THE MAGAZINE OF

LIGHT

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1945 * NUMBER 2

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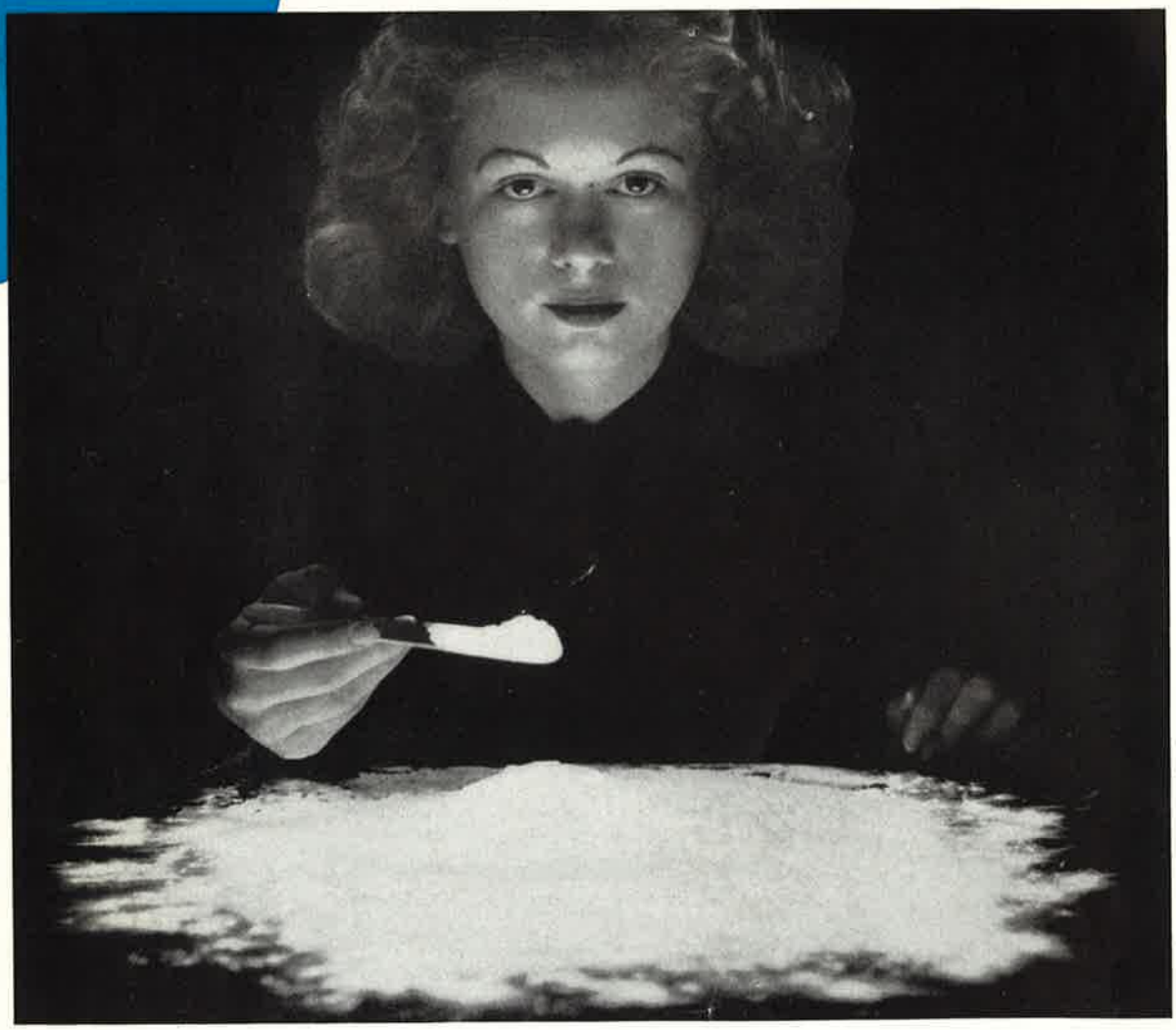


Powdered Light . . .

THE weird luminous powder that lights up this girl's face in called a *phosphor.* It is one secret of the amazing efficiency of General Electric Fluorescent Lamps. Coated inside a fluorescent tube, phosphors transform *invisible* ultraviolet rays into *visible* light—the soft, cool, abundant light that is making seeing easier in war factories, stores, offices, and many homes.

G-E Lamp Research developed these phosphors from a combination of many elements and has refined and improved them again and again in the interest of more light and better light. And research has constantly worked to improve G-E Fluorescent lamps in dozens of other ways. You get the full benefit of all this research when you buy G-E Fluorescent lamps—the lamps that *Stay Brighter Longer.*

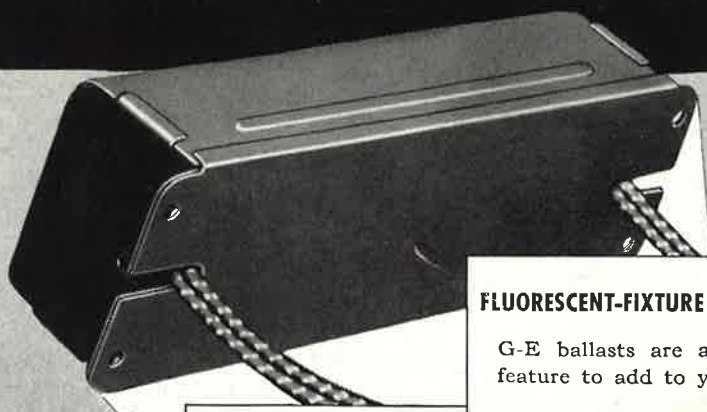
G-E MAZDA LAMPS

GENERAL ELECTRIC

BUY MORE WAR BONDS

Hear the G-E radio programs: "The G-E All-Girl Orchestra", Sunday 10:00 p. m. EWT, NBC; "The World Today" news, Monday through Friday 6:45 p. m. EWT, CBS; "The G-E Houseparty", Monday through Friday 4:00 p. m. EWT, CBS.

16,000,000 G-E ballasts have been installed since 1938 ... 99.5 per cent are still going strong



FLUORESCENT-FIXTURE MANUFACTURERS:

G-E ballasts are a powerful sales feature to add to your product.

FLUORESCENT-FIXTURE BUYERS:

Specify G-E ballasts—to help assure good performance, negligible maintenance, and long life of your fluorescent installations.

HERE'S a recent report from a Midwestern bomber plant: "The 12,000 G-E ballasts we installed in 1942 have been operating round-the-clock ever since. To date there have been only six electrical failures." A performance record 99.99 per cent perfect!

This experience is not unique. Even the *over-all* operating record of G-E ballasts is better than 99.5 per cent perfect.

Other outstanding features of G-E ballasts are: **quiet operation**—assured by an unusually close fit between core and coils and a rigid clamping structure; **cool operation**—assured by use of low-loss materials, and a special insulating compound that rapidly dissipates heat; **matched characteristics**—matched with the lamps they are to operate to assure rated lamp life and rated light output; **adaptability**—convenient dimensions that permit a standard-width wiring channel for practically all fixtures. Catalog GEA-3293F contains complete data. *General Electric, Schenectady 5, N. Y.*

GENERAL ELECTRIC

408-29E-5206

Buy all the BONDS you can —and keep all you buy

THE BROWN-OUT *Has Its Brighter Side**

By HOWARD ILGNER, Superintendent, Bureau of Electric Service, Milwaukee, Wisc.

LAST fall it was the consensus that blackouts, dimouts and brown-outs were definitely a thing of the past and that all future efforts could be pointed toward improving night traffic conditions in the postwar period.

Today, we have the brown-out as a conservation measure. We face conditions as we find them. But a checkup on our street lighting, now brought into sharp focus by the absence of other illumination, should prove to public officials the need for the establishment of definite lighting standards.

In spite of the ability of our generating plants to produce electrical energy in the required amounts and our networks to transmit and distribute it to the points where it is needed, the brown-out is with us on an even more restrictive basis than the original plan.

The fact is that in most parts of our country the generation of electrical energy requires fuel and the war requirements have created a shortage in the supply of coal and other fuels.

While the orders prohibit the use of electricity for outdoor advertising, promotional, decorative and ornamental lighting, and show window lighting, the orders, in addition thereto, prohibit the use of electricity for white way street lighting in excess of the amount determined by local public authority to be necessary for public safety.

While this may seem to be the greatest affliction of all, yet if the order is carried out as it is written, it should have very little effect on the great majority of street lighting systems.

Not only are there relatively few streets in this country lighted in excess of that necessary for public safety but on the other hand, there are too few of our streets lighted to the extent generally considered adequate for public safety by competent authorities.

Two years ago when the brown-out threatened to become a reality, the Street and Highway Lighting Committee of the Institute of Traffic Engineers recommended that street and highway lighting should not be reduced below the minimum required footcandles for night traffic safety, as given in the Traffic Engineering Handbook and the Illuminating Engineering Society's "1940 Recommended Practice of Street Lighting."

At that time we were assured by the War Production Board that any conservation program worked out would be so designed as not to affect adversely public morale, health or safety. It appears from a careful study of the recent War Production Board's orders that their attitude is much the same.

It is essential, however, that the persons responsible for public safety swing into action and properly guide the "Local Public Authority" in making determinations as to curtailment where public safety is at stake.

Engineers in charge of traffic and public lighting should furnish such data as are needed to make intelligent decisions.

Street lighting is one of the most important factors in night traffic safety. There must be safety from attack and robbery of the many workers, especially women, who use the streets during the late night and early morning hours in these war days, and for the protection of property and equipment against sabotage.

The contribution of street lighting in effectively preventing pedestrian and vehicular traffic accidents and their resulting toll of human life, personal injuries and economic losses is proportional to the effectiveness of the street illumination in providing visibility adequate for accurate, certain and comfortable seeing, not just expended watts or generated lumens.

(*Continued on page 23*)

* Condensed from *Public Safety*, March, 1945.

WELL READ!

May we suggest that you take a second look at the advertisement on the inside front cover of this issue . . . "POWDERED LIGHT."

Just as we go to press comes the report that this ad was one of the best read and best remembered ads in the weekly magazines in which it appeared. Based on Starch Readership Surveys it rated second among 60 ads in the February 24th issue of POST and second among 66 ads in February 19th LIFE.

The young lady is Miss Lillian Janashak of the Chemical Products Division, Nela Park; the black-light photo was taken by Howard Tesreau, Nela Park photographer; the advertisement was prepared by Batton, Barton, Durstine and Osborn.

The MAGAZINE of LIGHT

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THE COVER SUBJECT

From the G-E Lamp Department's series of natural color photographs developing the "Moving the Sun" theme, featured in current advertising, we have chosen a cover for the Magazine of LIGHT. The subject is a grade school class in an outdoor classroom. The idea of learning geography outdoors in the presence of nature on a warm spring day is especially appealing because of the daylight. In our climate, temperature and gray days require a large part of our activities to be carried on indoors, classes in geography, too. For our safety and comfort indoors, many facilities have been created and modern lighting is one of the most versatile of these. Thanks to the patient genius of the men in G-E laboratories, we are able today to bring most of the effective appeal of sunshine to our work indoors. The "Moving the Sun" outdoor classroom picture is the work of Victor Keppler, one of the nation's most famous photographers.

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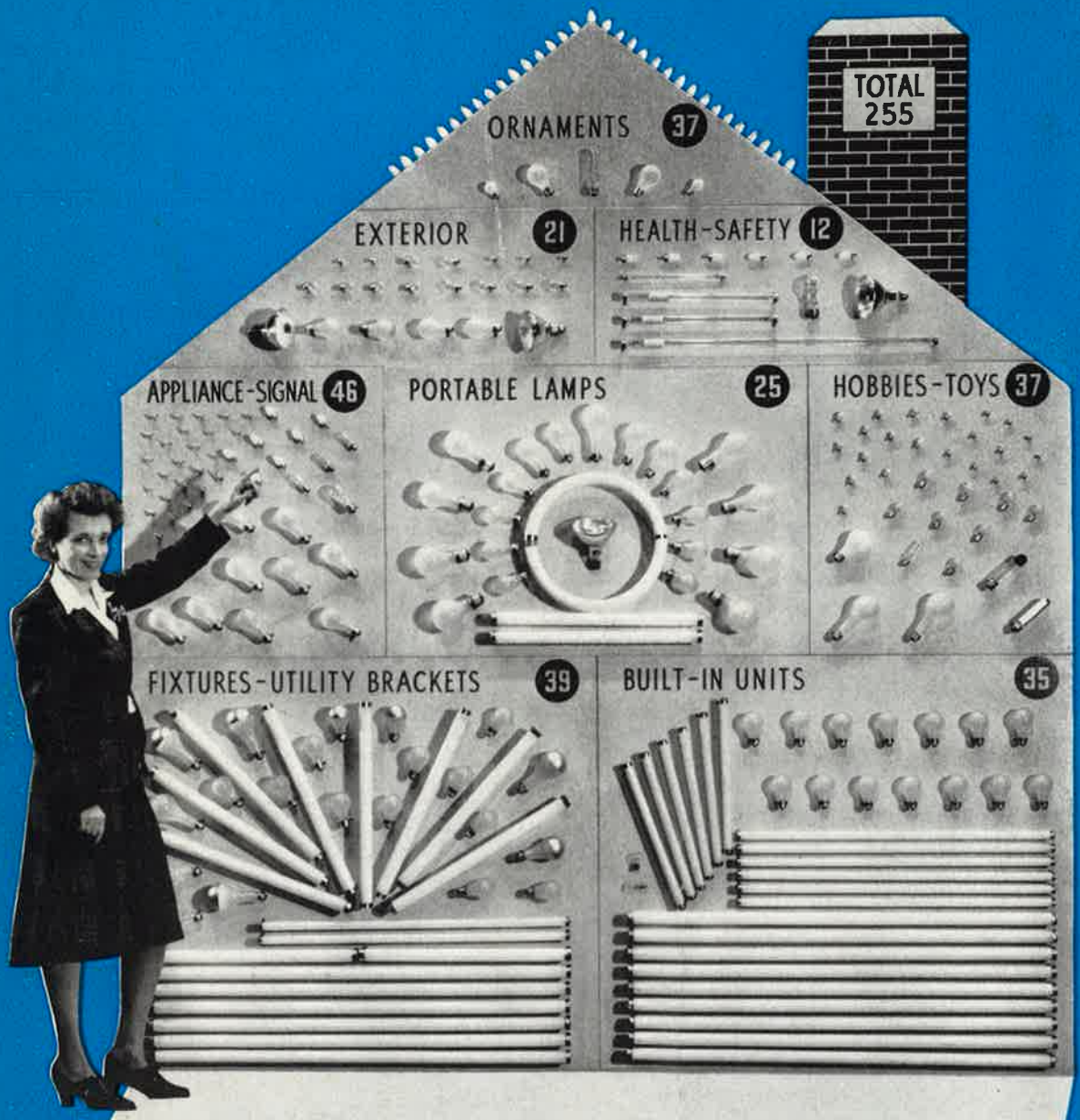
Published in the interests of current progress in the science, art and business of lighting by the Lamp Department of General Electric Company at Nela Park, Cleveland, Ohio. Subscriptions will be accepted for the issues of 1945 at the rate of 20 cents per issue, the total for all issues for the year not to exceed $2.00. Single Copies are available at 20 cents. Foreign rates $2.50 for all issues of 1945. **Advertising:** Only advertising of General Electric products will be accepted. **Prices:** Prices for foreign shipments may be obtained from the International General Electric Company.



