibility. Often, high levels of lighting are needed for critical seeing. And yet, atmosphere and pleasant surroundings are important if the room is to be bearable during the many hours that some executives must spend in conference.

funeral homes. Traditionally, these places have been furnished and decorated in residential style. It's appropriate that they have comfortable and familiar types of residential lighting elements.

lobbies and sitting rooms. These should be friendly places. Often, they are the customer's first contact with a particular place of business. First impressions are created here.

educational institutions and public buildings. These are difficult to personalize because of their large size. However, there are many places where custom-lighting touches can help to create a friendly environment that puts people at ease.

specialty shops . . . or even special departments in large stores. These are more attractive and appealing, with a distinctive environment, when residential lighting techniques and fixtures are used.

Summary of Residential Lighting Characteristics

1. Non-uniformity of lighting distribution.
2. Flexibility of intensity, color, and distribution.
3. Stylized and colorful luminaires.
4. Low mounting of luminaires.
5. Extensive use of wall lighting.
6. Customizing and personalizing of installation.

NON–UNIFORMITY of lighting distribution is characteristic of living, dining, and entertaining areas. Each lighting element contributes to the over-all general lighting, but performs its own function — washing a wall with light, highlighting a picture, or lighting a reading chair . . . In commercial areas, restaurants are prime examples of this approach to attractive lighting.

FLEXIBILITY. To satisfy the homeowner's desire to "fiddle", dimmers, photocells, and pulley fixtures, for example, provide opportunities for flexibility. Multiple lighting systems satisfy a variety of needs in both residences and commercial interiors. In this respect, the "play" room and the conference room have needs in common . . . high footcandles for visual acuity, low-level downlighting for viewing slides, wall lighting for displaying objects on vertical surfaces . . . all help to create a comfortable, pleasant atmosphere.

COLORFUL AND STYLIZED LUMINAIRES. Although there are many residential fixtures that are so stylized and colorful that they do not provide good lighting, there are many excellent ones that do become a basic design element. In stores (this is a supermarket), many residential lighting fixtures add a decorative touch or draw attention to a particular selling area.

LOW MOUNTING OF LUMINAIRES. Although ceilings are important to home lighting design, much of the lighting equipment is at or near eye level—creating pools of light and bright accents in the room. In stores, in which a touch of elegance is desired, the styling of the fixtures becomes very important. In some places, such as private offices, lobbies, and reception rooms, portable lamps and decorative hanging fixtures add a softening — even gay — touch to the lighting in the area.

EXTENSIVE USE OF WALL LIGHTING. Walls occupy the greatest part of the visual field. Lighted walls can make a room look larger, can emphasize windows and artwork, and can help make up for a drop-off in lighting levels near the perimeter of a room . . . as it does in the private office, here.

CUSTOMIZING AND PERSONALIZING. The most effective residential lighting installations are tailored specifically to the interests and activities of the family. Lighting highlights things they like, and adds beauty and personality to the interior. It is not easy to do this in commercial interiors, but opportunities do exist. For example — in the advertising artroom are high footcandle levels, good shielding, and favorable reflection factors. The addition of downlights, some color inserts above the louvers, and wood trim — combined with a three-level ceiling treatment — have given this office a very special custom look.

Part II

When you can measure

by **Dr. S. K. Guth, Mgr.**
Radiant Energy Effects Laboratory, Nela Park

In Part I I outlined what seems to be a real breakthrough on the evaluation of discomfort glare and presented the basis of a computational procedure for determining it. Using the formulas (described in Part I) we can calculate ratings for any kind of lighting situation — whether the space is large or small — involving a few or many luminaires regardless of their size or shape.

Formulas are useful, and in fact necessary. Developed on the basis of fundamental data they are, however, only the first step in the evaluation of any process. The final, and most difficult test of a formula comes when the things it predicts are compared with subjective observations of actual situations. One cannot expect that predicted and observed reactions will match precisely; if they fall within reasonable limits it's cause for rejoicing.

The Test

So the test was made. A study by an independent investigator included data from 100 observers for six experimental conditions in a simulated office involving from two to 12 luminaires. Results were presented in terms of what was judged to be the borderline between comfort and discomfort (BCD).

