LIGHT

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No. 4, 1966

LIGHT

Published in the interest of the progress of sound Lighting Practices

Editor: ELLEN SAUER

Editorial Board: A. K. GAETJENS, MARTIN R. KING, E. THEMAK, JR.

CONTENTS

COVER AND FRONTISPIECE

To Tom Knowles, head of our Photographic Section, lamp colors, spectrum, and spectral energy distribution are old but ever fascinating aspects of the lamp industry. Photographing some of these aspects can be quite a challenge. The blue dichro-PAR lamps at left and those on the back cover were photographed by Vance Roth, one of the newest members of the Photographic Section.

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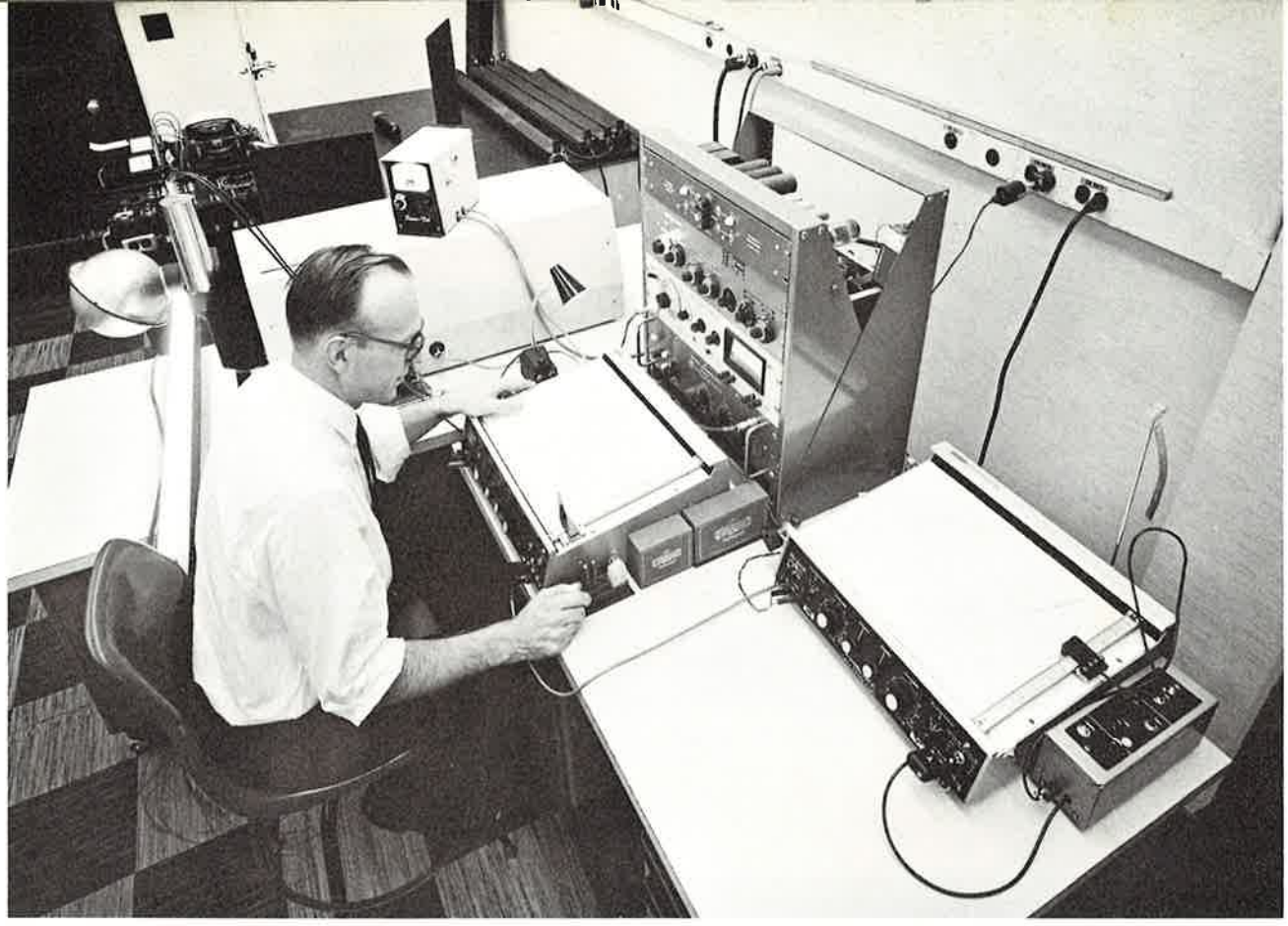


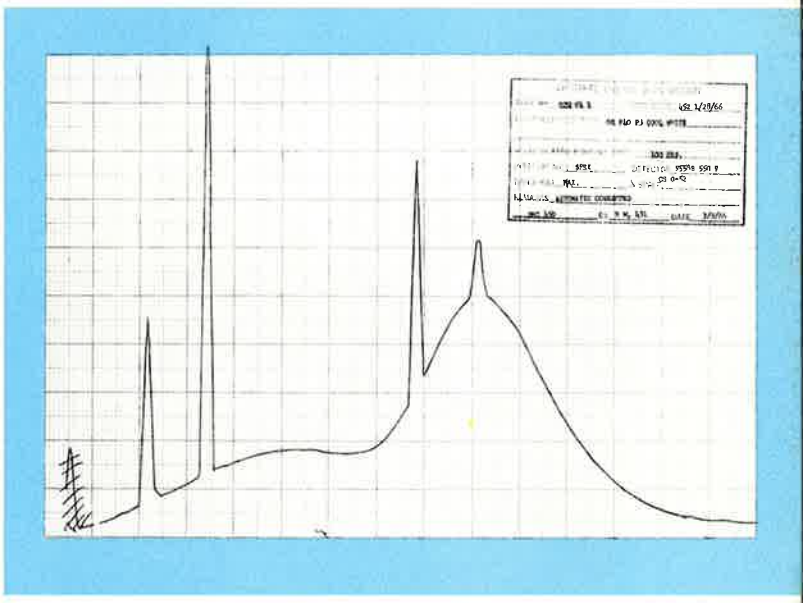
In the Spectral Measurement Center, Dr. R. L. Brown operates a direct-recording spectroradiometer to measure the spectral radiant energy from the center section of a four-foot, standard white fluorescent lamp. (recording, below)

S.E.D. What Does it Mean?

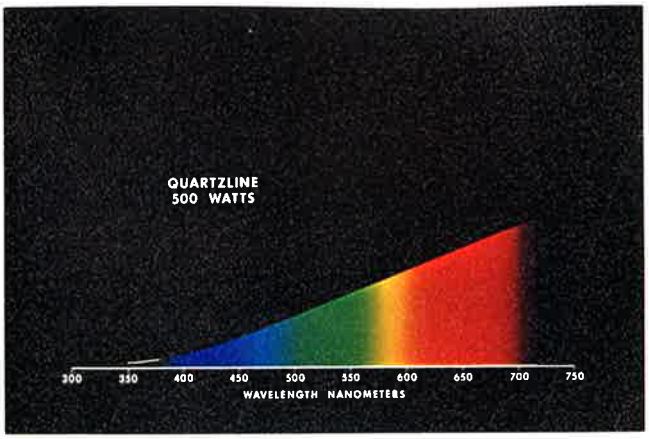
by **W. G. Pracejus**
Advanced Product Planning, Nela Park

The spectral energy distribution (S.E.D.) of lamps has become more important as we move into the Third Age of Light. The measurement of lamp color is not new, of course, and has been going on for years, but the new light sources now available — and to come — have made these measurements more important to lighting designers.

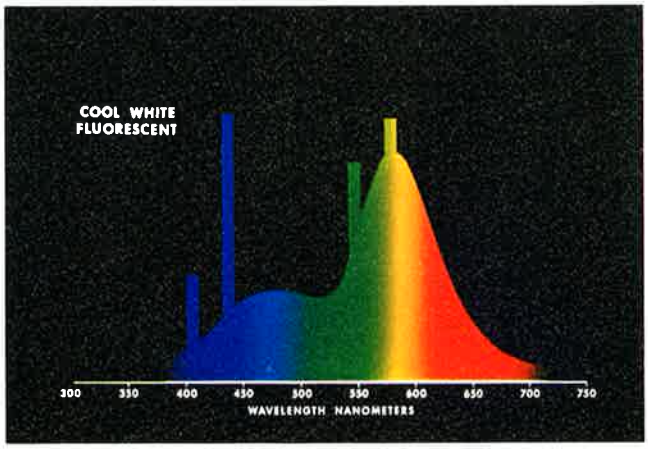
Special equipment is required to make the measurements. Specially trained people are required to use the equipment and to interpret the results. To show how this is done, we selected a cool white fluorescent lamp for measurement of spectral energy distribution. The other spectrums, shown here, are a graphical representation of the radiating properties of the light source which can be mathematically related to its color. A colored spectrum is used with the spectral energy distribution curve of the lamp as it is received from the spectral measurement center to dramatize the lamp's color characteristics. These colorful presentations produce an easily read qualitative comparison of light sources.



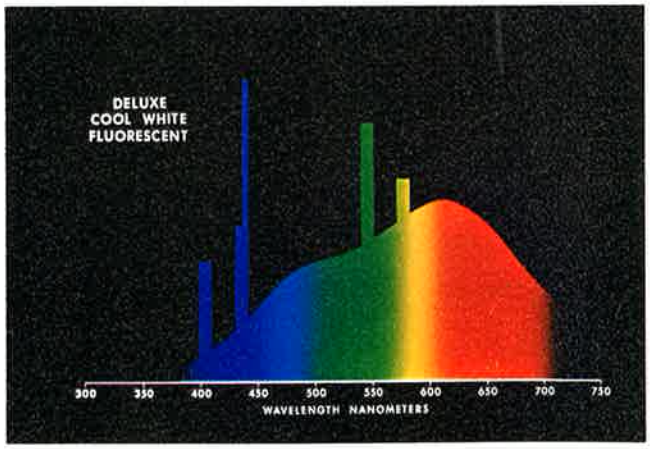
An accurate linear recording of the relative energy at each wavelength of the light source is obtained by the optical system. It becomes the basis for the curve on the spectral distribution sheet that may be obtained on any type of lamp manufactured by the General Electric Company.