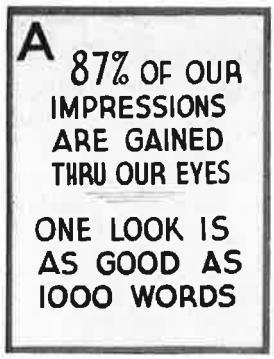
"Comforts of home" are much in the minds of Americans in uniform today. Good lighting is one of those comforts which can be simply provided. In a recent survey Nela Park specialists counted a total of 255 lamps which would figure in the health and safety and general enjoyment of an average six-room home. The total includes decorative and photographic lamps as well as those required for comfortable seeing.

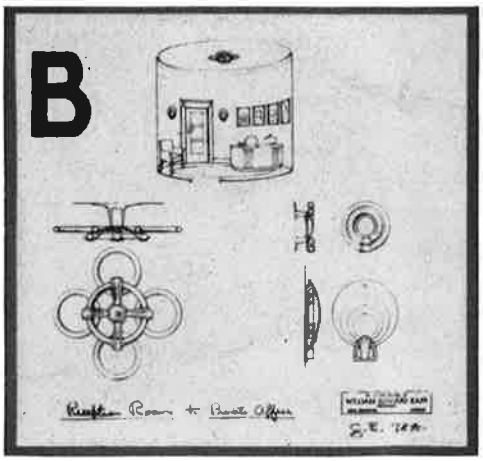
LIGHTING . . . *Design for Seeing*

By WARD HARRISON, Director, Nela Park Engineering Division

Prepared from an address before the Architectural League, New York City, and also delivered to a group of architects of Chicago.

IN THE accompanying illustrations are shown the fluorescent lamps we had available at the start of the war. (Demonstration 1.) Six years ago with fluorescent lamps we were able for the first time to produce colored light at very high efficiency. Back in 1939 we believed colored lamps would represent a substantial proportion of the business. In fact, however, this proportion never reached 5 per cent. Perhaps it is one of those applications of light which naturally proceed slowly, or perhaps, the colors which we have offered are too saturated. War regulations have very properly banned the colors but

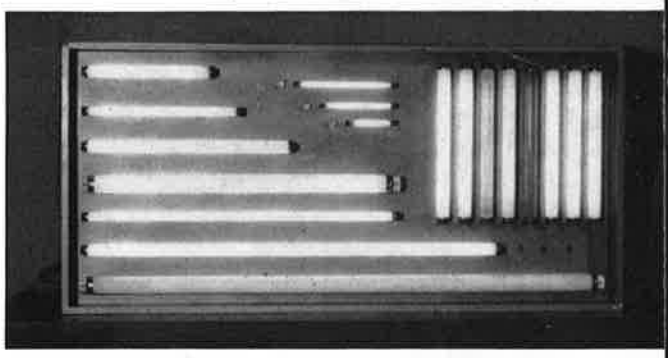




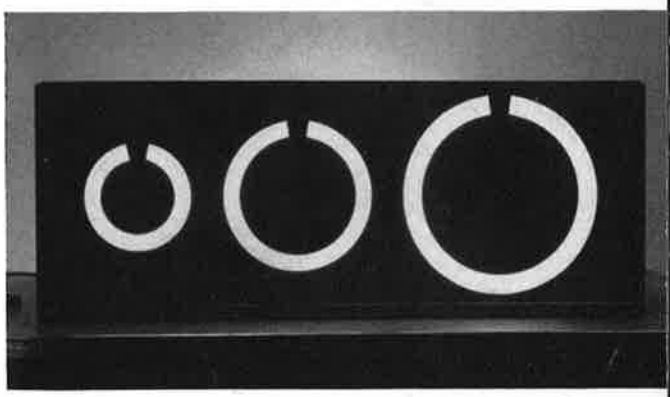
practically all the sizes of these lamps are still available in white and in daylight. Literally, millions of lamps, or as some put it, thousands of miles of them are now doing service in warplants. It's common knowledge that such new plants have generally proved themselves capable of larger output than was expected of them, and this result is believed to be due, very definitely, to the advantages of a new plant planned exactly for the work in hand, plus better facilities, such as better ventilation and more and better lighting.

At an early date we expect to make available in the fluorescent line certain lamps such as the Circline in three sizes, (Demonstration 2-3) which should find considerable application in portable lamps for the home, also for decorative lighting installations in many other interiors. Some architects believe that interesting designs can be worked out for ceiling fixtures. Note the one in the sketch by W. E. Kapp, a prominent architect of Detroit. (Chart B.)

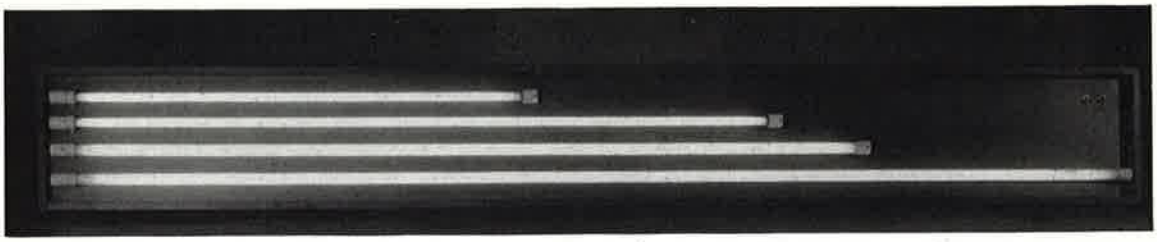
Another group (Demonstration 4) named "Slimline" lamps with reference to their length which is 50 to 100 times the diameter. We foresee their application in many locations, and in particular where the architect wishes to accentuate his structure either inside or out with long, slender lines of light. This will now be



Demonstration 1



Demonstration 2-3



Demonstration 4

accomplished, too, at no sacrifice in lighting efficiency, for the longest lamps run at 65 lumens per watt, 25 per cent more efficient than any type or size of fluorescent lamp heretofore available from any source. The lamps are designed to run at either of two levels of brightness. We recommend the lower brightness when they are to be used exposed to view.

All the Slimline lamps start instantly whereas earlier types of fluorescent lamps started less smoothly. Practically instantaneous starting for all types of fluorescent lamps is what we expect after the war. Often people inquire, "Are these lamps hot cathode or cold cathode?"

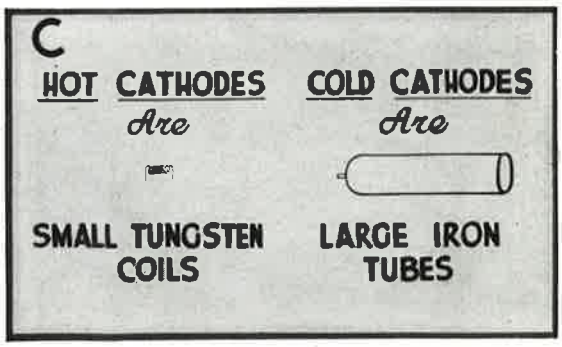
In Demonstration 5 there are three lamps all operated in series on the same circuit, that is, with the same current flowing through all, and they all look alike. The bottom lamp has an iron (cold) cathode—the second one, tungsten, has a (hot) cathode and the top lamp is both hot and cold—hot cathode on one end, cold on the other. In each case the central light giving part of the lamp doesn't know and doesn't care at all what type of cathode its current flows from.

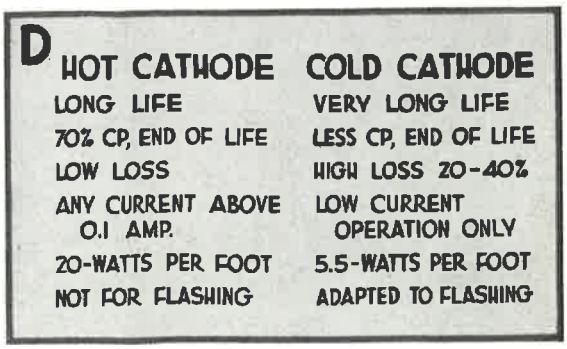
The difference is nothing you can *see*, but, in brief, we know that whenever electric current leaves a solid conductor, a piece of wire for example, and starts to travel through a fluorescent lamp, a certain toll is exacted, that is, there is a loss of some of the electric power supplied, and this loss is converted into heat in the gas near the conductor, the cathode, at the point where the current leaves it. If the cathode is small like the little coil of tungsten wire which forms an incandescent lamp filament it becomes red hot and is called a "hot cathode." If it is a relatively large piece of sheet metal—say the size and shape of a child's thimble, only longer—it does not become much heated and is therefore termed "a cold cathode." (Charts C and D.)

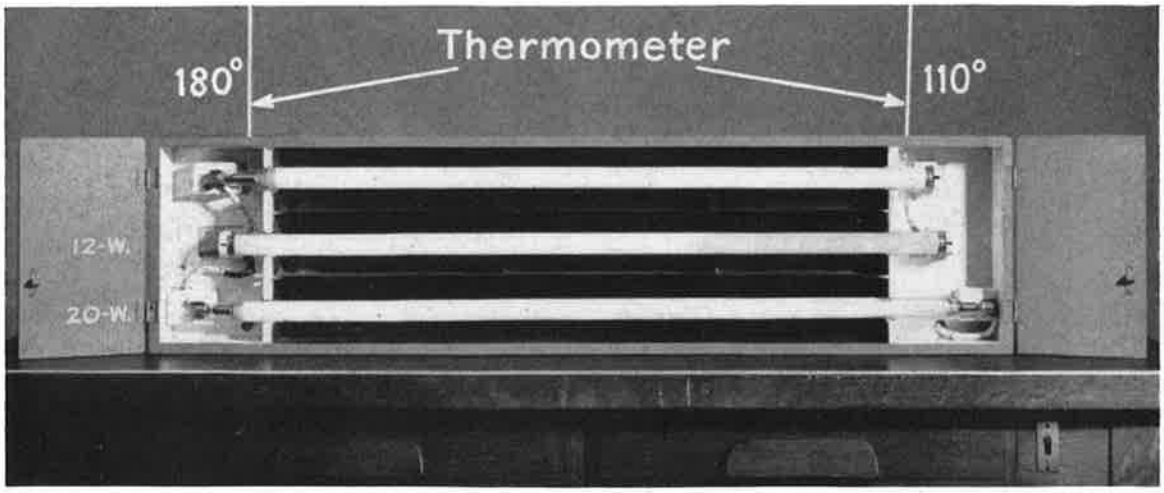
Now up to a certain point, the hotter a cathode is, the easier the current leaves it and the less the loss of power. For example, the cathode toll or cathode loss in a 3-foot iron (cold) cathode lamp, is 40 per cent and in an 8-foot cold cathode lamp it is usually about 20 per cent of the power supplied. With the tungsten (hot) cathodes the losses are less than 1/6 as much. Note in Demonstration 5 the thermometers at both ends of the hybrid lamp. The temperature of the iron cathode, left, is 110° above 70° room temperature and of the tungsten cathode end only 40° above, demonstrating that the cold cathode construction actually gives off more heat than does the hot cathode.

What are other differences between iron and tungsten cathodes? For one thing, the tungsten coil will withstand being turned off and on several thousand times but the iron will stand that service indefinitely, perhaps a million times or so. Therefore where the lamps are to be flashed continually, use iron cathodes.

All fluorescent lamps live a long time; the life of a hot cathode lamp is *2500 to 6500 hours* or 3 to 8 times that of an incandescent lamp. But after a year or more of service, the coil of







Demonstration 5

a hot cathode eventually fails so that the lamp will no longer light, whereas the cold cathode lamp, perfectly made, might theoretically go on forever. The extra life isn't a very valuable feature, however, because other things being equal, the candlepower of the tungsten and iron cathode lamps goes down identically with the hours of use and most hot cathode lamps live so long anyway that, because of the diminished light output, it is cheaper to throw them away than to keep on burning them.

For all of these reasons the fluorescent lamps announced by the General Electric Company to date have been of the tungsten hot cathode type. We may, however, at some future date supply iron cathode lamps for special uses such as continuous flashing on and off.

Another thing to be kept in mind is that the ability to operate fluorescent lamps of given dimensions at different currents will not in the future, be confined to Slimline lamps. Thus if a 100-watt lamp, is equipped with the proper cathode for the lower current it can be operated at 40 watts.* It is interesting to know that as the watts go down, the efficiency goes up, so that instead of 42 lumens per watt it becomes 54 lumens per watt at 40 watts. In other words, 50 per cent of the light for 40 per cent of the power. There is a great advantage (which I shall emphasize further on) from the standpoint of comfortable lighting in keeping the brightness of light sources low. By installing ten lamps at half power instead of five at full power, this is accomplished to a marked degree. It is true that more sockets and more lamps are required, but since there is a definite gain in efficiency, total cost of illumination should remain about the same, and the increased comfort is obtained without penalty.