Note that the average difference between predicted and observed luminaire brightness as shown in the following table is less than seven per cent.

Condition	No. Luminaires	Luminaire Brightness Predicted	Luminaire Brightness Observed
1	1	705	680
2	2	490	540
3	2	520	500
4	4	365	410
5	4	365	410
6	12	250	255

This falls within the 10 per cent limits obtained with the 48 experimental conditions used in the development of this discomfort glare rating method (see last illustration in Part I).

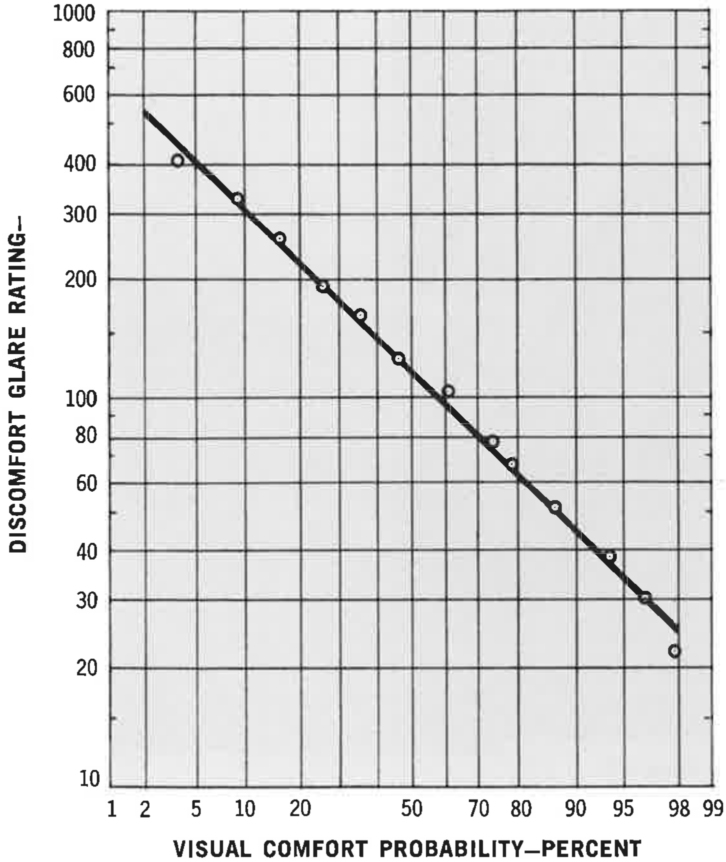
Figures of Merit

Discomfort ratings computed with the formula increase with glare, and thus do not agree with our usual concept of figures of merit. We are accustomed to thinking that higher numbers indicate a better situation.

Therefore, to overcome this psychological obstacle we developed an inverse scale in terms of the per cent of observers who will be expected to find a given lighting condition acceptable. To do this we utilized the thousands of observations obtained with more than 200 observers who judged the acceptability of lighting systems in terms of the BCD sensation. From this analysis came the Visual Comfort Probability rating (or VCP) shown in the last illustration of this article. The numbers at the side of this chart represent the computed ratings of the luminaire brightnesses judged to be at BCD by the observers . . . . in other words — the discomfort glare rating (DGR). The figures across the bottom represent the per cent of people who may be expected to find an environment visually comfortable. Therefore, by converting values of DGR (Discomfort Glare Rating) into Visual Comfort Probability (VCP) we have an estimate of satisfaction in terms of per cent of people. This has a decided advantage, because it becomes a meaningful figure of merit for comparing different lighting systems that may be under consideration for a specific space.

Some people may wish to use adjective rather than number ratings. To provide this, we can key the descriptive terms employed by several other investigators to our numerical ratings as shown in

By converting values of DGR into VCP we obtain more meaningful ratings in terms of the per cent of people who would be expected to find a given environment visually comfortable. For example: a Discomfort Glare Rating of 120 means that only 50 per cent of the occupants will judge an environment to be acceptable. To satisfy at least 80 per cent of the occupants of a space, the DGR can be no greater than 63 (right).



the following table. These represent the degree of glare sensation experienced by an average observer for various values of DGR and VCP.