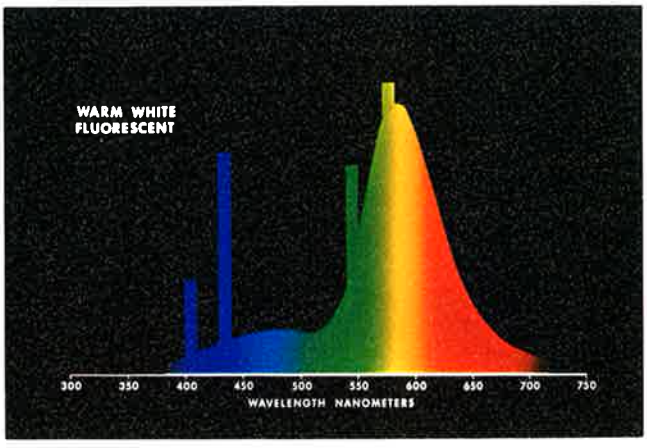
500-WATT QUARTZLINE ®



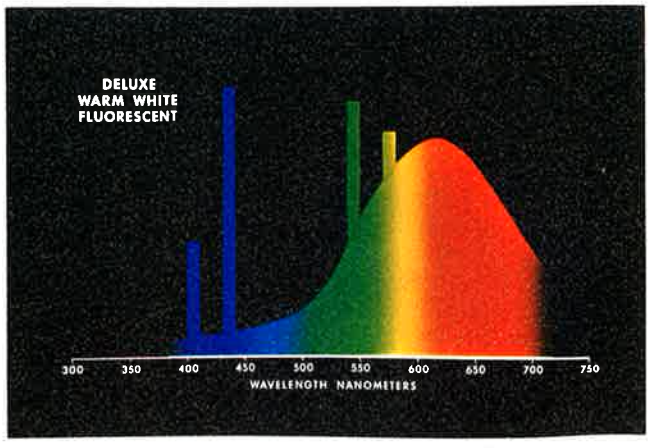
COOL WHITE FLUORESCENT



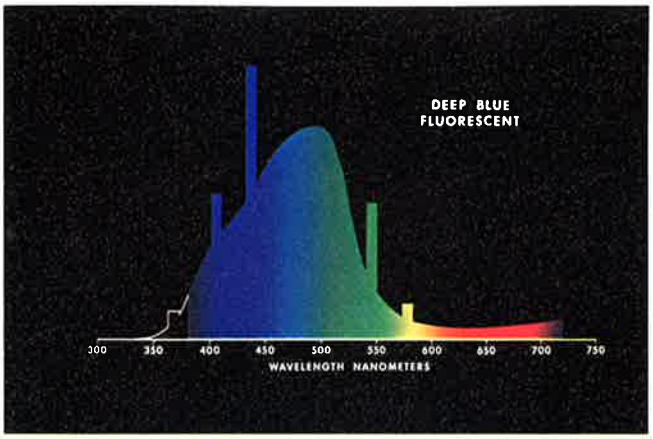
DELUXE COOL WHITE FLUORESCENT



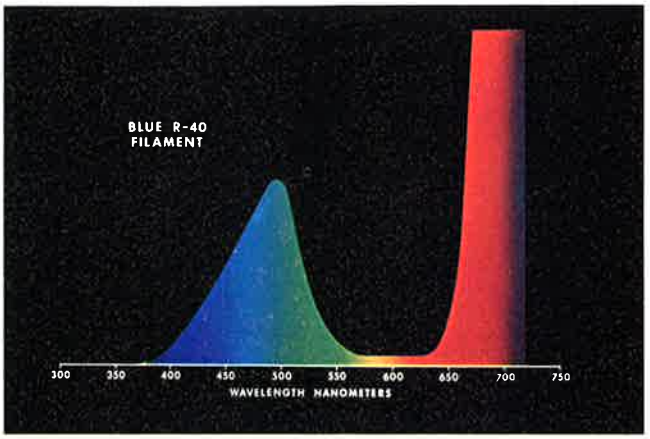
WARM WHITE FLUORESCENT



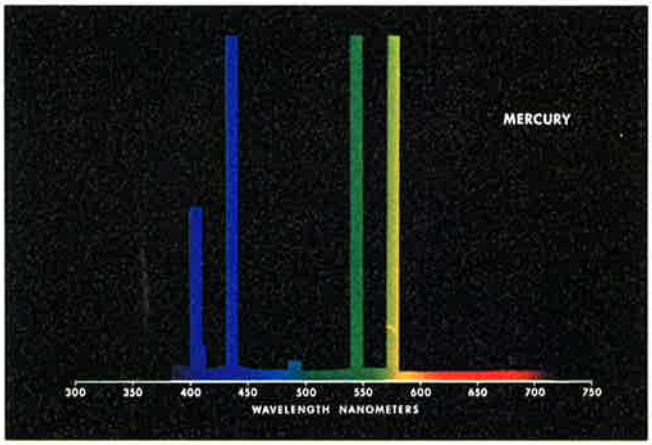
DELUXE WARM WHITE FLUORESCENT



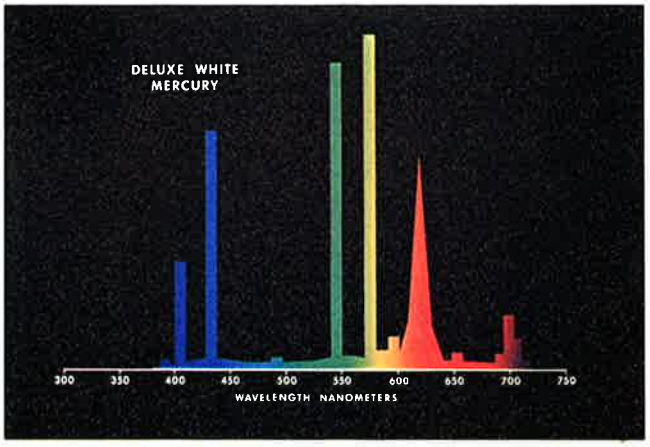
DEEP BLUE FLUORESCENT



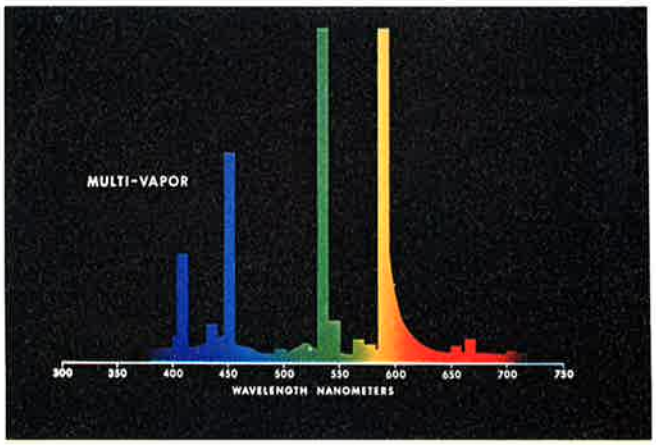
BLUE FILAMENT



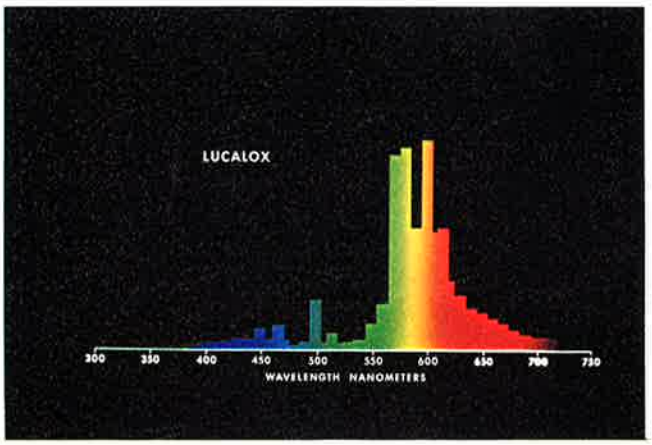
CLEAR MERCURY



DELUXE WHITE MERCURY

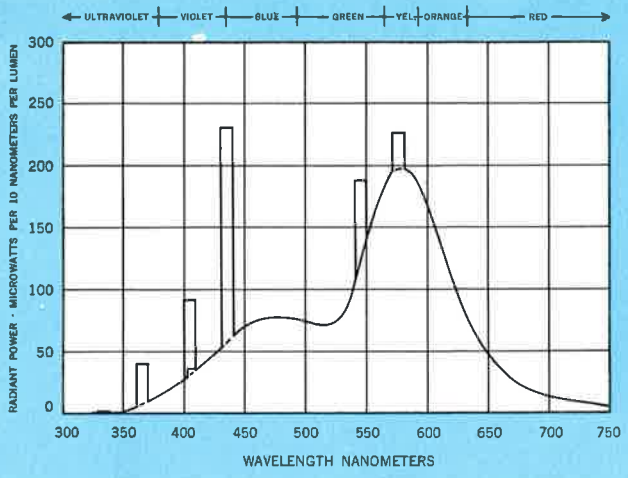


MULTI-VAPOR ®



LUCALOX * LAMP

** Trademark of General Electric Co.*



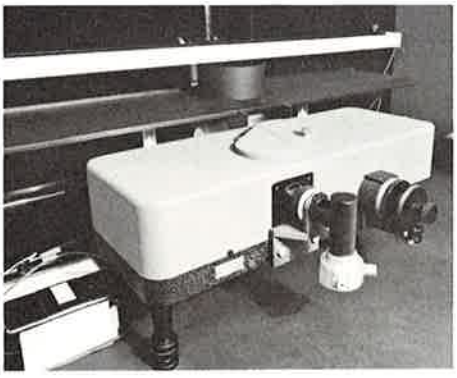
APPROXIMATE INITIAL SPECTRAL ENERGY DISTRIBUTION

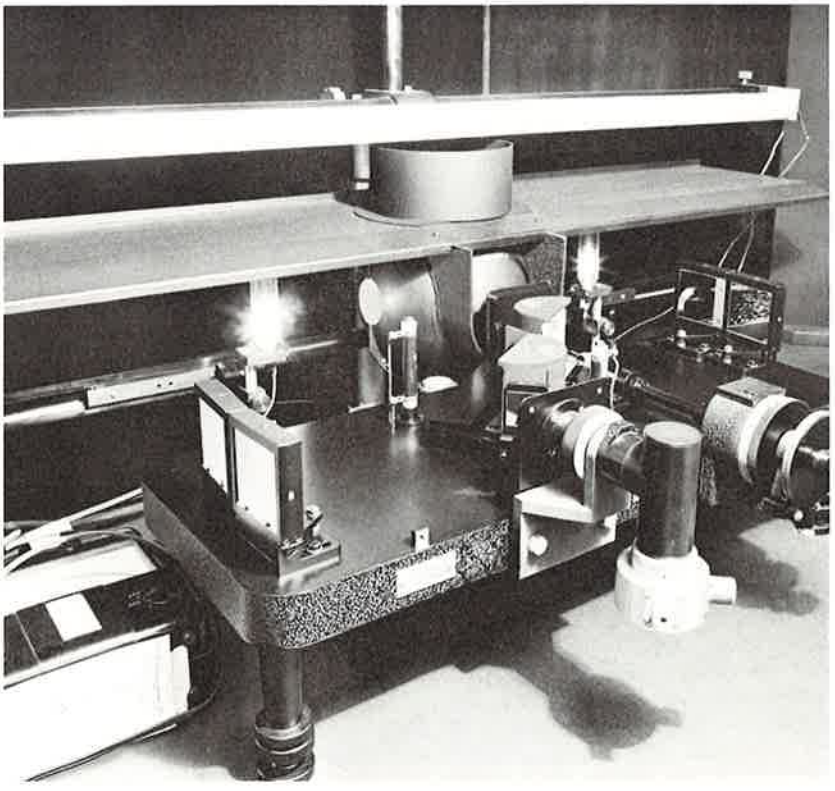
LAMP DESCRIPTION: F40CW COOL WHITE FLUORESCENT DATE: FEBRUARY 11, 1965	C.I.E. CHROMATICITY: X= .367 Y= .364 COLOR RENDERING INDEX: 66 AT 4200 °K	GENERAL ELECTRIC LARGE LAMP DEPARTMENT NELA PARK CLEVELAND, OHIO 44112

SPECTRAL DATA: F40CW FLUORESCENT

```
COLORM    14:34   CL FRI 11/04/66

F40CW SMC243

INPUT E,F1,F2,F3,F4,F5
?1,1,1,1,1,0

WL          INT          MW/L/10NM          PC.L/10NM          NORM.AT578
 390          30           19.4162        1.32030 E-4           671.1
 400         41.6          26.9238        7.32329 E-4           930.6
 410          53            34.302        2.79904 E-3          1185.7
 420         68.6           43.104        1.17243 E-2          1489.9
 430          80            51.7766       4.08414 E-2          1789.7
 440          93            60.1903       9.41377 E-2          2080.5
 450        103.5           66.986            .173092          2315.4
 460          113           73.1345           .298389           528.
 470        116.2           76.5              .473382           .3
 480          11[illegible]  77.0177           .727972
 490                         75.7233          1.07103
 5[illegible]                [illegible]       [illegible]
                              .73731
                             64.0089                             .2[illegible]
 436          267           172.805           [illegible]       5973.2
 546        106.5           68.9276           4.61205           2382.6
 578         44.7           28.9302           1.74908           1000
 408          7.3            4.72462          3.34125 E-4        163.3
X= .3719     Y= .3754       RED= 17.4633

CHROMATICITIES   REFERENCE LAMP              TEST LAMP
SAMPLE           U                V          U                 V
 0               .2215            .332       .22               .3332
 1               .2668            .3393      .2535             .3412
 2                                 .3[illegible]  .256          .356[illegible]
 3
                                  -8.[illegible]                .001
 4                                -1.0692  E-3                 .0119
 5               -1.[illegible]11 E-2        4.53209 E-4       .011
 6               -7.59067 E-3     3.70690 E-3                 .0084
 7                5.90152 E-3     3.66778 E-3                 .0069
 8                1.66625 E-2     3.22506 E-3                 .017

COLOR REND.INDEX= 65.5864    AT COLOR TEMP   4200
AVE VECTOR LENGTH= .0093
VIS.LUM.EFF.= 338.185

TIME:  24 SECS.
```

Typical spectral distribution curve of a lamp with (right) some data obtained from the pen recorder on the spectroradiometer. The first column of data is fed to a computer, which translates the figures into those used in plotting the curve on the spectral distribution sheet. The apparent color temperature, chromaticity coordinates, and the color-rendering index are obtained in this program, also.





The Carl Leitz double prism monochromator (small picture shows cover in place) is manually operated, and is used to obtain basic spectral measurements. Information received from this is used to calibrate color standards . . . for the direct recording instrument, and for monitoring product color in development, manufacturing, and for testing.

On The Barrelhead

by **A. L. Hart**
Lighting Development, Nela Park

A warm, inviting atmosphere is created in this women's clothing department with de luxe warm white fluorescent lamps in the valances, and with recessed incandescent general lighting. Because the color-rendering properties of these two sources are similar, there is no radical color shift as the clothes are taken from the display to be tried on.

Color is fundamental to virtually every aspect of modern merchandising. A tremendous amount of time and talent is expended on developing colors for products, for packaging, for advertising, and for the selling space. And yet, color is present only as we see it; and it can be seen only when the object or space is lighted. It is dependent upon lighting.

All light sources have individual color characteristics which can be analyzed and applied to enhance the sales appeal of goods and of the store itself. There are many lighting tools available to the store designer. Some have been with us for years; others are new, and the list grows rapidly.

Color Rendering