The second part of my talk is planned to deal with the use of light sources, both new and old, so as to produce an adequate, pleasing and comfortable illumination result. That is the kind of lighting which wears well. Of course it is too much to expect that any installation planned in 1945 will be pointed to with pride in 1955 or 1960; the industry moves too fast for that. On the other hand, some installations planned as late as 1942 are already recognized as unsatisfactory in 1945 and this is something quite inexcusable, a situation which could be entirely avoided by skillful planning. Installations that become obsolete quickly are principally those in which the lighting is inadequate and/or uncomfortable, and I wish to emphasize therefore the factors that tend to make a lighting installation uncomfortable, also those that can make it comfortable.

I would like to introduce the subject by reminding you of the story of the eminent physician who because of his love of the work took over the brunt of the lecture course to senior medical students. On the completion of his final lecture he said, "There, gentlemen, I have taught you all I know about anatomy and about the amelioration and cure of human ills. Unfortunately, one half of what I have told you is not true. Still more unfortunately, I do not know which half it is." A professor of mathematics would never have said that, but a good reason why the physician felt that he did not have all the right answers was because the science of medicine has to do with the behavior of human beings, and therefore, is not an exact science. Illuminating Engineering is in the

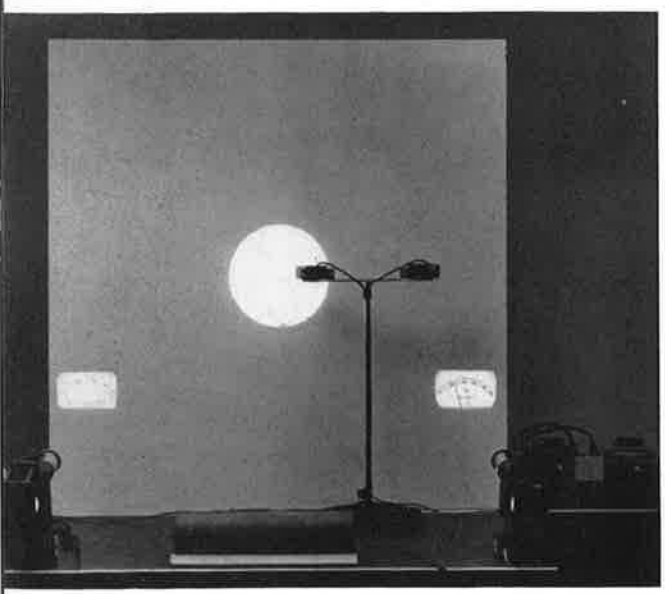
* Demonstration 6 is not shown because it could not be reproduced by printing.

same category. Lighting is for humans to see by, and humans do not all react alike under fixed lighting conditions, nor do they have the same likes and dislikes. Therefore, I can only tell you what lighting I believe will generally be pronounced comfortable. As in the case of that eminent physician, what I tell you may be subject to a possible correction factor of 50 per cent.

Will you try to recall the most pleasing and effective artificial lighting you have experienced. It was likely in a theatre. There is something very attractive about a theatrical stage as the curtain goes up. Its large area almost fills the field of view, at least it does so for people in the first eight or ten rows. The sources of light are all concealed yet the stage may be so brilliantly illuminated that you see quickly and easily all the things you wish to see. The stage is very different from a movie screen which is a relatively small bright area against a large black background, and except in the case of a most engrossing picture, makes one conscious of unpleasant and trying contrasts. There is one other pleasing feature about stage lighting, namely, one doesn't see aluminum furniture or mirrors or other shiny objects so placed that amazingly bright reflections get back into the eyes of the audience. The property man would be fired for that, at least in normal times.

To recapitulate, on the stage there is lots of light.

50 to 200 footcandles or more



Demonstration 7

E	100-WATT LAMP
STD. OPERATION	½ POWER
100-WATTS	40-WATTS
4200-LUMENS	2160-LUMENS
42-LUMENS PER WATT	54-LUMENS PER WATT

No direct sources of light are visible
No indirectly lighted expanse of ceiling is visible
There are no unpleasant reflections from shiny surfaces.

The question naturally arises: Why can't we duplicate these conditions in other locations, in an office building, for example. The principal reason is that if sources of light are concealed from view in one direction, they are generally visible from another. In a theatre all the audience faces the same way which just isn't practicable in most offices. You may know, too, that stage lighting is not particularly comfortable from the standpoint of the actors.

It seems inevitable, therefore, that in our quest for adequate and comfortable lighting, we shall have to do a little studying as to what sources will be found tolerable in the visual field and what ones will not. We might start by assuming that up to a given brightness any light source is comfortable and above that, it is not. Let's try it. If I set the brightness of a demonstration source so that it appears just glaring to me, a meter projected on the wall reads 1000. A meter measuring the brightness of the surrounding area reads 10. Now if we should bring up the surrounding, say, to 50, then the globe would no longer appear glaring. You might say, "Ah, I understand. . . . it isn't absolute brightness that causes glare, it's a matter of contrast." That is, if we increase the brightness of the background by 10, we can increase the light source by 10 also. But, curiously enough when the light source and its surroundings are both up about 10 to 1, you would not like it at all. Suppose we readjusted the light source brightness downward until it was pleasant. Laboratory observations show that where the background brightness is up 10 to 1, we can increase the light source about 2 to 1 and maintain comfort. We come now to a statement embracing what we can observe by Demonstration 7.

Proposition 1—"To double the brightness of a light source without discomfort, increase the surrounding brightness 10 times. Conversely, reducing light source brightness greatly increases comfort."

You can see why I am enthusiastic about lamps at half power.

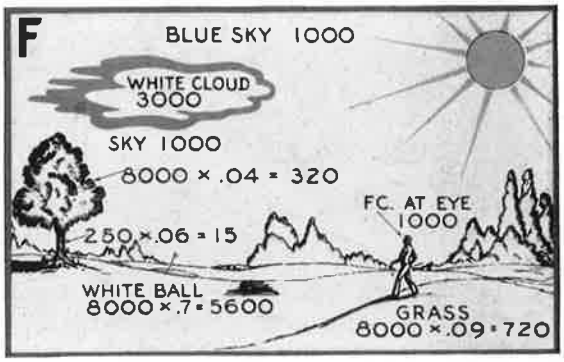
From Demonstration 8 we learn that a source which is fairly comfortable and reasonably in accord with the rule of Proposition 1, achieves this effect even though the background seems dark. But suppose we make the light source much larger by opening the diaphram. What then? Our conclusion is expressed in the form of

Proposition 2—"Discomfort from a light source of fixed brightness increases with its visible area."

That explains to you why even indirect lighting can and frequently does cause discomfort if you have to look at too large an expanse of ceiling, particularly when the ceiling has to be bright enough to give you the 40 or 50 footcandles of illumination that you may need on your work.

So much for the brightness of light sources. Now let us approach the problem of comfort from another viewpoint. What kind of outdoor lighting conditions have you found most pleasant? Is it on an overcast day? I think not—rather something more like this sketchy representation of a sunny day on the golf course.

What are this scene's (Chart F) outstanding characteristics? Just as in the theatre, the light source, the sun in this case, is well outside the field of view and furthermore the total range of brightness over all visible objects is moderate. We can measure these brightnesses with the same instrument we used for the glare source a little while ago, or we can compute them well enough if we know the quantity of incident light and how much of it they reflect. For example, the tree, or rather its leaves, receives 7000 footcandles from the sun and perhaps 1000 from the vault of the sky, a total, let us say, of 8000. About 4 per cent of this light is reflected from the tree so that its brightness is a little over 300. The brightest sizeable area in the picture is the white cloud and it would measure approximately 3000 footcandles. As a matter of fact, nearly all the brightnesses fall between 300 and 3000, that is, a range of 10 to 1. The golf ball is outside this range, but it is very small in area so that, as we learned from Proposition 2, it is not likely to be a source of glare. The situation would be quite

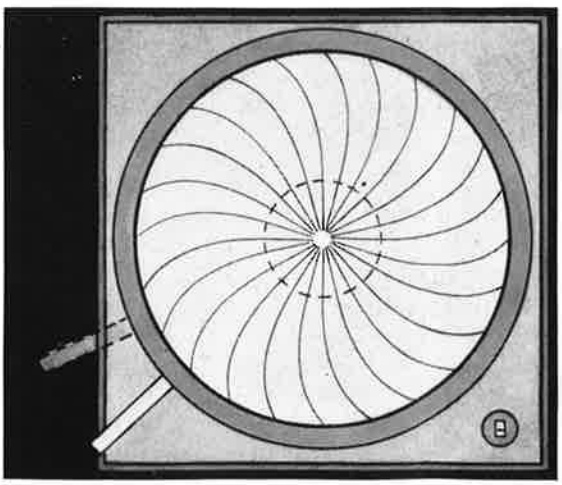


altered if for the golf ball we substituted a large patch of snow under the August sunshine. The trunk of the tree in deep shade is at the other extreme, far below 300 footcandles in brightness but it too subtends only a small angle at the eye and therefore merely adds depth and interest to the picture. I think we are ready now for

Proposition 3—"For comfort keep the ranges in brightness, particularly of adjacent areas in the visual field, within reasonable limits—10 to 1—if possible."

Your attention should be called to one other thing in this picture that contributes materially to the comfort of the golfer. The footcandles measured at his eye are only about 1000 which is very much less than the footcandles (8000) on most of the things he is looking at. I would like to incorporate this in our

Proposition 4—"Always have much more light on the work than at the eyes if possible."



Demonstration 8

* Demonstration 9 is not shown because it could not be reproduced by printing.

Both laboratory and field observations have shown that this is very important; nevertheless, because of our limited time I am going to ask you to take this Proposition 4 more or less on faith, and likewise the two which follow.

In the corridor illustrated in the photograph (Chart G) glare would not be a very severe consideration even if bare lamps were used because no one stays very long nor should he tax his vision very greatly in a corridor. However, a long line of light sources is visible here and the point I want to make is that their individual glare effects are cumulative, in fact, as

nearly as we know, each one of them makes approximately the same contribution toward reducing visibility and probably toward causing discomfort. This is expressed in

Proposition 5—"Each one of a row of light sources makes the same contribution toward glare assuming uniform light distribution in the lower hemisphere."

Proposition 5 suggests why it is that a lighting system which would be reasonably satisfactory in a private office might prove very objectionable in a large general office five times as long. The glare effect would be multiplied by five. I think you will agree that you could recognize a man at the far end of this corridor much more readily and comfortably if deep beams were extended across it at intervals and hid the distant fixtures. In an office as well as in a corridor, cross beams are effective in concealing distant lamps and what is just as important, concealing the distant bright areas of ceiling in an indirect installation.

And now we come to

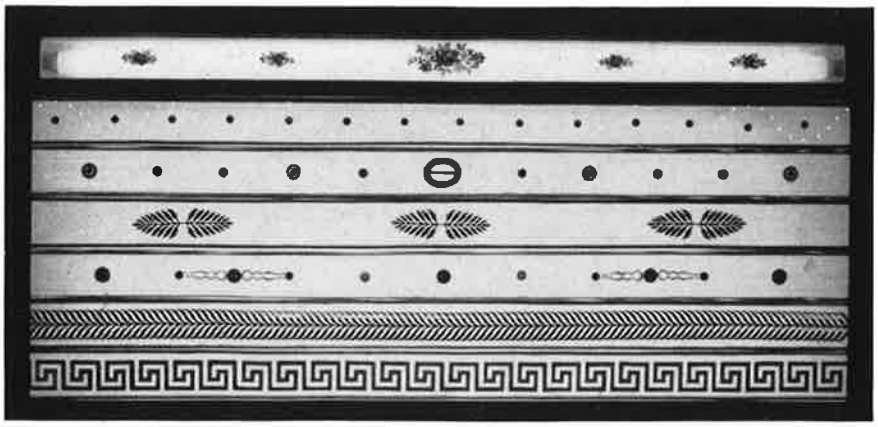
Proposition 6—"Mounting light sources high greatly reduces glare."

Experience has shown that where lamps are located 40 feet or more above the floor, almost any kind of light source, even a bare 500-watt incandescent lamp, can be used with comparative comfort. In most buildings this is of course a totally impractical height, but never lose an opportunity to place light sources up close to the ceiling. Looking at the question more broadly, it may be that the opportunity to locate light sources higher is in itself an adequate reason for specifying office ceiling heights greater than the recently popular 9 foot 6 inches.

With existing limitations on the placement of light sources in most buildings, we find from experience that we cannot generally use unshielded lamps and obtain comfortable lighting. Either they are too bright for their surroundings and thereby violate Proposition 1, or they are too large in area violating Proposition 2, or too many fixtures are visible violating Proposition 5, or they have to be hung too low, Proposition 6. Shielding, therefore, becomes important. Shields may either be opaque or translucent. There are objections to opaque shields because of appearance and because of the severe brightness ratios that they set up violating Proposition 3. Glass or plastic shields overcome this disadvantage and have a wide usefulness. There is a place, however, for a material which combines the durability and inexpensiveness of metal with the translucency of glass or plastic. We have recently completed a development along this line which we have termed "luminous metal." It is really just thin sheet metal with small perforations close together.

Some sample strips of the luminous metal with decorative designs worked out by McStay Jackson of Chicago are shown in Demonstration 10. They are in copper, brass, and aluminum. In general, they make their best appearance when painted flat white.