Degree of Glare Sensation	Discomfort Glare Rating	Discomfort Glare Estimate (%)
No glare-	less than 35	..
Unnoticeable	35	95
Acceptable but not imperceptible	50	87
Acceptable	65	75
Distracting but not uncomfortable	90	64
BCD	120	50
Barely uncomfortable	160	34
Perceptibly uncomfortable	220	20
Uncomfortable	300	11
Just intolerable	400	5
Intolerable–greater than	400	..

Glare Evaluation

Now that we have a universal glare evaluation procedure, significant questions are asked by potential users. "Will it be necessary for me to make such calculations for every lighting installation?" "How big a job is it to make these calculations?" "Who will provide the information we need for making calculations?"

Obviously, using the formulas requires the determination of the factors of luminaire brightness, size, and position, and the average brightness of the field. This, of course, is time-consuming and tedious. In general, it is not expected that lighting designers will have to make such calculations except for a relatively few specific situations. Visual Comfort Probability ratings can be provided in several useful ways. Manufacturers can prepare tables of VCP's for their specific luminaires for rooms of various sizes. Or generalized tables can be developed for a variety of typical luminaire light distributions. These will permit the user to find a distribution matching that of the luminaire being considered, and he can determine the VCP very quickly. Such tables would be similar to those now used for co-efficients of utilization. Computers can be used for this purpose so that the preparation of such tables should become a fairly routine matter.

Calculations for a specific lighting installation are not difficult. Special charts and nomograms* have been prepared which considerably reduce the labor involved. Detailed instructions and procedures are being prepared.

And when will all this be available? No specific date has been — or can be — set. But the lighting industry is well aware that this kind of information is needed, and that it must be as simple and as specific as possible. In the interest of the progress of good lighting practice it must come — and the sooner the better.

* Available from the author.

Welton Becket & Associates
St. Joseph Hospital Chapel, Burbank, California

Lighting Designer: Sylvan R. Shemitz

Off to School Again!

As it has periodically since the electric lamp was invented, lighting education faces new questions. Where does it belong? In an engineering school? In a research lab? In a fine arts course? In an architectural school? Where?

It fits into all of these places, because lighting influences the habits and actions of all people – regardless of where they might be or what they might be doing. It fits in everywhere.

Lighting has received considerable recognition in engineering schools. It is the product of technology. But it no longer attracts as many young devotees as it did before so many changes in engineering education concepts took place. In its application light has scientific, engineering, and aesthetic implications. So it is finding its way into architectural colleges – incorporated either in the standard course, or offered as a special course for an advanced degree – or both. The architectural student who goes on to specialize in lighting might become a lighting consultant – either an independent, or connected with a large architectural firm. The most successful lighting designers today have an empathy with and an understanding of architecture. Schools of architecture and design are aware of this, and regard it as a challenge to train lighting designers.

Characteristically, perhaps, a number of architectural schools from whom we have heard recently are planning a laboratory approach to the subject . . . Kansas State University, Penn State, and Columbia, for example. Columbia is researching an environment lab – thermal, sonic, and visual – to be incorporated in a new building. The concept of the total environment is being recognized by many people in many industries.

William L. Pereira & Associates

Lighting Designer: David M. Merrill & Associates

Architect and Engineer . . . . Both

This trend to the architectural schools does not mean, of course, that photometry and the study of electrical distribution can be ignored. They will remain, hopefully, in the electrical engineering schools. Students of these subjects may become engineering consultants to the architectural firms who realize that lighting is a "design medium". It is becoming more apparent that the architect should be able to knowledgeably specify performance. The engineer should effectuate it. In some cases, the architect is the lighting designer. At other times, the services of an independent lighting consultant are called for. Regardless of how the final result is accomplished, these people should be able to create a total environment that is comfortable, attractive, economical, and above all – suited to the purposes of those human beings who occupy the space.

The majority of jobs calling for the services of an architect and of a lighting designer are not only the famous name buildings, but also thousands of other facilities throughout the country. These range from drug stores to banks and fire stations. Each requires a special approach to design – and this is equally true of the lighting. It should relate not only to the design of the building, but to the use to which it is put by the people who use it. America has need for the trained abilities of people who can design more beautiful, more useful buildings that can serve the needs and reflect the aesthetic awareness of its population.

W. D. Riddle A.I.A.

Eero Saarinen & Assocs.

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