Perhaps one of the most important aspects of lighting design for merchandising is the color-rendering properties of the light source. The color-rendering properties of a light source refer to the effect of its light on the color appearance of an object as compared to the light from a familiar or reference source which may be present or remembered. (Our memory of colors is highly fallible — ed.) In general, we are familiar with the color effects of daylight, and tend to rely on it in making a color judgment — even though daylight varies greatly in color quality, depending on the time of day and on sky conditions. We also tend to rely on incandescent lighting. This is an incongruous situation, because daylight emphasizes cool colors. Incandescent lighting accentuates warm colors. Color and color rendering are, in many ways, subjective — i.e., the function of the individual — what he expects to see, his memory, and his likes and dislikes.

Because "true color" or "true color rendering" is really indefinable, perhaps the approach to choice of lamp color lies in the use of the terms, "reasonable" or "appropriate" as applied to the color-rendering characteristics of the various light sources and specific merchandising situations.

Atmosphere

The choice of an appropriate light source may be narrowed somewhat by deciding whether the space should have a warm, perhaps intimate character,

Carpeting and other home furnishings are usually delivered and seen first in daylight, but nighttime appearance is often the most critical. Incandescent lamps (Quartzline, here) help to create a color situation similar to that in the home.

or a cool, crisp appearance. This decision may be influenced by the type of merchandise displayed, and how and where it is used. Automobiles, sporting equipment — outdoor items — might, from a psychological standpoint, be displayed best in a cool environment. Following the same line of reasoning it might seem best to display evening gowns in a warm, dramatic setting.

The classic, public "image" of a store type could provide a basis for choice of atmosphere — a cool, clean, efficient drugstore versus a warm, "fresh-out-of-the-oven" bakery, for example. On the other hand, the designer of an open-front store may wish to make the interior light compatible with daylight coming through windows. Then, a cool light source would be the logical choice.

Lighting level is another consideration. Cool sources are usually preferred where higher levels (100 fc and up) are desired. At 50 footcandles or less, the warm sources may be preferred. However, there is some indication that as the brightness of the luminaire is decreased through better shielding, warmer sources may be desirable at higher levels, especially if the color scheme is neutral-cool.

Warm light sources include de luxe warm white and warm white fluorescent, incandescent (including Quartzline®) and the Lucalox lamp. Cool sources include de luxe cool white and cool white fluorescent, DeLuxe White mercury, and Multi-Vapor lamps.

Fluorescent White

The decision to choose de luxe cool white over cool white for a supermarket, or de luxe warm white over warm white fluorescent in a department store, is less obvious than the choice between warm or cool atmosphere. This is because the color-rendering differences are more subtle than color differences. However subtle, the differences are real. They affect everything in the space — decor, merchandise, and perhaps, most importantly, the people. The average shopper may not be aware of the color of white fluorescent lamps used in a store, but she does react to the color effects of the lighting. Although there are other factors involved, she probably bases her judgment of the color quality of the lighting largely by its effect on skin tones — on her hand as she reaches for a head of lettuce, or on her face as she tries on a hat. Therefore, where color is important as it relates to a buying decision, or where the proper atmosphere may keep the shoppers a few minutes more, fluorescent lamps that help to render complexion colors reasonably well are desirable. For this reason, de luxe cool white or de luxe warm white lamps are to be preferred to the cool white or warm white colors — even on a lamp-for-lamp basis at the expense of the illumination level.

Acceptable color rendition can be achieved in a system using cool or warm white fluorescent lamps if properly combined with incandescent. At least 30 percent of the footcandles should be incandescent, and the distribution of light should be similar to that of the fluorescent system (not spotlighting).

High-intensity Discharge

Combining sources of different color characteristics is also the key to the use of high-intensity discharge sources in merchandising areas. The newest of these, the DeLuxe White mercury lamp, provides a cool light. Most observers agree that it renders skin tones as well or better than does a cool white fluorescent

Dignified, yet glittery might best describe the environment of this jewelry store. The pale blue decor is enhanced by cool white fluorescent general lighting. But each of the display areas is downlighted by incandescent lamps to develop sparkle and highlights in precious stones and silver, and to add desirable warmth to customer complexions.

lamp. Its application is appropriate in sales areas where the appearance of packages and people is important, but where color judgments are not critical. The general grocery section of a supermarket is an example. The DeLuxe White mercury does have the line spectrum that is typical of mercury lamps, and cannot be classed as an excellent color-rendering source. In color sensitive areas, then, combination with incandescent on a 70-30 fc ratio is suggested — as with cool white fluorescent.