And now I come to a different, but by no means least important consideration having to do with comfort in lighting. I can probably explain it best by means of two boxes lighted to equal brightness. (Demonstration 11.) Naturally enough two black letters put in the boxes stand out with equal distinctness. Each letter is at the front of its box, that is, in the plane of the opening. If I push the left-hand letter back toward the rear of the box, that makes little difference, the letter still remains black against its background. However, when I push the other letter back, it begins to fade



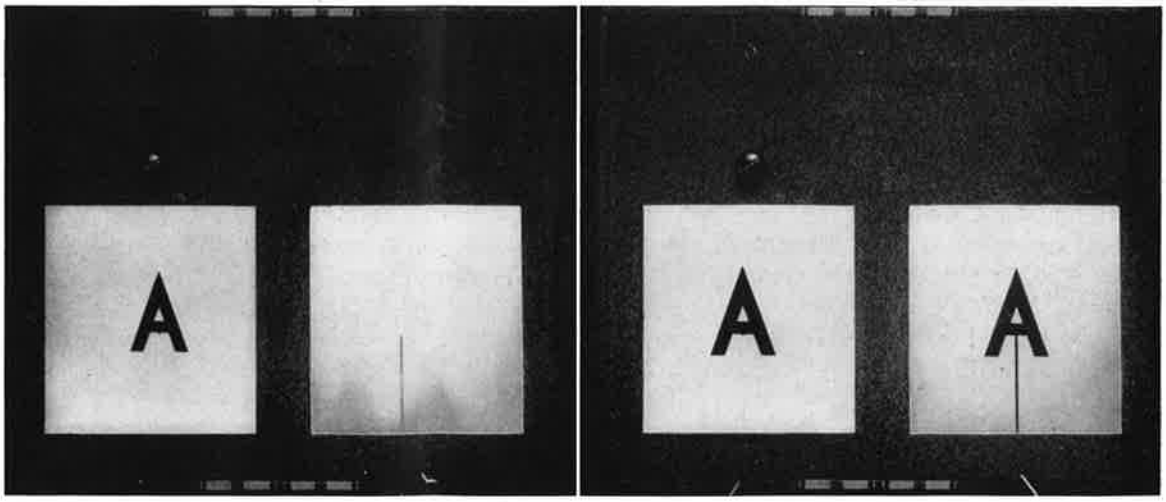
Demonstration 10

"We have recently completed a development along this line which we have termed "luminous metal." It is really just thin sheet metal with small perforations close together."

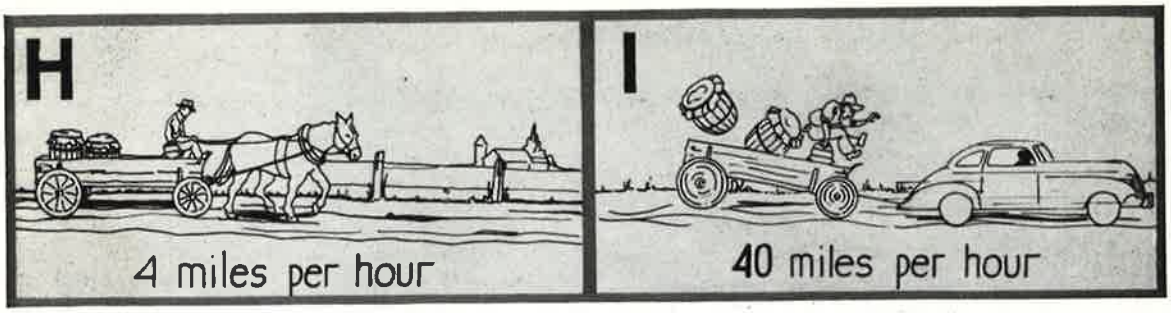
from view. There is nothing different about the letters, therefore there must be something different about the boxes, and there is a real difference. The left-hand box is illuminated to 10 footcandles by means of one small lamp, the other box is illuminated to 250 footcandles or 25 times as much. If I turn off the light, you will see that it's literally been true that "black is white" if you put enough light on the black. Photometric measurements show that the white lining of the left-hand box reflects 75 per cent and the black of the other box 3 per cent. This difference is just counterbalanced by supplying 25 times more light in the black box. If we turn the white faces of the letters to the front all the conditions are reversed. The point I want to make is with regard to the letters is that you cannot see the dark letter against the dark background at 250 footcandles as well as you can see the black letter against the white background at 10 footcandles. Actually, it would take several thousand footcandles to achieve equal visibility.

A well-printed book with large type, held at normal reading distance, is just as legible as the larger letters on this chart are to most of you, and 10 footcandles will illuminate such a book reasonably well for reading just as it illuminates this chart. (Demonstration 12.) However, reading a well-printed book is a very minor seeing task in a work-a-day world. A real task, such as the third and fourth carbon copy of a shipping memorandum which has to be read carefully both in the office and in the factory is quite typical. Continued work on such memos can cause severe eye fatigue where the illumination is inadequate. If 10 footcandles are right for a well-printed book you need not less than 30 footcandles on a phone book.

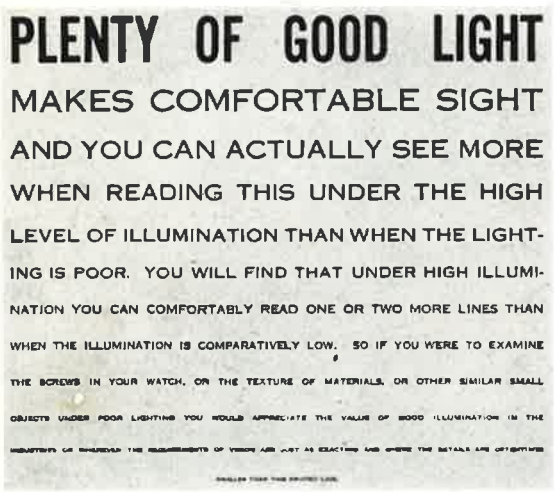
When we come to such tasks as stitching with black thread on black cloth, we approach the condition of the black letter in the black box, and more than 1000 footcandles, in fact, full sunlight will not be too much. Finally, please observe that 100 footcandles helps you to recog-



Demonstration 11



nize smaller letters than can be seen at 10 footcandles. Usual recommendations for offices and drafting rooms are 40 footcandles and 75 footcandles respectively and are based on such considerations. I think you will agree it is not too much. The cost of providing 40 footcandles of artificial light today is actually a little less than the cost of 4 footcandles just before the beginning of World War I. Due to a much greater appreciation of the value of good lighting, 40-footcandle systems are more common today than 4-footcandle installations were then. So here is



Demonstration 12

> *Proposition 7*—"Comfortable lighting requires that sufficient footcandles should be supplied for easy seeing of indoor tasks. These levels of illumination are far above those for barely seeing."

And now by illustration, I want to connect this Proposition No. 7 with the six propositions which have preceded it. You will recall that the earlier ones all had to do with the negative or discomfort features of lighting which was poorly planned. Some of you may be old enough to have ridden on a lumber wagon. If so, you know it didn't have any springs. When drawn by horses at about 4 miles an hour (Chart H) it wasn't so bad, but what would it be now if furnished with an engine or was towed along behind an automobile at 40 miles an hour? (Chart I.)

Lighting at different levels is not so different from the lumber wagon at different speeds. When you have low levels of lighting—2 footcandles or perhaps 4—you find it difficult to see but you may be quite comfortable in other respects. Usually you are not much bothered by light sources that are too bright or by contrasts that are too great. But when you get up to 40 footcandles, you will get bumped pretty hard by glare if you don't take precautions against it. In an automobile, we have learned that if we are to ride comfortably at 40 miles an hour, we must have good springs and we must also have large, resilient tires, and these things are worthwhile, for with them we get to places quickly and comfortably. Few of us are willing to stick to 4 miles per hour to avoid the necessity of having more carefully designed vehicles.

In the same way, we must have carefully engineered lighting if we want the advantage of the quick and easy seeing we get at 40 footcandles. True, we haven't worried so much about glare as we have about bumps because our eyes seem less immediately responsive to abuse than do our buttocks. However, clients have a right to expect that their eyes will be properly provided for in any new facilities which they ask you to design for them—whether it be in a new structure or a remodeled old one. In other words they want both productive footcandles and comfort.

In this presentation we have not discussed many questions, such as reflected glare from work, or from polished desk tops, or from that really needless source of ocular pain, the glass covered desk. Other utilitarian aspects of lighting of equal importance have also been passed over. There has been no time to talk about

(*Continued on page 37*)

RADIANT ENERGY *from Fluorescent Lamps**

By MATTHEW LUCKIESH and A. H. TAYLOR, Lighting Research Laboratory, Nela Park

THE advent of a new scource of artificial light commonly results in various suspicions and complaints. This is sometimes true in a lesser degree when a radical change in a lighting installation is made. Anyone who has witnessed various major advances in light production and in systems of lighting, and who has been in a position to receive inquiries and complaints, knows that many suspicions are entirely unwarranted from either a factual or a theoretical basis. Some appear to spring from a confusion of glare with a meager acquaintance with the known facts of radiant energy. Confusion of this sort can only be dissipated by quantitative measurements or experienced observation and analysis. Complaints of fluorescent lighting which have any factual basis are generally found to be due to glare from bare lamps in the visual field or to other violations of the principles of good lighting and seeing conditions. Those which involve indictments of the radiant energy emitted by fluorescent lamps find no support in knowledge and experience or even in sound theory.

Many in the lighting industry recall the suspicions which arose when the mercury lamp—the Cooper-Hewitt mercury arc—was introduced for lighting purposes. It was accused of emitting ultraviolet energy in quantities harmful to the eyes and even to the skin. Its discontinuous spectrum was accused, on the basis of vague unsupported theory, of being detrimental to the visual sense. Similarly infrared energy emitted by filament lamps has been accused, and still is occasionally, of harmful biological effects, notwithstanding the fact that no such effects of infrared energy have been established. Furthermore, there is no sound theoretical basis for such a suspicion.

Even the meager and spectrally limited ultraviolet energy from tungsten-filament lamps was seriously suspected of being harmful. Bulbs of special glass and even "protective" eyeglasses were recommended in the early part of the tungsten-filament era. When the blue-green bulb converted the tungsten-filament lamp into a so-called "daylight" lamp, a minor flood of suspicions and complaints arose. Many were ridiculous in varying degree, as is true in these early years of fluorescent lighting. Glare and poor seeing conditions, including inadequate light upon the task, have been the common causes of the justifiable complaints.

In appraising suspicions and complaints of light and lighting, it should be borne in mind that most persons who make the original complaints can scarcely qualify as competent observers or analysts. Furthermore, there is no more fruitful field for quacks and quackery than in the field of light, color and radiant energy. Note the extensive use of so-called color-therapy notwithstanding the lack of a sound foundation of acceptable proof. Lighting is not entirely free from this kind of practice "beyond knowledge" which, whether intentional or not, is quackery. Of course, a certain illuminant may possess specific advantages in specific cases involving the appearance of color, esthetic or psychological effects, and the mixture of artificial light with natural daylight.† However, common illuminants do not differ significantly in their contribution to visibility. Even the differences in effectiveness in this respect among colored illuminants are surprisingly slight as measured by various criteria which have been adequately developed by careful and extensive research. Purely monochromatic light is an exception under certain conditions, but obviously this as well as the other "colored" illuminants is not acceptable for general lighting practice.†

Ultraviolet Energy

No reputable manufacturer would make a light-source available to the public without adequate control of the output of ultraviolet energy. Nevertheless, fluorescent lamps have been extensively subjected to suspicion in this respect and some eyesight specialists and others have advocated tinted eyeglasses or safety glasses to "protect" the eyes from the ultraviolet energy emitted by these lamps. It should be realized that the composition of the glass envelope of a light-source can be so controlled that the short-wave limit of the spectrum of the transmitted energy can be fixed at any point desired. For example, the manufacturer may decide to limit the spectrum of a light-source to that of natural sunlight or skylight. It should also be realized that the harmful effect of ultraviolet energy not only depends upon the wavelength

* Reprinted in part from *Illuminating Engineering*.

† *Light, Vision and Seeing* by Matthew Luckiesh, D. Van Norstrand Co., New York, 1944.

of the energy but also upon the intensity of energy upon the eyes, skin, etc. In addition *time* is a factor. In other words, the harmful dosage of energy of a given wavelength is a matter of *time* times *intensity*. Without quantitative measurements of these factors in terms of the biological effect under consideration any conclusion is purely speculative.

The spectrum of natural sunlight or skylight ends in the ultraviolet region in the neighborhood of λ2950. At high altitudes it may extend slightly further but it seldom if ever reaches λ2900 anywhere that human beings are exposed in large numbers for long periods. Careful studies of the erythemal effect of ultraviolet energy have been made for normal eyes and skin. The effectiveness of energy of wavelength longer than λ3150 in producing erythema of the skin or conjunctivitis (inflamation of the conjunctiva or outer membrane of the eye) is negligible excepting in dosages never encountered with fluorescent lamps indoors and rarely encountered outdoors.

In a laboratory equipped for such work delicate measurements of ultraviolet energy in various prescribed and meaningful ways are readily made. For many years ultraviolet energy has been a major interest of the authors and their colleagues. Although the intensity of ultraviolet energy (shorter than λ3150) from sunlight and skylight outdoors varies considerably even on clear days, typical results obtained during midday in midsummer are presented in Table I. This band of ultraviolet energy is measured in microwatts per square centimeter for the levels of illumination indicated for the various illuminants. It is seen that the intensity of this erythemally effective energy is commonly a hundred times greater on a clear day outdoors during the midday hours in midsummer than it is for 50 footcandles of direct or unreflected light from white (3500°) fluorescent lamps. The ultraviolet energy shorter than λ3150 emitted by daylight (6500°) fluorescent lamps is about 2.3 times that from white fluorescent lamps. The actual output of this ultraviolet energy from fluorescent lamps varies with the thickness of the glass, with the coating of the phosphors and other factors but the variations are insignificant for the present purpose.

In the lower part of Table I the values of ultraviolet energy shorter than λ3150 are erythemally weighted. Thus they represent a better picture of the effects upon the skin and the conjunctiva. The values in the third column indicate that sunlight and skylight on a clear day during the midday hours in midsummer are commonly several hundred times as erythemally effective as 50 footcandles of direct light from white fluorescent lamps.

TABLE I

Intensity of Ultraviolet Energy Shorter than λ3150 Measured in Microwatts per sq. cm. for Certain Levels of Illumination during the Midday Hours on Clear Days in Summer, Compared with That from White (3500°) Fluorescent Lamps.

a. Direct sunlight
b. Skylight, clear blue sky
c. Sunlight plus skylight
d. Direct fluorescent light, 3500° white

	Foot-candles	Microwatts per sq. cm.		Microwatts per sq. cm. per footcandle	
		Actual	Relative	Actual	Relative
Intensity of Ultraviolet Energy Shorter than λ3150*					
a.	6600	56	70	0.0085	0.53
b.	1900	117	146	0.0620	3.85
c.	8500	173	216	0.0205	1.28
d.	50	0.8	1	0.0160	1.00
Intensity of Ultraviolet Energy Shorter than λ3150 Erythemally Weighted†					
a.	6600	7.5	214	0.00114	1.63
b.	1900	15.6	450	0.00820	11.7
c.	8500	23.1	660	0.00272	3.88
d.	50	0.035	1	0.0007	1.00

* Most surfaces do not efficiently reflect ultraviolet energy shorter than λ3150. Therefore, the footcandles due to reflected light are generally accompanied by relatively little of this erythemally effective energy.