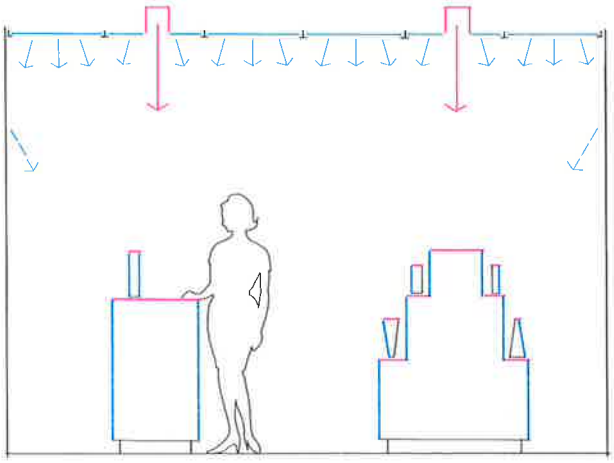
The Multi-Vapor and the Lucalox lamps represent a greater opportunity for the lighting designer than perhaps any light source of the past. Their compact arc tubes, inherently high efficiency and color are already stimulating development of new techniques of light control and application.

Present Multi-Vapor and Lucalox lamp designs are applied effectively in merchandising when combined with incandescent and/or fluorescent lighting. Experience with such combinations is being acquired, and to date, appropriate systems include: equal levels of illumination from Multi-Vapor, Lucalox, and incandescent lamps; equal levels of Lucalox and de luxe cool white fluorescent; and equal levels of Multi-Vapor and de luxe warm white fluorescent lamps or incandescent lamps.

The intermixing of the several colors might be handled in such a way that the shopper is unaware of the combination. This could be done by mounting all of the lamps above a luminous or louvered ceiling or in an otherwise totally indirect system.

More interesting, from a design standpoint, is the possibility of achieving new and exciting spatial color relationships. In one approach, the dominant color sensations — warm or cool — might be imparted to the space by using Lucalox lamps or Multi-Vapor lamps respectively to illuminate the upper walls and the ceiling. At the same time, a shielded fluorescent system would produce an equal or greater illumination level on counters and displays.

The ultimate objective of any store lighting design is to utilize the available light sources in such a way as to complement the architectural and decorative aspects of the store; to develop an atmosphere in which customers and sales personnel are happy; and one that provides appropriate color rendering at the point of sale. In the final analysis, it is the color and color-rendering characteristics of the selected sources that play a vital part in design success.



Spectrally different light sources may be used in diffuse and highly directional systems. Vertical and horizontal surfaces may be lighted more or less uniformly with the diffuse system. Only horizontal surfaces benefit from downlights.

Color in the Factory

by **J. P. Frier**
Lighting Development, Nela Park

The colorful world we live in has also been extended to the world we work in — not excepting factories. The color-rendering qualities of light sources are receiving more attention, particularly in relation to the appearance of people. This is not a temporary trend. It relates to many social and economic factors that are increasing in importance. Naturally, color-critical jobs such as color matching, continue to receive immediate attention, but the color of light, and color in surrounding surfaces are increasing in importance in industry.

Color in the Environment

Color preference is subjective. Everyone has his own likes and dislikes about colors. And until recently the lighting industry had concerned itself primarily with developing and installing lamps that would be suitable for a given application in terms of what could be measured — i.e. the amount and quality of light that could be produced and used most economically and effectively. There is a need for color specification as well. Helping to bring this into existence is a new system of color specification which has been accepted by both the Illuminating Engineering Society and the International Commission on Illumination. Included in their consideration are the many types of fluorescent lamps now being manufactured. The idea is to define or describe the color characteristics of any lamp. The next step will be to establish acceptability standards for lamps for specific application. Application of the color-rendering method — other than in the color-matching field has not been considered. It will be some time, probably, before general lighting specifications will be available.

In the Meantime

But now we are entering the Third Age of Light. With the recent developments in high-intensity light sources — notably Lucalox — there has been some concern over the color rendition of these sources. In general, high-intensity sources do not have as good color rendition as general service fluorescent lamps. Most industrial areas, however, even where color work is done, can still take advantage of these lamps. Rapid identification of colored materials or color-coded wire or parts requires a minimum of 200 fc. In large industrial spaces this can be provided by putting in additional local or supplementary lighting with de luxe cool white fluorescent lamps. Combinations of high-intensity sources will also provide better color rendition than individual lamps. For example, equal wattage of Lucalox lamps and Multi-Vapor lamps will provide approximately the same appearance as warm white fluorescent. It is not anticipated, however, that combination systems will be used for industrial lighting. Improvements in color will result primarily from improvements in the sources themselves. A good example of this is the new De Luxe White Mercury lamp.

We can expect an increasing use of color in industry. It will be used not only in the basic sense of identifying specific areas and items of possible hazard, but to make the surrounding more pleasant. In many instances color will be used to relieve the sterile atmosphere that has been characteristic of many new installations such as clean rooms. Just adding some daubs of colorful paint to walls and machines in older industrial areas may improve the maintenance and general housekeeping situation a bit. But when more light is introduced, then color becomes more important to morale. A "tranquil" color is not enough—particularly where work requires quiet precision, anyway. Color and texture contrasts introduce vitality. Because the eye is continually roving — it's looking for a change of pace— the introduction of contrast by color stimulates the visual senses. And the color-rendering characteristics of light sources acquire more importance.

Color at Work

Color grading and color matching require light sources with specific characteristics. These industrial processes are conducted by people trained to recognize differences in colors under specific light sources. In the past, color grading was done under north light. When fluorescent lamps came along, attempts were made to duplicate natural north light — with varying success. The new color-rendering index should make it possible to specify light source characteristics needed. The exact recommendation will

Many precautions are taken in clean rooms to prevent the entrance of dust and lint. This does not mean that color is barred, too. Here, some attempt has been made to introduce color, which stimulates visual sense.

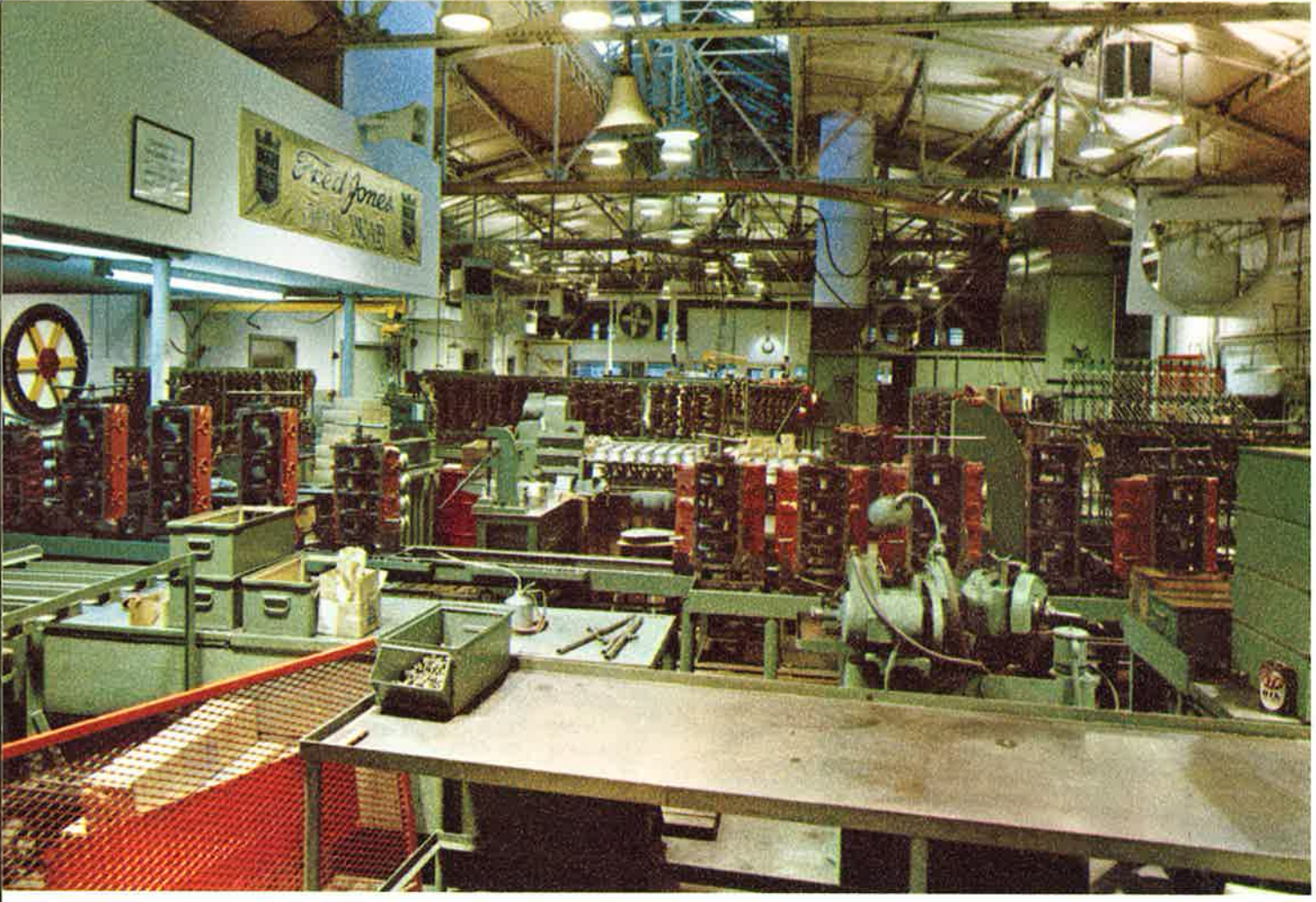
Localized fluorescent lighting is added to the mercury general lighting system. This increased the lighting level by 100 fc, and provided better color rendering in the silk screen process used in printing towels.

have to be made, and in some cases, lamps will have to be manufactured to meet these specifications.

A simple lighting technique for color matching has been used for years. The objective of color matching is not to show colors as they would normally appear (this can be done with de luxe cool white fluorescent) but to obtain the greatest color contrast. This can be done by using a color in the light source which is readily absorbed by the surface or materials being inspected. Differences in blue materials show up best under reddish light so that these should be inspected under incandescent lighting. Red materials should be inspected under bluish light or daylight fluorescent for best results. Colors should be inspected under both sources independently. If they match under both conditions they will usually match under any color light. The light level should be at least 200 footcandles.

Care must also be taken to avoid specular reflections. This means that the work or the light source should be positioned so that no light is reflected directly from the surface into the eye. Light reflected from the surface of the material is the same color as that of the light source, and masks the actual color of the surface. This problem is especially acute when the surface is smooth or shiny.