† A six-year record of erythemally weighted ultraviolet energy in daylight indicates that in midwinter it is about 0.1 that in midsummer at 40°N latitude.

In the last column of Table I are presented the actual and relative values of ultraviolet energy shorter than λ3150 *per footcandle*. When the footcandle intensities of sunlight, skylight and fluorescent light are multiplied by these factors it is seen that there is no cause to worry about the ultraviolet energy from levels of illumination from fluorescent lamps many times greater than those now being specified. In fact, workers in lamp factories exposed all day long to 600 footcandles of light directly from fluorescent lamps have suffered no effects attributable to ultraviolet energy. Actually the intensity of erythemally weighted ultraviolet energy upon their eyes is much less than the intensity their eyes are exposed to outdoors during midday on a clear day in midsummer. In this connection it should be emphasized that the biologically-effective ultraviolet energy is generally greatly reduced by reflection from most surfaces.

The intensity of erythemally weighted ultraviolet energy on the earth's surface due to sky-

light is often greater than that due to direct sunlight during midday.† This is indicated in Table I but an example is helpful.

If a person is standing outdoors on a clear day during the midday hours in summer with his back to the sun, the level of illumination at the vertical plane of his eyes may be 500 footcandles due to light from a clear blue sky. The ultraviolet energy shorter than λ3150 per footcandle of direct skylight is 3.85 times greater than that accompanying one footcandle of direct light from white fluorescent lamps. Therefore, from this viewpoint the 500 footcandles of direct light from the sky are accompanied by as much of this ultraviolet energy as 1925 footcandles of direct light from white fluorescent lamps or about 840 footcandles of direct light from daylight fluorescent lamps.

Considering, in addition to this, the fact that most reflecting surfaces have low reflection factors for this ultraviolet energy shorter than λ3150, there is no factual basis for suspecting that fluorescent lighting can possibly be harmful to normal eyes and skin. Obviously this statement is a safe one for levels of illumination many times greater than those of the best fluorescent lighting practice of the present time. If the comparison with skylight is made on the basis of erythemally weighted ultraviolet energy, as indicated in the lower half of Table I, it is obvious that several thousand footcandles of fluorescent light would be no more "harmful" than 500 footcandles of light during midday on a clear midsummer day.

It is possible that the conjunctiva may lose some of its adaptation to ultraviolet energy just as skin does during the winter months when the sun is at low altitudes. However, it should become adapted again just as the skin does outdoors. There is also the possibility of an abnormality of the skin or of the eyes in some cases which might make a person supersensitive. However, such a person should experience real trouble if exposed to skylight outdoors even for a short period of time.

Infrared Energy

Little space need be given to a discussion of infrared energy accompanying the light from fluorescent lamps. There is scanty evidence that this energy is directly responsible for any biological effect and certainly there is no proof that it is harmful to the eyes or skin in dosages obtainable under artificial lighting conditions.

† Seasonal Variations of Ultraviolet Energy in Daylight, Matthew Luckiesh, A. H. Taylor and G. P. Kerr, *Journal of the Franklin Institute*, 238, 1944, 1.

TABLE II

Intensity of Radiant Energy per Footcandle for Various Illuminants

	Microwatts per sq. cm. per footcandle	
	Actual	Relative
Clear skylight through ⅛" glass	4.9	0.61
Sunlight, midday midsummer	9	1.12
Sunlight through ⅛" glass	7.5	0.94
Fluorescent lamp, 40-watt, 3500°	8	1.00
Same through ⅛" clear glass	3.5	0.44
Fluorescent lamp, 40-watt, 6500°	10	1.25
Same through ⅛" clear glass	4.5	0.56
Tungsten-filament lamp, 60-watt	55	6.9
Tungsten-filament lamp, 100-watt	45	5.6
Tungsten-filament lamp, 200-watt	40	5.0

However, in respect to the quantity of infrared energy, light from fluorescent lamps compares favorably with that from midsummer sunlight and skylight.

It is seen in Table II that the total radiant energy accompanying one footcandle, supplied by light directly radiated from the bare light source, is about the same for fluorescent lamps as for midday midsummer sunlight. A sheet of clear glass ⅛ inch in thickness considerably reduces the total radiant energy per footcandle from these sources. Actually fluorescent light after passing through this additional sheet of glass is as "cool" as skylight entering through a glass window. Viewed quantitatively under proper consideration of footcandle levels, it is overwhelmingly obvious that infrared energy from fluorescent lamps is harmless to eyes if daylight outdoors is harmless. And certainly human eyes are adapted physically and physiologically to this and other aspects of the outdoor environment under which they evolved.

From Table II it is seen that the total energy accompanying a footcandle of tungsten-filament light is about five times the quantity accompanying fluorescent light or sunlight. In this respect 100 footcandles of direct tungsten-filament light equal about 500 footcandles of sunlight. The intensities of sunlight on the eyes and skin in the summertime are commonly 5000 footcandles.

Visible Radiant Energy

Certain vague ideas and loose theorizings in regard to the spectral character of light or visible radiant energy have persisted for a long time. In general they are important only as nuisances. With the advent of fluorescent lamps some of these have been revived and the "vita-

(*Continued on page 22*)

SLIMLINE LAMPS *in Tomorrow's Store*

By C. M. CUTLER, Nela Park Engineering Division

THE advantages which the new Slimline (and Circline) MAZDA fluorescent lamps will afford to the designer of commercial lighting installations become evident as one considers the illumination of a specific store. As pointed out in a previous article, the Slimline lamp has been given characteristics which supplement and extend the features available in the earlier MAZDA F lamps; thus the designer is given wider opportunity in utililizing fluorescent lighting to make a store more productive, distinctive and attractive.

Some of the features which differentiate the Slimline lamps are:

Dimensions and proportions. They provide both intermediate and longer lengths than heretofore available. They are thinner in proportion to their length, thus affording new appearance or style facilities.

Lower values of light output per foot of lamp.

Choice of auxiliaries for each lamp which makes it possible to select from a wider range of tube brightness values. Thus, the T-8 Slimline lamps operated at 100 ma. have only 70 per cent of the brightness of a 40-watt MAZDA F, whereas, the T-6 Slimline operated at 200 ma. has a brightness of 60 per cent higher than that of the 40-watt.

The availability of low brightness is important with respect to shielding requirements. The high brightness tubes make it possible to obtain better redirection of light flux and higher values of illumination from a minimum space, or with least obstruction.

Base and socket designs which facilitate insertion and removal of long lamps in cramped spaces.

How these features may be capitalized is suggested in the large illustration on pages 20 and 21 showing lighting equipment which might be installed in a postwar drug store such as the one designed by J. Gordon Lippincott for the General Electric architectural series.

Dimensions and proportions figure in nearly every general and specialized application suggested in the store sketch. First, let's consider the specialized applications, for it is in their variety that the combination of features, available in Slimline lamps, can achieve such distinctive and exclusive results. The streamlined simplicity of the layout and equipment of the modern store we have chosen for our example invites the factors inherent in Slimline lamps to heighten the objectives of the original design.

If we take detail A, we see how several Slimline features are combined to contribute special atmospheric values as well as the dual purpose of edge lighting the sign letters and providing accents for top shelf displays. The small diameter of the 42T6 lamp meant that shielding could be small and inconspicuous. Besides this convenience in applying a long line of light to the purposes mentioned, there were also the options of color, and either of two light outputs. The 42T6 may be either a 15- or 25-watt lamp. At the lower wattage, it gives 900 lumens, at the higher, 1400. The selection of the proper ballast at the time of installation determines the option of light output.

Detail B shows how a T-6 Slimline lamp permits an approximate ¼ reduction in the width of showcase lighting units as compared with the T-8 showcase lamp. From this, it is demonstrated in detail C that the narrow nose of a display shelf may house a Slimline lamp without apparent increase in shelf thickness. If the shelf is made of metal, the section could be increased towards the back to house the ballast. In showcases, the lamp indicated in the detail sketch will provide adequate brightness to give sufficient contrast with the general surroundings. The small diameter, again, makes practical the utilization of a source where it can bring out the display at the bottom of the case. Here, too, the base and socket designs facilitate insertion and removal of long lamps in cramped space. Lamps at two locations in a case may give more uniform distribution of light and minimize fading of certain kinds of merchandise. This method also offers the additional advantage of using an economical Tulamp ballast.

For an example of flush architectural elements where depth is limited, note the suspended ceiling in the sketch on page 20. Here the structural framing reduced the depth available for a continuous flush panel (detail D). The Slimline is a practicable solution not only because of its dimensions but also because the range of brightness possible with the two values of light.

The brightness contrast between the panel

and the surrounding soffit may be relieved by raising the brightness of the soffit. This may be done to some extent by concealing Slimline lamps at the top shelf of the back bar (detail E). Slimline may be used effectively for lighting the work area, too (detail F).

Displays become features when their brightness is several times that of their surroundings. The Circline lamp concealed behind a frame may encircle a small display and accomplish that as illustrated (detail G). This is merely one of the uses of Circline. (Others will be illustrated in subsequent issues of the magazine.)

General Lighting Fixtures

What do Slimline fluorescent lamps offer for fixtures? First, consider the physical dimensions of the lamps with reference to the proportions of present units. The small diameter coupled with relatively long length will probably give greater impetus to streamlined units with smooth, trim lines. We may expect this will tend to create the impression of lightness in weight. It is obvious that T-8 (1 inch) Slimline presents only ⅔ the width in sideview as the T-12 (1½ inches) which is the diameter of the popular 40-watt fluorescent lamp. This means that in sideview, a fixture may be only ⅔ the dimensions of that for the 40-watt F lamp to give the same degree of shielding and the same utilization of light.

Second, when the T-8 lamps are operated at 70 per cent of the brightness (100 ma.) of the 40-watt lamps, the lumens-per-foot are somewhat less than half of that of the 40-watt lamp. This means more than twice the lineal footage of lamps are required for a given illumination. This footage may be disposed in a more closely spaced pattern of fixtures or lines as compared with individual units. This may be done for appearance or reducing brightness contrasts between fixture and background for greater comfort in the store. The lower brightness of the lamp calls for a minimum of shielding unless it is desired for a particular appearance.

The same lamps may be operated up to 10 per cent higher brightness than the 40-watt T-12 fluorescent lamp. At the higher value, the lamps are giving three-quarters the light-per-foot of that of the 40-watt. This offers still another step in-between for disposing the light source in a pattern for a given illumination.

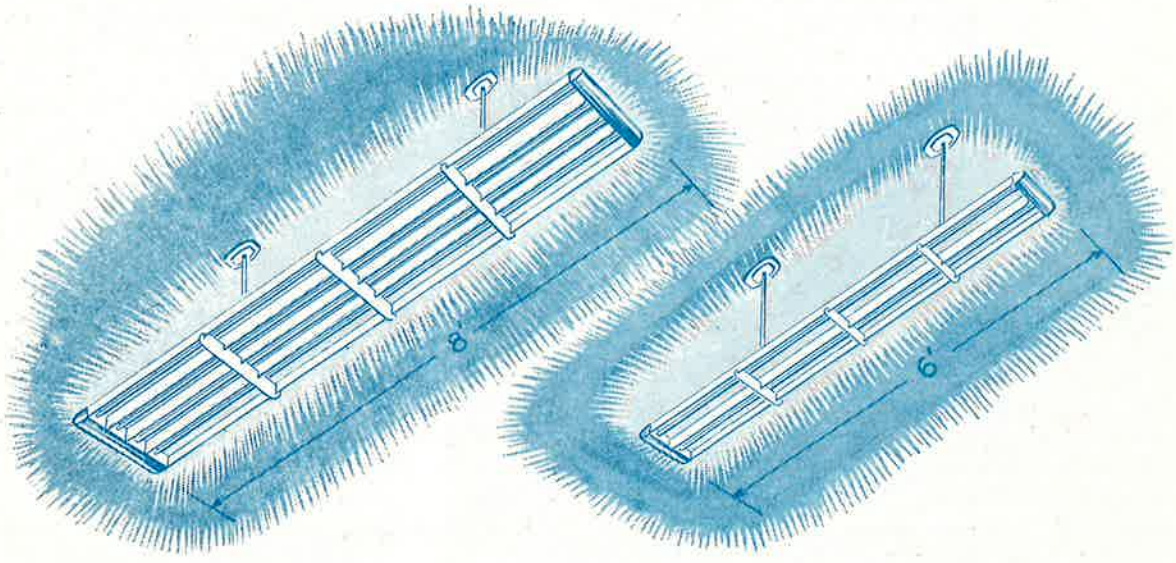
Slimline lamps increase the scope of fluorescent lighting by adding new facilities in physical proportions as well as options in light output.