Obviously, the use of color, of color coordination, and of color characteristics of lamps is still new to industry. But this is not a fad. It is a trend that will grow. We must be aware of it.



A Report from Oklahoma City

Re: Fred Jones Manufacturing Company

"This job has exceeded our best hopes by a great margin. The new Lucalox light source, in my opinion, is an outstanding source, and one which I like to work with. We can now do in a small package, that which we have dreamed of doing for a long time. Employees comment favorably on the color of the light. The effect on multicolored parts, both in assembly and in process of manufacture, is satisfactory. Ability of the workmen to see quickly and well under the now excellent footcandles has improved quality of work, reduced rejections, and has made for a much better all-round atmosphere in which to work.

"Proof of the value of this lamp is that two more buildings of Fred Jones Mfg. Co. are being lighted with LU-400 lamps. The new plant will also have LU-400 (400-watt Lucalox* lamps — ed.)"

Bill Irving

by **W. S. Irving**

Large Lamp Sales, Oklahoma City

The Fred Jones Manufacturing Company cleans and rebuilds engines. It has been in business more than 50 years. Although there are severe dirt conditions in many areas the work requires precision, and plant personnel can now see better. Here are some of their comments . . .

"Much better than the old lights . . . I can see much better . . . they are real good . . . no comparison with the old ones . . . when I get in this light I can make a better inspection . . . all right — they can't be beat . . . you can see what you are doing . . . real good, produce lots of good light."

Mr. Lewis Lee, Plant Manager, sent us these comments, and naturally, we are pleased, too.

* *Trademark of General Electric Co.*

CLEANING ROOM

Where engine is received, and initial cleaning and partial tear-down is done.

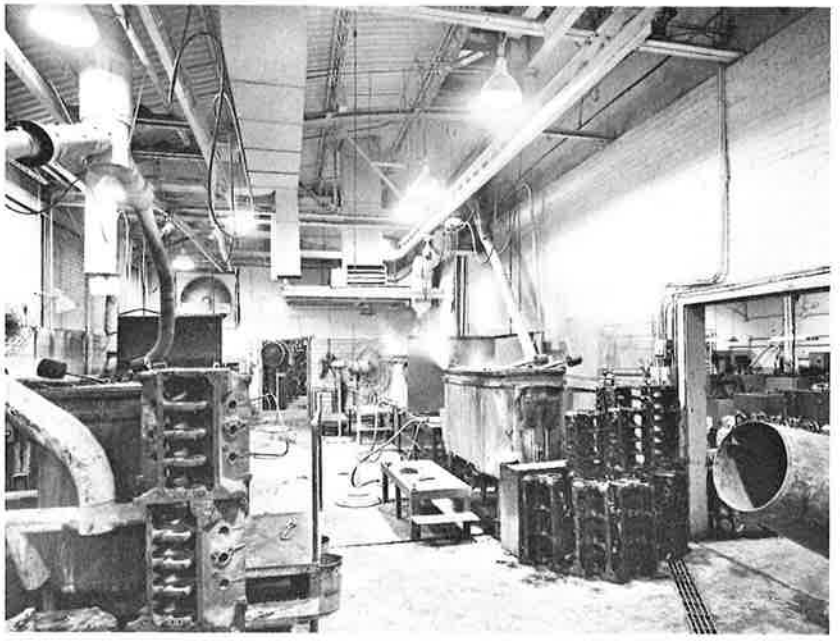
ORIGINALLY—lighted by two 150-watt A-line lamps and one 300-watt M/IF—almost 5 fc near light sources. Known as the "Mole Hole"

NOW—five 400-watt Lucalox lamps in deep bowl, 14-inch reflectors. Maintained footcandles: 300 plus. Room repainted. Floor covered with a grease-absorbing, sand-like material.

TEAR-DOWN ROOM

Engine is stripped down to the block, and then put into a solution. This bath makes it ready for further machining and assembly.

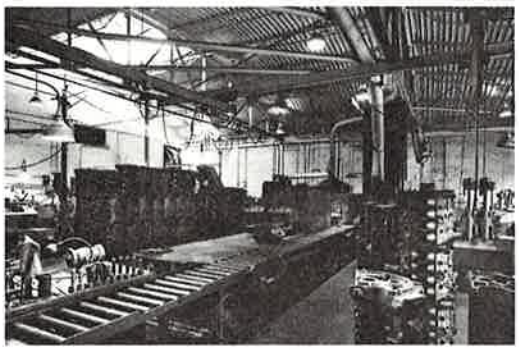
ORIGINALLY—lighted by six 400-watt mercury and six 500-watt incandescent lamps. Lighting level was 15 fc maximum.



NOW—room is repainted, and 14 Lucalox lamps, each 400 watts, supply 300 fc. Lamps are mounted at 16 feet. New, deep reflectors are used, because old ones were eaten through by acid fumes.

ENGINE BLOCK/PRE-ASSEMBLY

Blocks are inspected for flaws such as cracks, warping, etc.

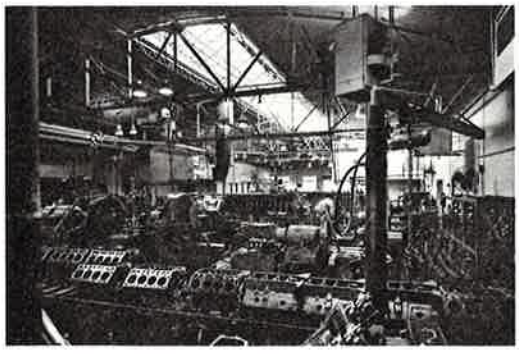


ORIGINALLY — eight 400-watt mercury lamps and eight 500-watt incandescent lamps. Average lighting level: 20 fc.

NOW — 19 Lucalox lamps (400 watts, each) in repainted fixtures in work area (250 fc); and 17 Lucalox lamps in the surrounding area (200 fc). Where additional fixtures were needed, they were 14-inch diameter, deep-bowl units.

MACHINE AND ASSEMBLY

Fine machine work is done on blocks and crankshafts. Pistons are fitted, and engines assembled.



ORIGINALLY—35-40 fc; 400-watt mercury lamps and 500-watt incandescent lamps, plus local lighting.

NOW — 300 fc; 48 Lucalox lamps (400 watts each) mounted at 16 feet; on 16-ft by 20-ft spacings. Old fixtures were cleaned, repainted, and sockets reset to bring new lamp into the focal area of the fixture. Ballasts were mounted near the units.

ENGINE TEST ROOM

As they come from the assembly line, engines are operated here. Engines and parts are sealed in plastic and packed.

ORIGINALLY — 35-40 fc; 400-watt mercury lamps and 500-watt incandescent lamps.

NOW — More than 300 fc. No local lighting. Nine 400-watt Lucalox lamps (16 feet to bottom of fixture) on 15-foot centers. Room, of course, was repainted, as all areas were.

Two rows each of two types of fluorescent lamps provide "day or night" lighting. The light of de luxe warm white fluorescent lamps blends with incandescent light and is well suited for evening makeup. De luxe cool white fluorescent lamps should be used for daytime. A man uses both sets of lamps for extra-good shaving light.

Fancy is as Fancy Does

by **Aileen Page**
Residential Sales, Product Planning and Application, Nela Park

For many busy people the bathroom is more than a utilitarian space; it is a kind of sanctuary. Often, it and the kitchen are the only rooms the commuter and the children see until evening. For this, if for no other reason, these rooms should, and can, be attractive as well as useful places.

New designs and new techniques in construction have made possible the use of interior spaces that could be used previously only for such things as closets and stairways. Fans, easily cleanable and colorful surfacing materials have made major contributions. Another element cannot be neglected — light!

A lighting system (really more than one) can be versatile. It is made more so by various types of comparatively low-cost dimming devices, automatically controlled switches, a variety of lamps with different color characteristics — many kinds of devices to meet the seeing needs of the occupants and to meet decorative requirements.

Lighting Techniques

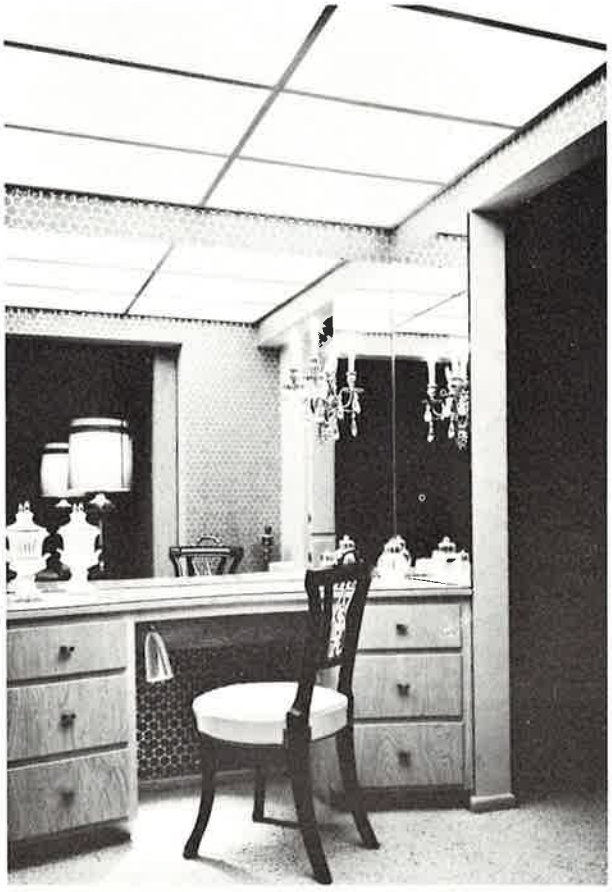
It is obvious that because of occupant needs and building designs there must be a better understanding of the structural elements of the lighting systems. Dimensions and spacing — the number and types of lamps that can be used effectively in a space, are increasingly important. This kind of information is available, because lighting engineers have been working on them for a long time. Such information should not be ignored. It can make the difference between usable, attractive space that helps to sell a house, and one that makes the customer vaguely uneasy and definitely unhappy.

Here are a few things a builder should know:

1. For wide mirrors with lighted soffits, use at least a double row of fluorescent tubes extending the full length of the mirror.
2. The soffit should be at least 18 inches to 24 inches in front-to-back width, and preferably not more than eight inches deep (top to bottom). The bottom covering should be of highly diffusing material to scatter light toward the face.
3. De luxe warm white or de luxe cool white fluorescent lamps — or two rows of each, separately switched — provide pleasing complexion tones.