DATA ON SLIMLINE LAMPS
(For Multiple Operation)

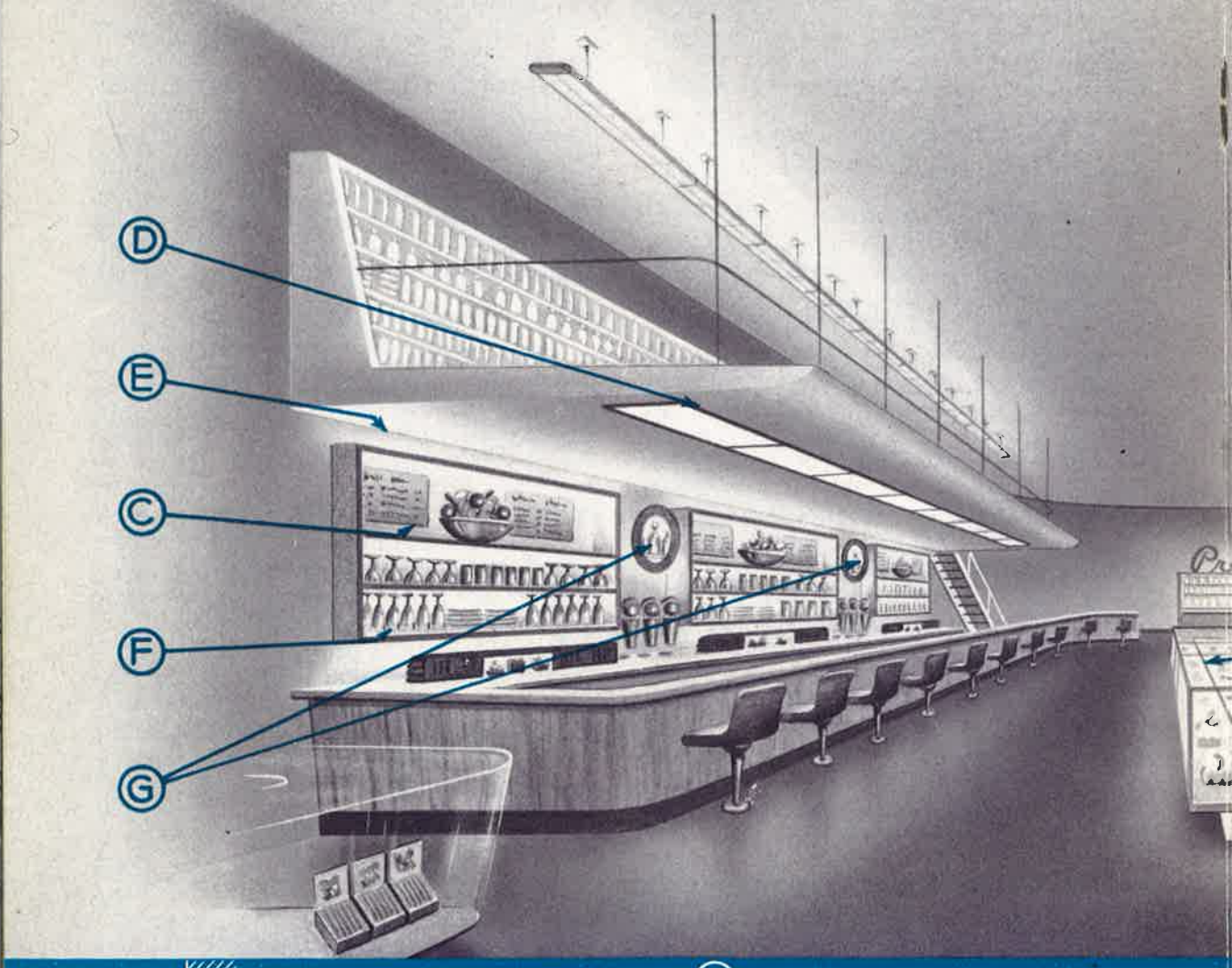
Lamp	Nominal Length* (Inches)	Max. Over-all Length of Lamp (Inches)	Current (Milli-amperes)	Watts	Lumens (Approx.)
F42T6†	42	40	100	15	900
			200	25	1400
F64T6	64	62	100	23	1400
			200	38	2150
F72T8	72	70	100	22	1400
			200	38	2350
F96T8	96	94	100	30	1950
			200	52	3300

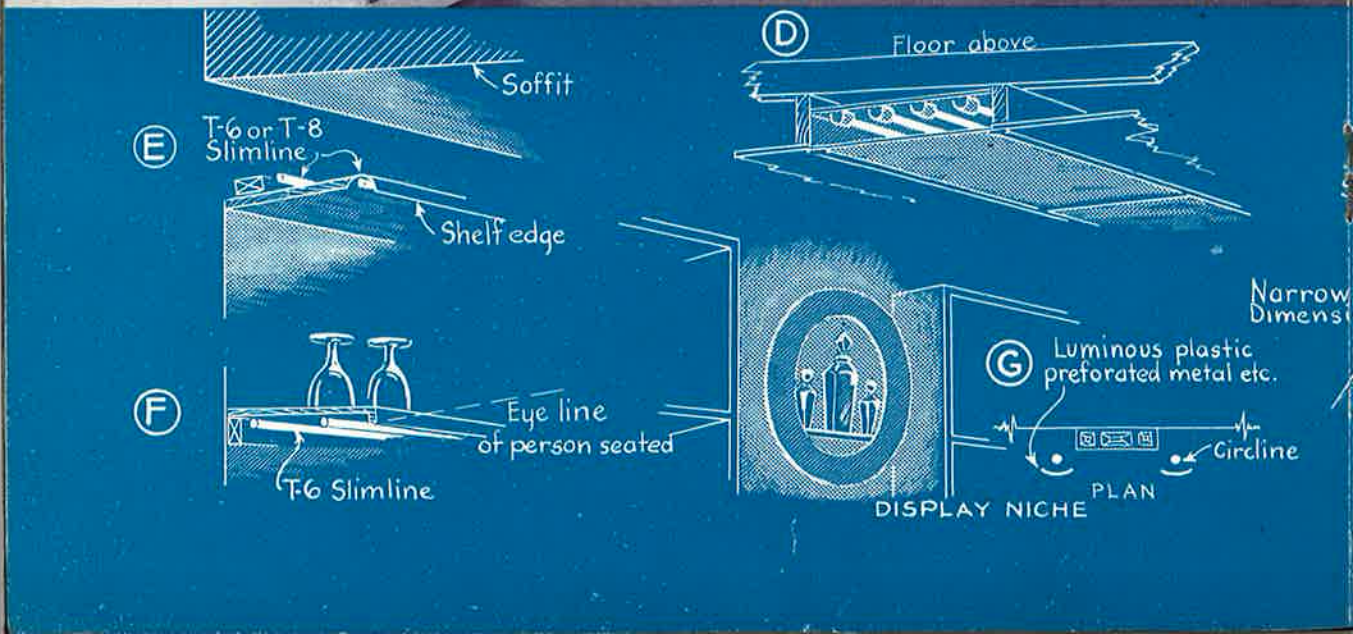
* Nominal length includes one lamp plus two multiple sockets.

† T-6 is ¾" outside diameter (approx.)
T-8 is 1" outside diameter (approx.)

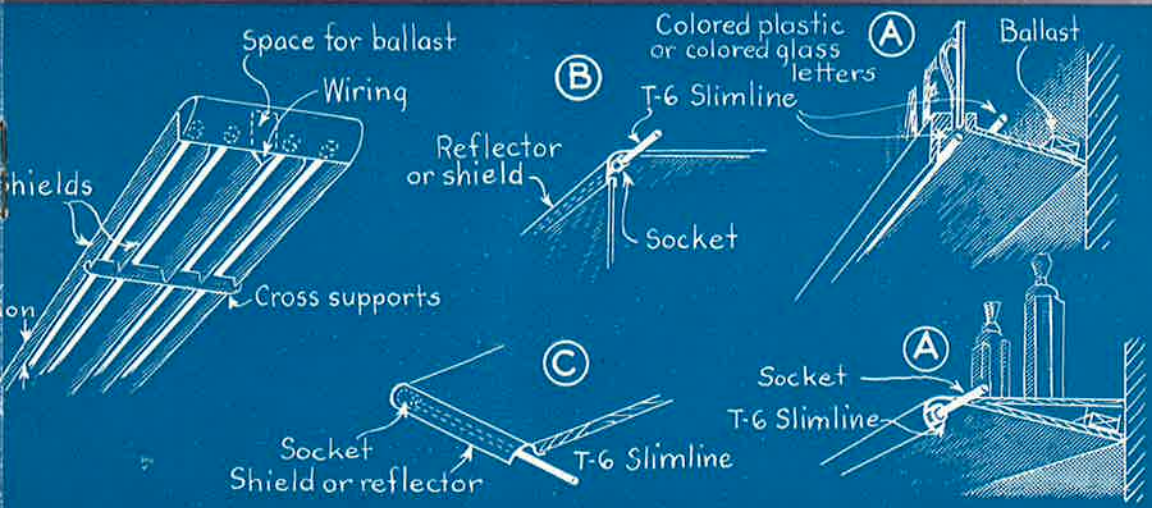


Slimline Lamps in . .





. . Tomorrow's Stores



WILLIAM L. ENFIELD

Nela Park scientist, well known to many Magazine of LIGHT readers, passes on.

DR. ENFIELD

THE electrical industry lost an outstanding leader and pioneer in the lamp development field with the death, on March 21, of William L. Enfield.

Coming to the Engineering Department of the National Lamp Works in 1910, his service with the General Electric Company continued to his death.

From 1914 to 1939, he held the position of manager of Lamp Development Laboratory at Nela Park. Since 1939 his post had been that of consulting engineer.

To Mr. Enfield's genius may be attributed much of the amazing progress which took place in the development of electrical light sources and in the modern art of lamp manufacture in the quarter century he headed the "LDL."

He possessed a rare gift of being able to stimulate and encourage others to leave no stones unturned in their laboratory pursuits.

Born at Chase, Kansas, on March 26, 1879—the same year Edison invented the world's first commercially practical incandescent lamp—Mr. Enfield was reared in the environment of the farm.

He attended Kansas State, Kansas State Teacher's College, Chicago U., and M. I. T. In addition to a B. S. in Electrical Engineering, an honorary Doctor of Engineering degree was conferred on him by Kansas State College in 1939.

The pioneering spirit of Mr. Enfield lives on to serve as an inspiration to those who carry on for him and for G-E in the Nela Park developmental laboratory.

Radiant Energy

(*Continued from page 17*)

min era" has added a new influence. Many who practice illuminating engineering are confused and even left in doubt, for the reason that they do not have a sufficient background of knowledge in various sciences to understand or to appraise these speculations. This is particularly true when the speculations are expressed in the complex unfamiliar language of branches of science not extensively associated with light and lighting.

During many years of research with visible and invisible radiant energy one becomes familiar with, and active in, various highways of science extending far beyond physics into such realms as physiology, biology, psychology, and ophthalmology. From this extended experience one must conclude that there is no proof at present that the spectral distribution of energy of any illuminant, suitable for general lighting applications, is any more detrimental to the eyes or visual sense than that of any other illuminant suitable for extensive use. As yet the only source of suspicion is loose theorizing or mere speculation with no foundation of sound theory or measurement. Theorizing is a necessary step in temporarily bridging the known with the unknown. However, it should be properly labeled and it must not ignore known facts and experience. Theorizing without any basis of fact is nothing more than speculation. Even this has its place but it should be confined chiefly to the realms of scientists. Certainly it provides no foundation for any conclusion or practice.

The foregoing portion of the article reprinted from "Illuminating Engineering" represents about the first half of the full text. For those who would follow the statement through to its reference to contemporary developments the complete article is recommended.

LIGHT REFRESHERS *for Existing Homes*

By MARY E. WEBBER, Nela Park Engineering Division

EXCITING and freshly creative as is the concept of new postwar homes (see the No. 6, 1944 issue), realistic thinking recalls—and not without gratitude—that millions of our American homes still stand and will for years to come. Fortunately for the millions of families who will occupy them, many of the ideas so smoothly integrated with the structure in the unfolding new architecture, can actually be applied to existing homes in pleasing, if modified forms to create in them, too, surroundings in better tune with the *human* needs of our chaotic and emotionally disturbing times. As postwar adjustments unfold, there will be increased dependence on the home's environment for repose, for renewal of depleted energies, and respite from deep anxieties—for "refreshment" of body and spirit.

The "design for living" homes, referred to above, sensitively interpret these needs in the emphasis on easier serviceability, on greater spaciousness (not solely dependent on large area), on a closer kinship between the inside of the house and the outdoors. Also on the flexible, enveloping, and generous artificial lighting to take over when Nature's lighting fails. Of these four particular factors contributing to more happily natural living conditions, it is the latter—generous artificial lighting—that has generally been given the least attention. This seems odd in view of the readily recognized "lift" we experience on the first bright sunny day after an extended period of heavy cloud-cast days, and in view of the known-so-well-it's-forgotten fact that the eyes cannot function at all without light.

The widespread inattention to the home's nighttime lighting may result from the belief that once the home was wired for *electric* light, the ultimate was reached. Because the early, readily-accepted forms of light gave effects so utterly different from Nature's lighting, it was assumed by many families that they could not, or need not have similar character. These families have been seemingly satisfied with whatever lighting the house provided and been hesitant to make the expenditures for newer lighting systems and so have not experienced the true value of lighting improvements and their significant influence on the home's intimate livableness.

In the quick-passing but relatively few years since electric lighting was introduced, continuing study and research have developed a maturing science and art of lighting. Combined with standards of specification for needed eyesight protection, for greater comfort, safety, convenience, as well as for decorative and spiritual effectiveness, a great human service is provided.

Lamp bulbs have undergone continuing development toward lower cost, higher efficiency, and increased types for broadened application. (See page 34.) Table and floor lamps are at last being designed as true aids to seeing instead of mere whims of fashion or decorative accessories. Ceiling fixtures—or necessarily substituting inbuilt means of suffusing the whole room—now bear no resemblance to their gas-jet or even further removed predecessors.

Yet today there remain over a hundred million of the "horseless buggy" type fixtures. There are still only an average of seven table or floor lamps in five-room homes that commonly have as many as sixteen groupings in which light is needed. And less than a third of all lighting equipments use the lamp bulb intended for them!

For this large majority of existing houses that must be the postwar homes of so many, there is indeed "refreshment" in store once their modernization can be undertaken. Now is the time for investigation and planning. May the following "idea" pages afford inspiration and guidance.

★

The Brown-Out

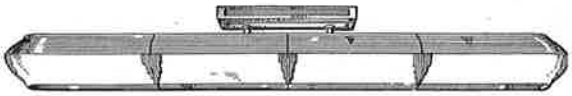
(*Continued from page 4*)

If you have never had a chance to compare your own street lighting with the type of street lighting approved by the Street and Highway Lighting Committees of the Institute of Traffic Engineers and the Illuminating Engineering Society, here is the opportunity—right in your own back yard—under your own local conditions.