4. If luminous ceilings or large luminous recessed panels are used, remember that these do not make local lighting at the mirror unnecessary. A pair of 20-watt fluorescent or 60-watt incandescent lamps at either side of a small mirror or above a large one would be the *minimum* needed for local lighting.
5. Luminous diffusing glass or plastic pendants used for local lighting at the mirror should be centered at or slightly above face height (about 65 inches above the floor) and at least 36 inches apart. They should be at least eight inches in diameter — preferably larger — and use 100-watt bulbs (or 150-watt if more than four feet apart). A high-low switch or dimmer is recommended for these to make them more pleasing when not in use for shaving or makeup.
6. If wall brackets or fixtures with unshielded bulbs are used (for example: bare-bulb crystal brackets, coach lanterns, colored-glass pendants) they should have very low-wattage bulbs or should be on dimmer switch. They should be considered as decoration *only*.
7. If theatrical-type lighting is desired, rows of bulbs should be at least 30 inches apart. Six 15- or 25-watt bulbs on each side will need to be supplemented by a lighted soffit or at least by a single fixture directly above the counter edge.

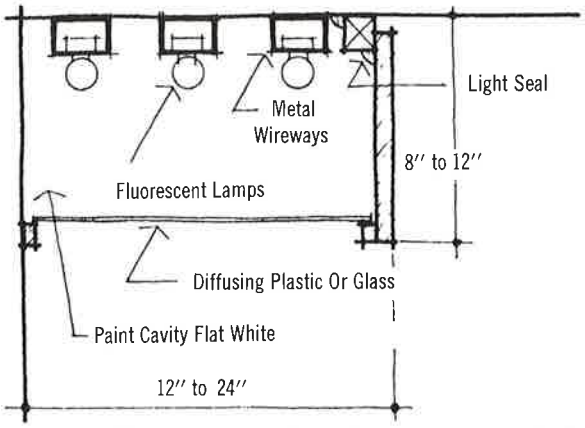
Incandescent lamps in the decorative coach lanterns call for de luxe warm white fluorescent lamps above the ceiling panel. This luminous panel is four feet square, and above it are four 40-watt lamps. Reliance on just the coach lanterns for illumination would be unwise, because alone they produce glare and discomfort.



The crystal bracket mounted on the mirror is considered simply decorative. The luminous ceiling provides the general lighting. The pedicure lamp provides useful local lighting.

Here, local lighting is not only useful, but adds a theatrical touch. De luxe warm white fluorescent lamps above the unusual ceiling provide the general lighting for the room.

Without the lighting this would be just an "ordinary" bathroom. But it has a luminous ceiling which makes it seem larger and open to the sky; and it has unusual lighting around the mirror. This not only frames the mirror, but it provides local lighting that is excellent for shaving.



Typical soffit construction. Note that this shows only three rows of de luxe white fluorescent lamps. In this case, all lamps would be of the same type — cool or warm.

Two 75-watt recessed floodlamps backlight the curtains and silhouette the cornice board. The effect is dramatic —

especially when other lighting in the room is not in operation. Note that the soffit is as wide as the counter.

Manipulating Light, PART II

by **T. K. McGowan**
Lighting Development, Nela Park

Part 1 of this article concerned itself with the kinds of lighting controls that vary electric illumination through dimming, and it examined the many types of systems and circuits that are now available for application of these controls to any incandescent and many fluorescent lighting installations. This part will examine some of the less-well-known types of lighting control devices to suggest that there is more than one way to turn a light on and off, and many of these devices, while often categorized as gadgets, do help solve the unusual requirements sometimes encountered. Their main benefit, however, is that they increase the usefulness and convenience of the lighting system.

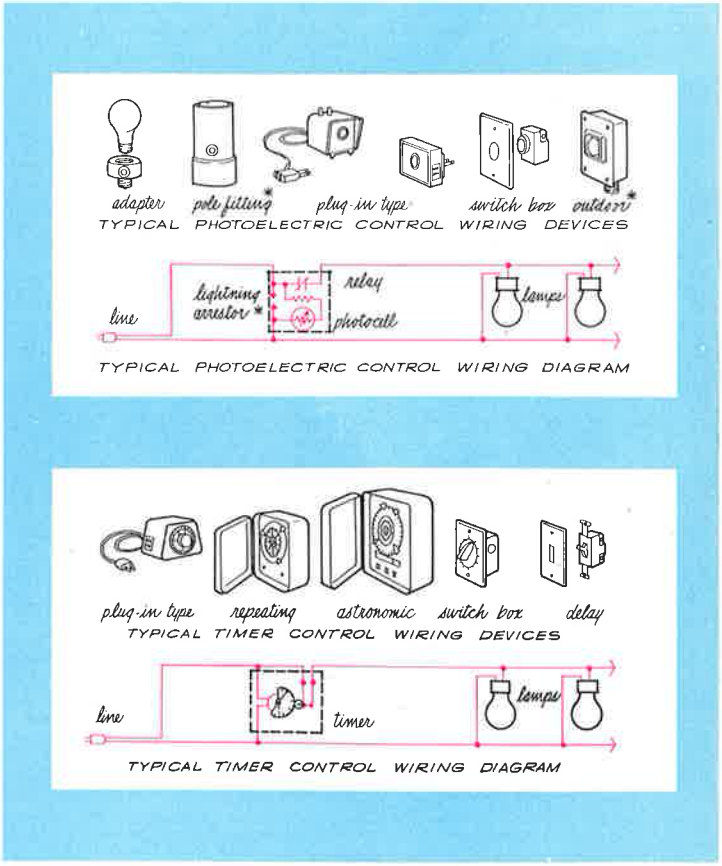
Photocell

The electric eye or photocell-controlled circuit is today an increasingly popular way to add automatic control and convenience to lighting systems, and has made possible the "dusk to dawn" and private lighting programs offered by many electric utilities. In most cases a small photoelectric cell, perhaps less than an inch in diameter, senses the level of natural light and switches its lighting circuit accordingly. Often the switching is delayed so that it will occur only after a pause of several seconds to prevent erratic operation from automobile headlights, or lightning flashes. This type of control is low in cost and has now been adapted to residential use through types designed for outdoor floodlights, area lighting, and even portable lamps. Prices range from about five to ten dollars for units capable of controlling up to 500 watts. An excellent use of these small photocells is in the new mercury post lanterns now becoming available. A post lantern equipped with a photocell control and one of the new 50- or 75-watt mercury lamps will provide maintenance-free lighting all night every night for more than two years of operation.

Timers

Switches which can be set to open or to close a circuit at predetermined times have long been used by appliance manufacturers and in commercial and industrial control applications. Today, however, small timers can be bought in department and hardware stores that can be used to control lighting circuits in the home as well. Several models on the market even compensate for the changing of the number of daylight hours during the seasons and will faithfully perform their function all year long, with resetting required perhaps only once every four years. In combination with a photocell, the timer may be used to turn on lights at dusk, then off at a specified hour, on again before daylight, then off as the natural light increases. In critical areas such as entranceways, parking lots, or street, this assures that lights will not only be on when needed on dark and stormy days, but also that they will be off when not required.

Some interesting interior and exterior lighting systems have been installed, using combinations of devices like these. A lighting designer, for example, wanted a building exterior to keep the same brightness contrast with the sky surrounding it as darkness approached. He, therefore, used a timer to turn on the building floodlighting before the sun went down.



Then as the sky began to get dark, a photocell connected to a dimming circuit gradually dimmed the lighting, keeping it in balance with the surrounding sky until dark, when a stop on the dimmer kept the lighting on at a low level for a subtle nighttime effect. The same idea could also have been used in reverse with the lighting coming on gradually as the sky darkened. In some interior systems, the lighting is connected via photocell and dimmer to the daylight outside, and as clouds or storms temporarily decrease the natural light, the interior illumination is increased correspondingly so as to keep illumination level on visual tasks more constant.

Low Voltage

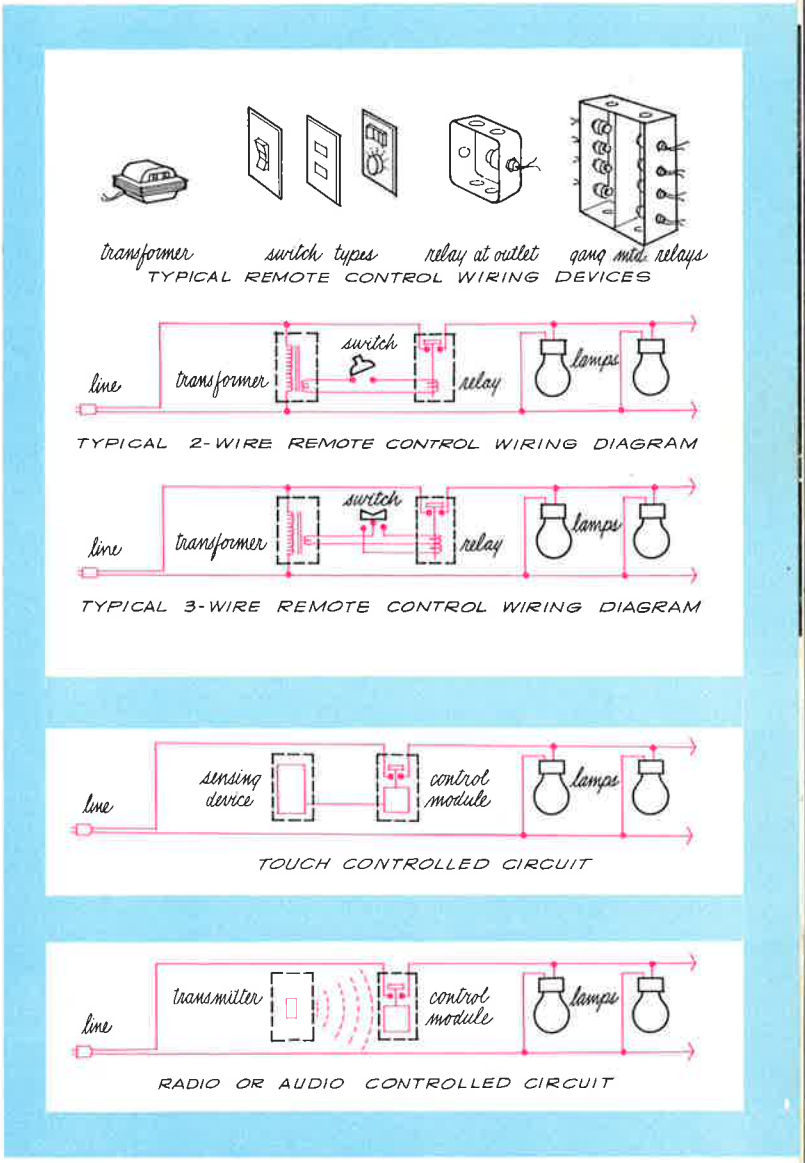
In many cases where lighting must be controlled from many points, or where there is a complexity of lighting circuits, or where flexibility is desirable in the lighting system, the low-voltage remote-controlled relay systems have been applied. Basically, these systems use special low-voltage control switches and wiring operated from a transformer to switch relays, which in turn control the standard 120-volt lighting circuit. Because the control wiring does not carry the lighting load directly, small, lightweight, telephone-type cable may be used and run wherever convenient behind moldings, stapled to woodwork or buried in shallow plaster channels.

In the circuits shown, any number of on-off switches may be connected, to provide control from many remote points. In a typical residential installation this might mean that the front post light could be controlled from the front entranceway, garage, back door, and master bedroom with equal ease, and without running heavy cable and three- or four-way switching lines through the house. By running a low-voltage line from each relay to a central point, such as the master bedroom, all relays may be operated from this point, with a selector switch allowing quick, convenient control of all exterior and interior circuits.

A motor-driven rotary switch available in General Electric's version of this system allows turn-on or shutdown of up to 25 separate circuits by pushing one button. Dimming may also be accomplished with the G-E system by using a new motorized control unit together with a recently introduced modular incandescent dimming system. Where moveable partitions are used, as in many schools and commercial buildings, this type of control allows great flexibility in switching arrangements and permits use of the lighting systems even during the time that rooms are being changed, because the low-voltage control circuits may be shut down while standard voltage circuits remain energized.

Other Control

More sophisticated devices have come along recently with the development of transistors and other solid-state devices. Now, many complicated control circuits can be placed in a small package safe from moisture, vibration, or shock — and used to perform complex control functions with ease. For example, a match-box-size module now on the market, costing between 10 and 15 dollars, can be used to control lighting systems by sensing the presence of a person or an object within the range of the lighting system. Possible applications include turning on display lights as a person or an automobile goes by a show window, illuminating rooms as soon as someone enters, or turning on protective lighting should an intruder enter an area.



Radio-operated remote-control circuits can also be connected to lighting systems just as they have been applied to open garage doors and control model boats and airplanes. Illuminating the pier as a boat approaches, or lighting the yard or house interior as the car enters the driveway are practical ideas that are certain to find widespread application as the realization of their possibilities grows.

As lighting engineers develop new and improved light sources, find better ways to control glare, learn to redistribute lighting heat, and to integrate the lighting systems into today's buildings, it seems appropriate that the electrical and mechanical mechanisms that control these lighting systems reflect this progress, and contribute to it for the benefit of the lighting user.

In this dining room are both incandescent lamp and fluorescent lamp systems. All lamps are controlled by dimmers so that brightnesses are kept in balance. The warm wood tones of the wall illuminated by de luxe warm white fluorescent lamps reduces possible color contrast.

Dimming is Not Impractical

by **Rose Coakley**
Lighting Institute, Nela Park

Why dim lamps in places other than the traditional ones — theaters, churches, restaurants? Aside from the pleasure of being able to do so, there are some practical aspects to be considered.

People and Physical Needs

As we all know, eye response to light varies with age. In general, the eye adjusts less rapidly when one goes from brightness to darkness than from darkness to bright surroundings. But, an elderly person going from a dark bedroom to bright bathroom experiences a visual shock which can be lessened when bathroom lighting is low enough to permit safe walking, yet bright enough (or adjustable enough) so that labels on medicine bottles, for example, can be read. Return to a dark bedroom is easier, too.

When there is illness — regardless of the age of the patient, but particularly when elderly people or children are involved — adjustable lighting (in home or hospital) reduces visual shock and discomfort. The general lighting level is adjusted to the needs of the

patient, but can be increased gradually. Perhaps the maximum amount is not required.

Psychological Aspects

It probably relates to the fact that for millenniums, people have been accustomed to the changing light levels of an outdoor environment . . . but we know that we are stimulated under high intensities of light; we relax under comfortable low levels; and can be depressed when there is too little light. And when there is no variation in lighting level we can experience a state of "sensory deprivation". Normal consciousness, perception, and thought may be maintained best when the lighting level is varied — so many people believe. Lighting designers may wish to pursue this thought further. To date, the idea has been applied commercially in restaurants where the lighting level is kept low purposely so that people will relax and drink more. In churches, the lighting level in the sanctuary is reduced so that attention can be focused on the minister or on the altar at the appropriate times.

At Home

It is here that dimming controls are being installed more frequently than ever before. In part, this is due to greater availability of low-cost, easily installed, uncomplicated dimmers . . . and an increasing demand for them. There are several rooms in the house where dimming control has obvious application. The bathroom has been mentioned. Actually, such control can be justified in almost any room. We need and want varying amounts of light for various occasions, moods, and tasks. In the living and family rooms, dimmers can be used effectively to meet the needs of activities ranging from games to relaxation.

In the dining room, where the center fixture is so often a type designed for an exposed light source, the possible glare of many lamps can be reduced, and greater comfort obtained, when a dimmer is used.

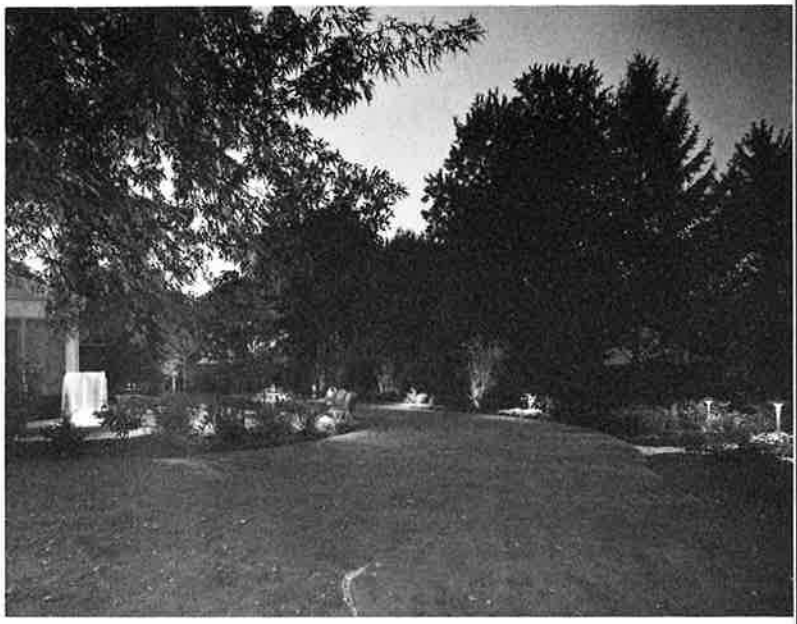
Even in the kitchen a dimmer is useful . . . particularly when there is dining in an adjoining area. Then, the atmosphere of a busy workshop is changed to that of a more social room, and kitchen clutter from meal preparation can be ignored more easily.

Inherently bright lighting devices, such as a vertical luminous panel, can be visually uncomfortable. A dimmer control may be used to reduce this problem.

In gardens, another aspect of dimming becomes most obvious — brightness balance.

Brightness Balance and Color

Often, if lamps are dimmed in one section and not in another the effect can be disappointing unless, perhaps, a change in the color of the light is desired. It must be remembered that the light from incandescent lamps becomes more red-orange as the lamps are dimmed. The same is not true of fluorescent lamps. These lamps merely produce less light — diffuse light — that at five or ten footcandles



If outdoor lighting units are too bright, or if some element should be emphasized in contrast to the others, a dimmer system might supply the answer.

In a child's room, visual needs vary considerably. Here, the crib faces away from the lighting unit, but the fluorescent lamps are dimmer controlled, anyway.

To appreciate outdoor lighting from the inside, the room must not be brighter than the exterior. Here, all of the units contain incandescent lamps. Probably all of them should be dimmed equally for best effect.

can be most unattractive. But there is a place for a fluorescent lamp dimming system, and one should understand what happens when a fluorescent lamp is dimmed.

Fluorescent Lamp Dimming

A fluorescent dimming system is composed of three parts — the lamp itself, the ballast (in some cases an auxiliary or slave ballast as well) and the control.

The fluorescent lamp uses current for two purposes — one to heat the cathode, and second — high voltage to cause a firing or discharge of the mercury vapor. The ballast supplies the high voltage and also acts to limit the current to design levels.

If there is an attempt to dim a fluorescent lamp system equipped with ordinary ballasts, the voltage drops as the current decreases, and the light drops out when the lamp is still at 50 per cent of full brightness. The special dimming ballast keeps the lamp in operation as it is dimmed. The performance of the complete dimmer system depends on how well the component parts work together.

There is a new system that works very well with General Electric's 6G-5012 dimmer. The new control operates in conjunction with the DS-5000 ballasts, and offers a ratio of 500 to one. Installation is simple and economical. No dimming auxiliaries are required.

Do's and Don'ts of Fluorescent Dimming

- "Season" (operate) fluorescent lamps at full brightness for 100 hours before attempting to dim them.
- Dimming ballasts are for use with 40-watt rapid start lamps only.
- For smooth performance and even light distribution, do not intermix lamp types or brands.
- Fluorescent lamps are designed for optimum light output when operated at a bulb wall temperature of 100 degrees F (room temperature normal). An increase of 40 degrees in the ambient temperature can decrease light output 20 per cent. This can happen in four-lamp troffers or in enclosed, close-to-ceiling shallow units. Lamps then cool as light output is reduced, and the result is an unpredictable, unstable performance. Dimmer control for such installations is not recommended. Air flow (warm or cool) over the lamps affects lamp performance, and a dimmer control complicates it.