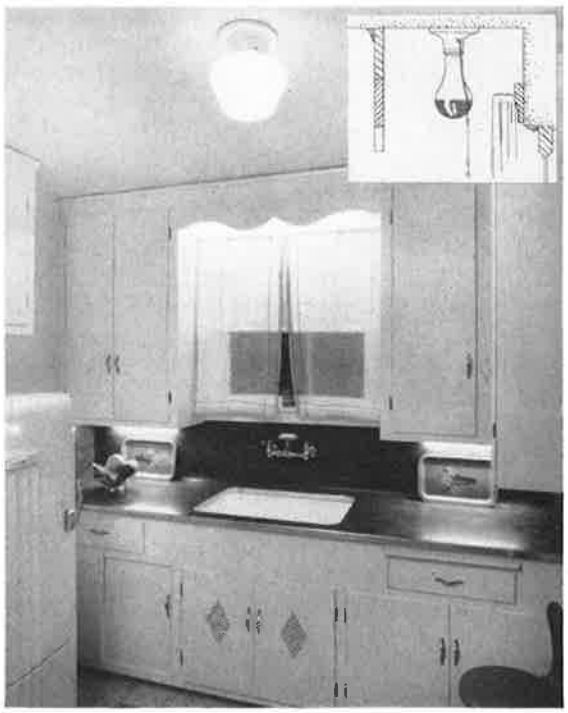
Sample installations of a temporary nature but with full efficiency and effectiveness can be installed and put in operation at a relatively small cost.

UTILITY

White plastic of high efficiency, held in cylindrical shape by the curved chromium cross bars, shields a 40-watt fluorescent tube and diffuses its light over the entire work surface on this sink wall with far greater smoothness and less shadow than its predecessor—the undersized "kitchen globe" shown in the inset. Note too, how much less obtrusive is the newer fixture despite its increased size, due both to the lower contrast between it and its adjacent ceiling and side wall and to its more harmonious "flow" with the lines of the room.



For the many homes in which kitchens have been modernized ↑ without thought of lighting, the fluorescent lamp with its multiple lengths offers a flexible means of adding daylight's counterpart over all the work centers—with no more working in one's own shadow. There is no slightest hint of "afterthought" in appearance, either. Fitting snugly under the cupboards on both sides of this two-wall kitchen are background-matching reflectors equipped with the 2-foot, 20-watt daylight tube, switch, and convenience outlet. (Tubes so placed are not necessarily shielded since they cannot be seen from normal eye positions). The over-sink space between the cupboards is spanned by the 3-foot, 30-watt tube in a reflector controlling the downward light in a narrow beam. The sketched fixture (two 40-watt daylight tubes) completes the "daylighting" and the owner's pride in her easy-to-work-in kitchen.

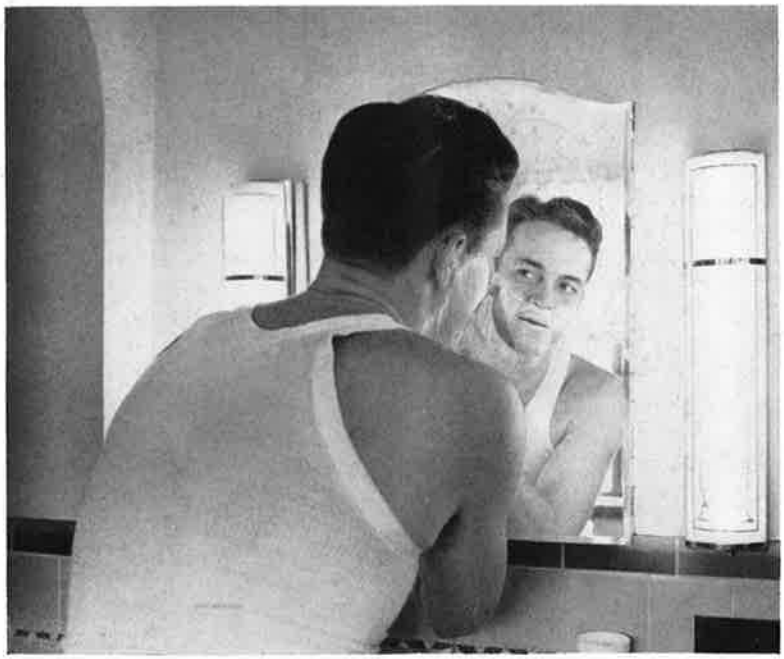


← Even the most modest home kitchen need not be deprived either of light where it is needed most or of that modern streamlined look. It can be attained inexpensively as in this small kitchen. An inserted valance board hides a plain pull-chain socket and 100-watt lamp (see cross-section drawing). The silvered-bowl type avoids the annoyance of hand shadows at the sink. Plug-in strip attached on the under-cupboard wall surfaces allows the use of 40-watt (or 60-watt if the space is longer) lumiline lamps and a convenience outlet for small appliances.

ROOMS

Basement laundries are often gloomy even in daytime and with the too-common meagre and tiring light for use in the evening—the only time many women have to struggle with the wash—it's little wonder dispositions snap. Once simple, industrial-type two-lamp reflectors (40-watt daylight tubes) are hung over the tubs and ironing space, there's no woman who wouldn't thrill with their help and wonder how she's ever put up with working in the "dark."

Despite the long-established standard for lighting outlets on both sides of the mirror, homes by the thousands must get along with but a single outlet above. But here is a new bracket (surprisingly low in cost) that makes the best of a bad start. The plastic open-top shade holds a lens which serves to focus truly revealing light on the face while the 100-watt lamp spreads softening light indirectly throughout the room. It boasts a convenience outlet too. The convenience and safety of 7-watt night-lights in baths, halls, children's or invalid rooms should not be overlooked. Note the plug-in type above the towel rack.



Fluorescent mirror-length brackets provide more light on the face than typical filament ones for clearer and smoother reflection. They allow no distorting brow, nose, or chin shadows no matter how tall or short the user! Shielding is often preferred for more finished appearance and is essential with the one-inch (T-8) tube.

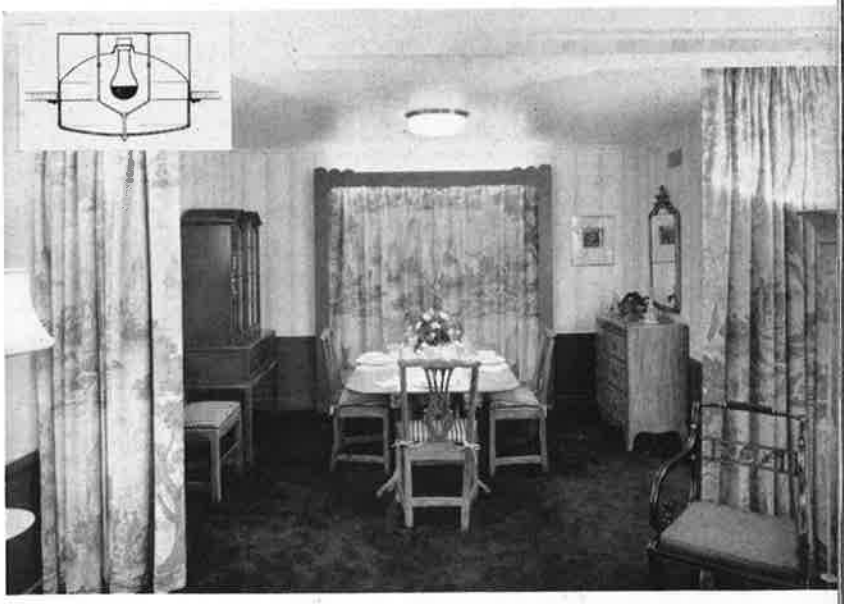
DINING

Something refreshingly new can be added to most dining rooms through a lighting plan that spells greater variety in keying the room's atmosphere to the occasion. The simple graceful crystal-draped fixture with its silk-shaded candles produces sparkle and emphasis on the table and the family group. But what woman doesn't look to candles to cast the party spell? We think the men would accept them more gracefully if they were augmented as in this room by background lighting. Plug-in strip was easily attached the full length on the bay side of the opening and equipped with five 30-watt lumiline lamps, preferred here to fluorescent tubes since the latter in giving nearly three times the light for the same space coverage would defeat the soft subtle effect.

This type fixture is a wise replacement choice for obsolete and over-ornamental bare lamp shower fixtures in the informal dining room that must double in its family use. Its shade conceals a glass bowl that diffuses the downlight from a 100–200–300-watt lamp, allowing low or moderate amounts for dining and plenty when the table serves for games or study. The metal urns (balancing pairs on opposite walls, 60 watts each) fade into the wall paper when not in use and produce low over-all light to complement candles. (See opposite page.)

ROOMS

Spaciousness and greater flexibility are immediately gained by taking out partitions between the small dining room and living room—thus creating the currently popular dining alcove. Then a fixture close knit to the ceiling is preferable. Added dramatic downlight can be attained without high fixture-brightness if a reflector and 150-watt silvered-bowl lamp is recessed above the ceiling line (see inset). The unusual window treatment with its projecting frame includes lumiline lamps across the top—for a change of pace in the setting and for keeping the alcove alight when the table is not in use.



BED

Ceiling fixture—three 60-watt lamps

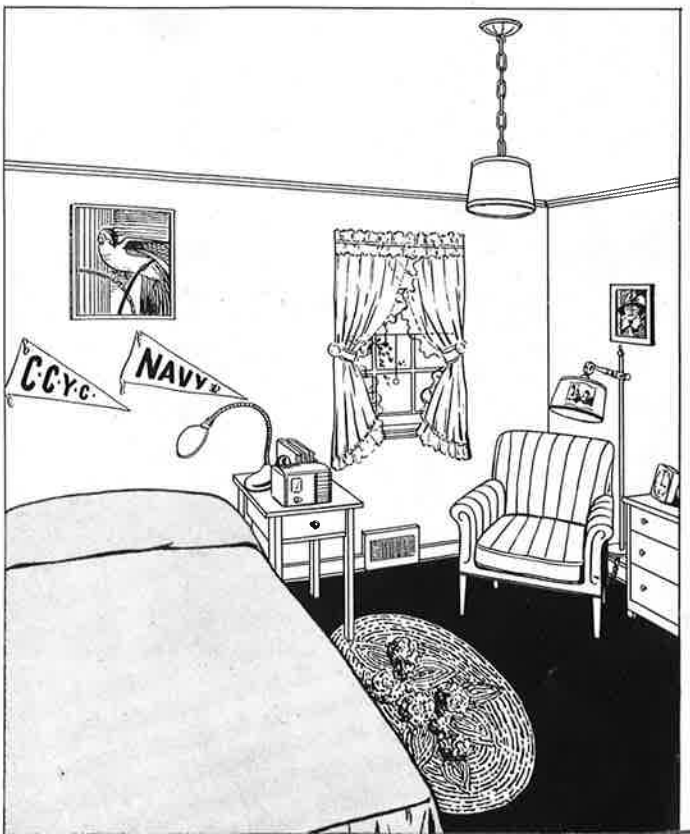
Swivel-arm floor lamp—100–200–300-watt lamp

Headboard:

Inset box—two 15-watt lumiline lamps end to end

Reflector—two 60-watt lumiline lamps end to end (30-watt fluorescent applicable)

The room—at right—"comes of age" with the young boy occupant in this miracle of modernization—above. Space is planned for bedside accouterments within reach and without clutter in the smartly tailored cabinet-headboard. It is free standing and built high enough so that pillows may be propped up for good reading posture without losing the usefulness of either shelf or light. Switches placed within the shelf control the glass-covered light box inset in the top—for decorative highlight, and the front surface-mounted reflector and lamps—for truly good reading light. And convenience outlets are wired in for the radio, electric blanket unit and clock! The fixture and chair lamp are nicely selected for harmony of line and forthright function.



ROOMS

A simple and practical dressing table fits neatly into this trim and space-saving wall treatment for increasing storage capacity in the small bedroom, and the need of other furnishing than beds is thus obviated! The window assures undeceiving make-up light for daytime, replaced at night by the vanity lamps (60 watts each). Their white shades fuse effectively and comfortably into the white curtains and Venetian blinds. Because of the uncommonly low stool, lower-than-usually-recommended lamp standards bring the shades correctly at face height.

So closely coordinated is the lighting with the use and appearance of both the separate groupings and the unified scheme in this redone room that its final livableness is as satisfying as the "brand new." Coherence is fostered by the similar toned rose-biege walls and carpeting, by the mirror composition with its seeming side frame of light, and by the over-spreading soft lighting from the ceiling fixture and adjustable bed and bridge lamps.

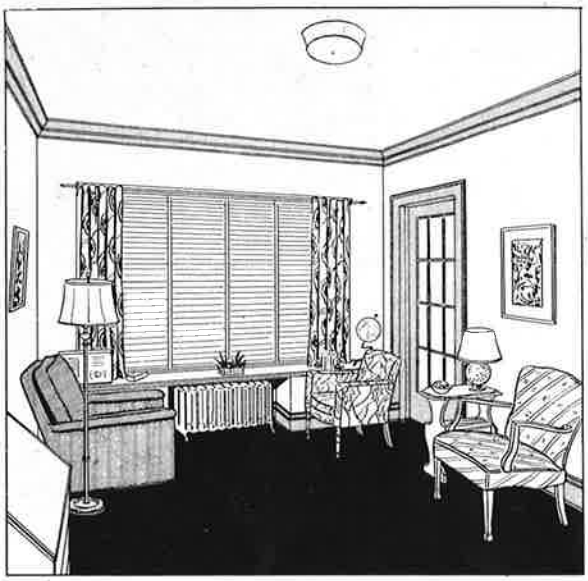
Ceiling fixtures—three 60-watt lamps

Pin-to-wall lamp—150-watt lamp

Bridge lamp—50–100–150-watt lamp

Mirror brackets—two 30-watt white fluorescent

Built-in desk lamp—40-watt lumiline lamp.



LIVING ROOM

"Don't Fence Me In" could well be sung with heartfelt literalness by the tenants of this apartment living room. Its 11 x 12′ dimensions are the more cramped by "busy" fabric design, dark woodwork, heavy cornice, and depressive and rigid nighttime lighting. Too few portable lamps with under-sized bulbs receive no lighting lift from the ceiling fixture. While the dense parchment drum succeeds in hiding the unsightly bare-lamp fixture underneath, it also absorbs most of its light, leaving the room in contrasting pools of light and dark.

"Quieter" and more tasteful slip covers, drapery fabric which blends with the wall-paper, and ivory paint correct the most obvious decoration incongruities. It is the trick of widening the window and suffusing the wall and ceiling with soft, yet accentuating lighting that really adds space in illusion and refreshment in reality. The draperies are pushed back over the narrow wall areas (allowing greater daylight infusion) and unified by the wall-to-wall wood strip backed with lumiline lamps. The stage is set for relaxation, music, or conversation. When eyes dictate activity, the strip lighting is spelled by the new purposeful ceiling fixture for more general, yet mellow room lighting, and close within each major grouping is a portable lamp keyed both to good aspect and to comfortable seeing. (See below for similar treatment with fluorescent.)