So . . . if there is to be a dimmer system, get the best lighting equipment available. Use spring-type sockets. Ballasts should be of the same rating from the same manufacturer. Lamps should also be of one brand, be of the same color, of the same age, and made at the same time, if possible. A large percentage of lighting installations can be better installations if adequate dimmer controls are included.

Lighting News

PEOPLE

Two G.E. Lamp Division men have been named Fellows of the Illuminating Engineering Society. They are: *B. F. Avery*, New York Sales District senior engineer; and *R. D. Churchill*, manager of Special Lamp Application at Nela Park. The organization has 10,000 members, and since 1945 there have been 189 Fellows named.

B.F.Avery

R.D.Churchill

Dr. S. K. Guth, manager of the G.E. Radiant Energy Effects Laboratory developed a straight-forward, simplified method for calculating the visual acceptability of a proposed lighting system, and explained it to members of I.E.S. attending the National Technical Conference in Minneapolis this fall.

A. A. Eastman, Visual Research Engineer in the same lab., also presented a paper to the I.E.S. This covered the adequate evaluation of the visual effectiveness of a lighting system. During his investigation he measured and evaluated the correlation between flux contrast, equivalent contrast, and relative footcandles under a variety of materials used in panels, louvers, and luminaires. The conclusion — none of the lighting materials evaluated is superior in controlling loss of visibility caused by veiling reflections.

PRODUCTS

De Luxe White Mercury Lamps

In addition to the 175-, 400-, and 1000-watt sizes previously introduced, limited quantities of small sizes are available. These lamps that contain the rare-earth phosphor are: 75-, 100-, and 250-watt sizes. Production is also getting underway on 700- and additional 400-watt types.

Studio-Stage-Display Spotlight

This 750-watt tungsten-halogen light source has a planar filament and operates at a color temperature of 3200 degrees Kelvin. It has four times longer life, four and one-half times greater total light output over life, higher stability of light output and color, and is more compact than the lamp it directly replaces. Primary application is in focusable, lens-type spotlights.

Five New 1000-watt Mercury Lamps

New mercury reflector spot and flood lamps for high-bay and large-area indoor and outdoor industrial and commercial lighting applications are available. In initial efficiency and life these new lamps are comparable to standard mercury lamps of the same wattage. However, they are expected to offer lower over-all lighting costs because of better maintenance of light output throughout life.

For 277-volt Operation

There are general service and reflector lamps that could be useful in small installations, for standby lighting, and for limited usage areas.

In commercial and industrial buildings 480Y/277-volt distribution systems are being installed more and more often. In general, it is recommended that step-down transformers be installed for lighting, because 120-volt incandescent lamps are less fragile and 25 percent to 30 percent more efficient than higher voltage lamps – with the exception of 277-volt Quartzline®.

However, there are some places where the higher-voltage lamps might be used effectively, and lamps ranging from 25 to 1500 watts are available. Ask your G-E lamp agent about them.

PUBLICATIONS

From I. E. S.

"Lighting and Air Conditioning" — 32 pages with cover. Includes these five subsections; Electric Lamps as Heat Sources, Luminaires as Heat Sources, Lighting Systems as Heat Sources, Methods of Controlling Lighting Heat, and Systems for Controlling Lighting Heat.

"Color and the Use of Color by the Illuminating Engineer" . . . covers the importance of color for walls, ceilings, and furnishings in creating a harmonious luminous environment.

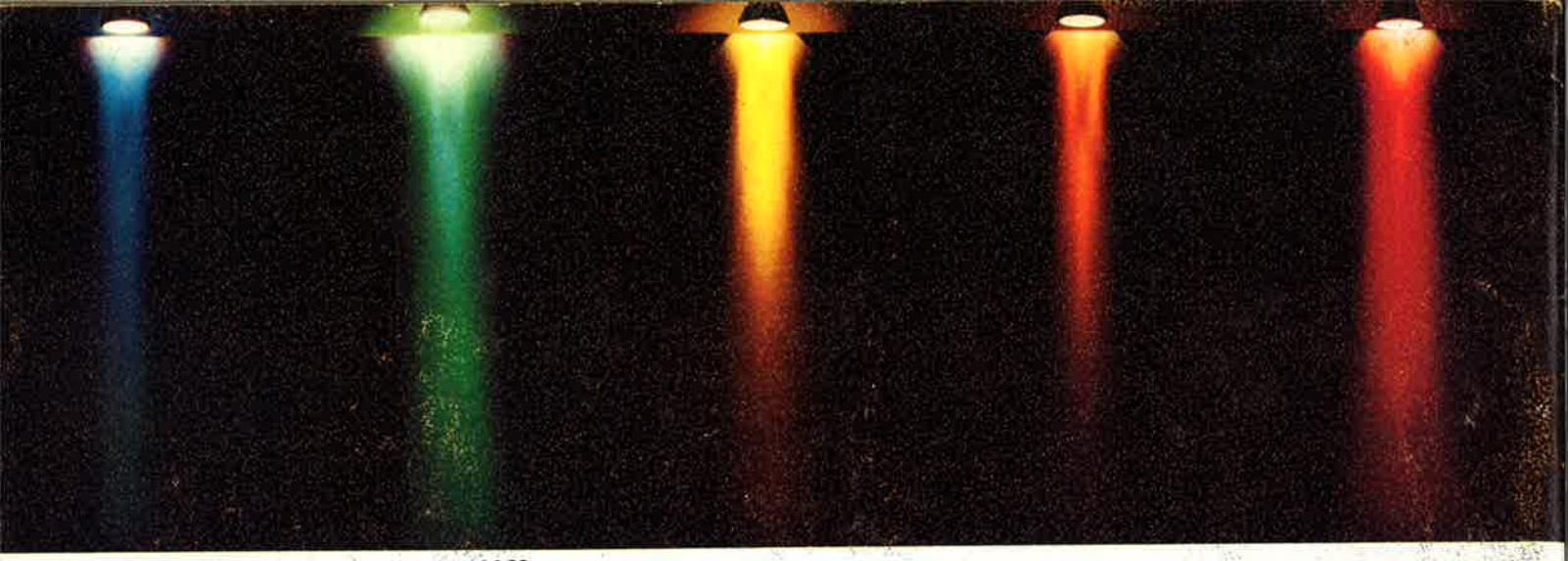
"Lighting for Hospitals" is a 32-page report on the lighting of areas peculiar to hospitals.

"Guide for Lighting Audiovisual Areas in Schools." This is a 16-page booklet that covers such items as setting TV screen controls, location of screen and projector, etc.

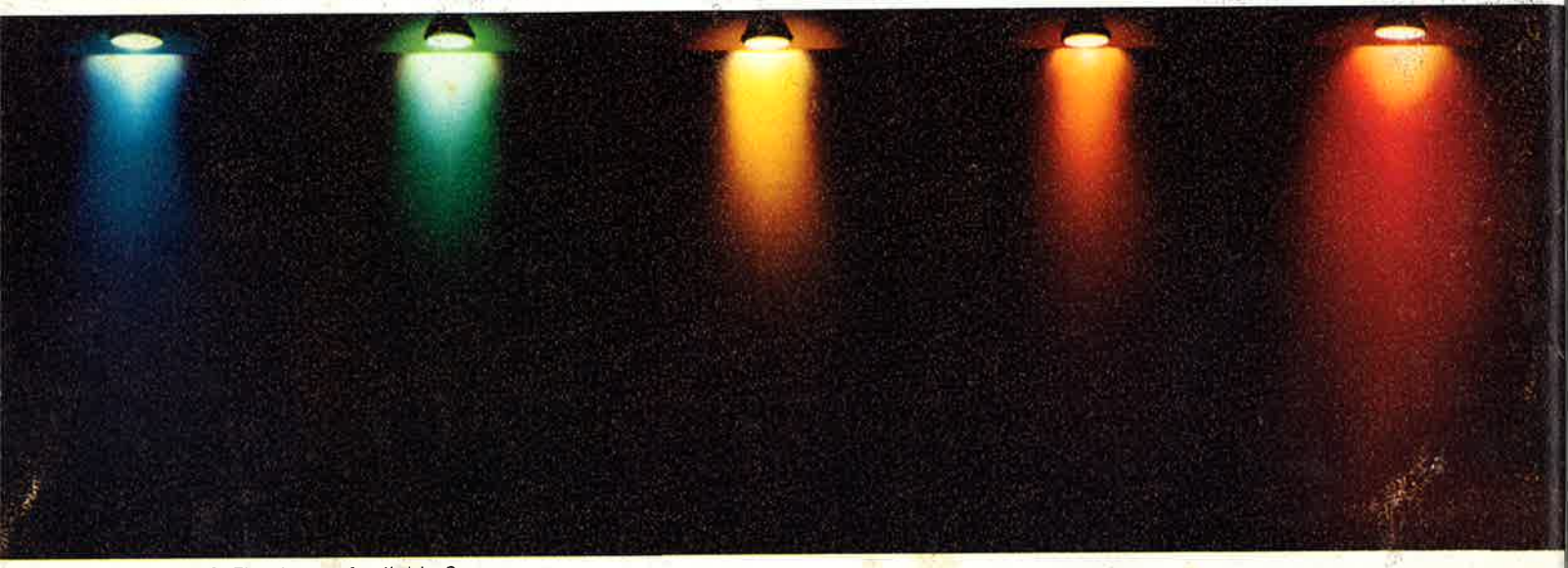
Write the Publications Office, Illuminating Engineering Society, 345 E. 47th St., N.Y., N.Y. 10017 for further information.

From G. E. — Coming!

Available this spring should be a technical publication, TP-132. It is to be a 32-page publication called, "Landscape Lighting". It covers all types of outdoor lighting applications, including recreational areas, shrubbery, security, and decorative.



Dichro-PAR Spots . . . Introduced in 1963



Dichro-PAR Floods . . . Available Soon

THE LINE'S DOUBLED

Now, there are colored PAR lamps with these features:

- spot and flood beam patterns the same as those of clear lamps
- 150-watt colored lamps that won't break in the rain — any color — any operating position
- high light output and color purity that only dichroic filters can provide

With the new G-E dichro-floods you can even feel the difference. The beam-controlling configurations are on the outside of the bulb face to assure proper color control with the dichroic filter. Flood lamp colors match spot lamp colors.
Ask your nearest Large Lamp Representative for more details.

Progress Is Our Most Important Product

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