Ceiling fixture—three 60-watt lamps

Wood valance—seven 30-watt lumiline lamps

Bridge lamp (at left)—150-watt lamp

End-table lamp—100-watt lamp

Large table lamp (not shown)—two 60-watt white lamps

Though the wall lighting installation here appears as if incorporated in the original structure, it was actually applied years later. Fluorescent tubes are used in preference to lumiline for their much higher light output, because the aim is primarily functional to illuminate directly the sheet music and keyboard. The wiring channel and three 30-watt tubes run the full length on an applied wood strip which is mounted tight to the lower edge of the structural beam forming the recess. The opposite wall has a similar structural recess and is light-treated in the same manner and most advantageously so, since the room's depth is nearly double its width and the room has no center fixture. The two luminous walls, shedding light flatteringly throughout the room, create by themselves, an enchanting social atmosphere or, in combination with the portable lamps, a most comfortable environment for concentrating eye activity.

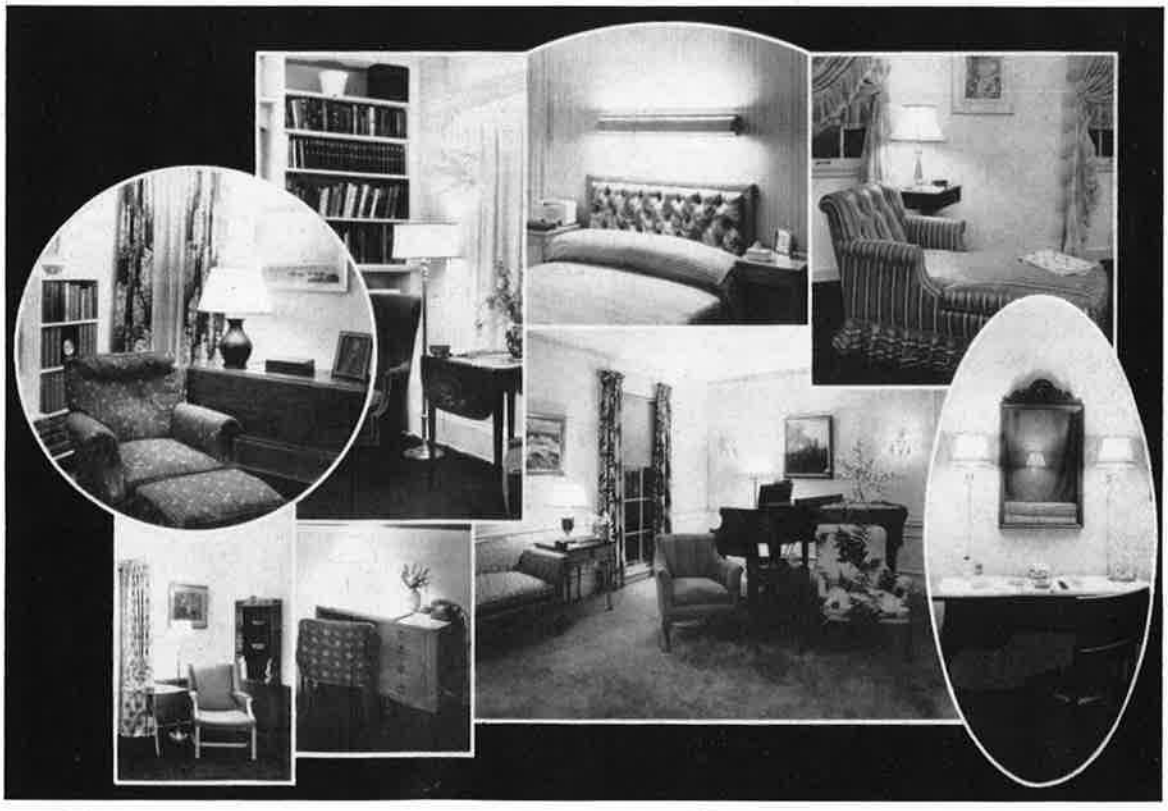
It's too generally accepted that a portable lamp—especially if it is not skimpy in height and uses the "right" size bulb—will just naturally light whatever one wants to see by it. But that's not necessarily so!

The background is dark in these pictures to emphasize the lighted effect on the magazine, but should not be so in practice for it offers eye-tiring contrast with the lighted page.

The lamp bulb is located so high within the narrow portion of this too-sharply-curved shade that its light cuts off far short of covering the opened magazine.

Better, isn't it? And worth checking beneath the shade to make sure the bulb or bulbs "sit" low enough to allow an effective spread of light—but not, of course, to shine in the user's eyes.

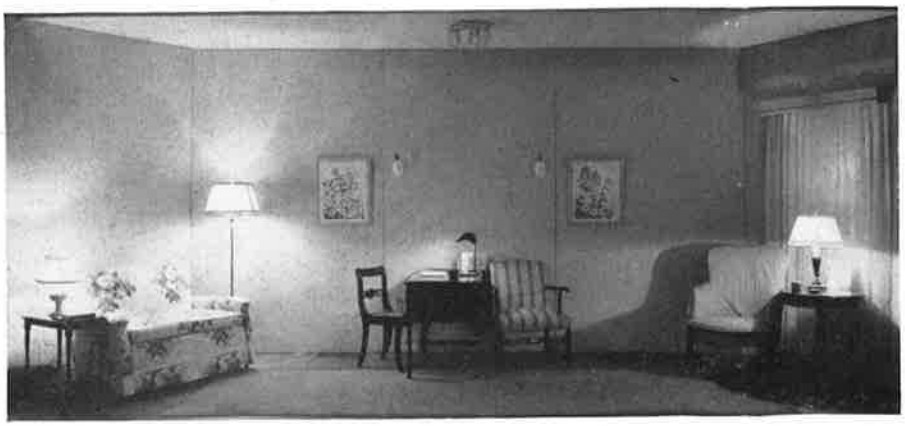
These appealing and inviting groupings may dispel the too common belief that decorative harmony and eye-worthy lighting quality need be incompatible in a lamp—never when selection and placement are guided equally by design and lighting commandments. The table on the following page endeavors to outline the latter, and one's own home setting suggests the former.



A CHECK LIST FOR CHOOSING "EYE-WISE" PORTABLE LAMPS

(Lamp Heights, Shade Sizes and Bulb Wattages for Common Types and Uses)

Lamp Types and Uses	Lamp Height To Top of Shade (Approx. Inches)	Shade Diameter Lower Edge (Approx. Inches)	Inner Bowl① Width of Upper Edge (Inches)	Total Bulb Wattage	
				Filament Lamps	Fluorescent Lamps②
Lamps for Flat-top Home Desks . Never placed in front of user.	24–28	15–18	Bowl preferred—8–9⅜″ diffusing type	100–150	.....
	14–18	Full-length shielding	None	.....	30–40
Lamps for End Tables . . . . (Based on 26″ high tables. Low-seat lounge chairs with lower tables can use shorter lamps than higher tables by higher-seat chairs.)	19–23	14–18	Bowl preferred. Special etched or prismatic type—6″	100–150	.....
Large Table Lamps	24–30	16–19	Bowls preferred—9⅜–10″ diffusing	120–300	.....
Vanity Lamps for Dressing Tables	20	8–10	No bowl	60–100	.....
	20	Full-length shielding preferred	No bowl	.....	15
Vanity Lamps for Dressers . .	26	8–10	No bowl	60–100	.....
	26	Shielding preferred	No bowl	.....	20
Pin-to-Wall Lamps . . . . . 1. For use over sinks, telephone tables, each side of mirror (hung so that center of shade at face level).	Top of shade③ hung 54–62″ above floor	8–10	No bowl	60–100	.....
	Hung 48–60″	Full-length shielding preferred—possible exception of bath, powder room mirrors	No bowl	.....	15–40
2. For longer period eye use at desks, sewing machine, chairs, over beds, davenports, dinette tables, etc.	Top of shade hung 54–62″	10–18	Bowl preferred—8–9⅜″ diffusing	100–150	.....
	Hung 48–60″ above floor	Full-length shielding	No bowl	.....	15–40



A stage set, to be sure, but your home is <u>your</u> stage setting. Study its nighttime atmosphere. Do you find deep, gloomy shadows, disturbing spottiness, fixtures you'd rather not turn on because their light is not flattering?

A CHECK LIST FOR CHOOSING "EYE-WISE" PORTABLE LAMPS

Lamp Types and Uses	Lamp Height To Top of Shade (Approx. Inches)	Shade Diameter Lower Edge (Approx. Inches)	Inner Bowl① Width of Upper Edge (Inches)	Total Bulb Wattage	
				Filament Lamps	Fluorescent Lamps②
Bridge Lamps④ . . . . . Upturned socket preferred. Use with small secretaries, slant-front, or flat-top desks. Beside—toward rear—small-scale chairs. The larger scale of fluorescent models serve larger-scale desks and chairs.	50–58	10–14	Bowl preferred—8–9⅜" diffusing	100–150	.....
	42–50	Full-length shielding	No bowl	.....	30–40
Floor Lamps④ . . . . . Placed at rear side of davenports, chairs, and at keyboard side of pianos. Swing-arm types allow exact adjustment of light.	54–60	16–20	Bowl essential, 9⅜–10" diffusing	150–300	.....
Some have supplementary down-lighting	.....	.....	Filament lamps require 4" diffusing cup; fluorescent need no additional diffusion	120–180	Or 30
Torchieres . . . . . Not to be used for eye work. Serve for over-all room lighting in living rooms, dining rooms, recreation rooms, halls. Best used in pairs.	60–66	Not equipped with conventional shades	Inverted decorative (dense) bowls—6–16"	100–300	.....

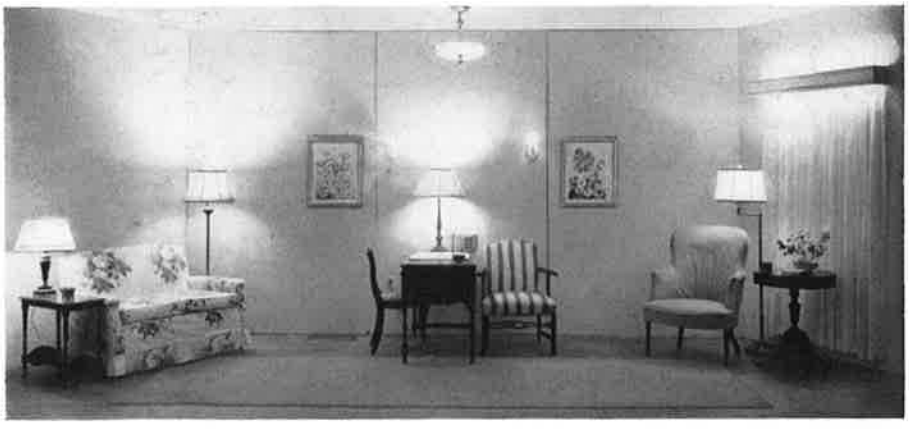
① The first certified lamps on the market introduced diffusing bowls within the shades. Their purpose is to improve the quality of lighting for the more exacting eye tasks, to break up the harsh light inherent in 100-watt and larger filament lamps, to soften shadows, and to reduce reflections from shiny surfaces. This improvement in quality is not gained without some loss of light. The shape, size and density of the bowls are important; certified ones are an insurance against unwarranted loss of light. Table lamps under 24 inches tall when equipped with a bowl, require special bowls which bend the light for greater spread (compensating for the lower height). For more casual seeing use, table lamps 19–24 inches high, equipped with two adjustable sockets (using the smaller 60-watt bulbs) are satisfactory.

② Wattages listed refer only to that consumed by tubes. From 4.5 to 9.5 additional watts consumed by ballasts, depending on tube size. Only portable lamps already developed using straight tubes are included. Postwar developments using the circular lamps will extend fluorescent usage to greater variety of table and floor lamps.

③ The hanging height of pin-to-wall lamps is often a compromise between positioning lamp low enough to be within 24" of task to be lighted and high enough so that when standing a few feet from it, one cannot look into the top and see the bulb.

④ An adjustable feature in the lamp stem is most desirable in order to fit the lamp most comfortably to the varying seat heights of lounge chairs and davenports.

If so, change your setting too for smoother and more soothing interplay of light and shadow. Better balanced and inter-related lamps may also give several "steps" of light. Fixtures to turn on at will, allow varied effects to suit the "act."

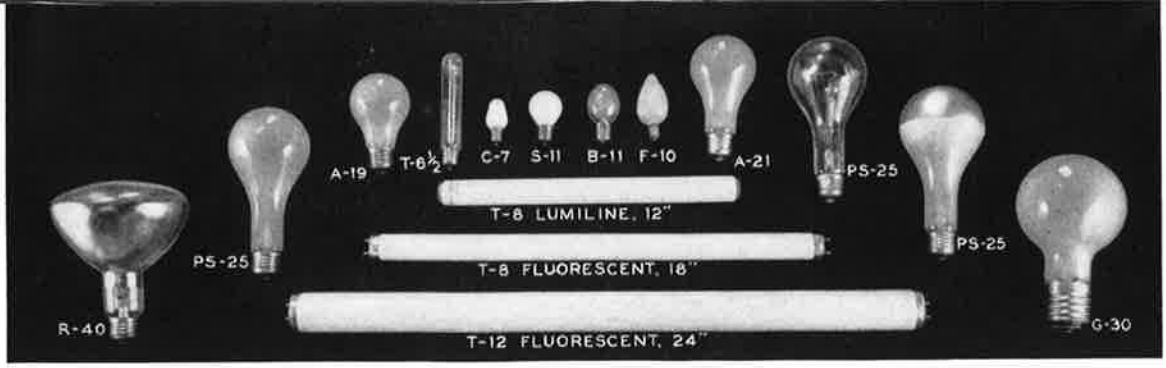


GENERAL ELECTRIC MAZDA LAMPS

The data given here are necessarily restricted to lamps most frequently recommended for home use. Wartime restrictions have eliminated a number of lamp types, finishes, sizes, and voltages previously supplied. The table will therefore be subject to revision when these restrictions may be lifted.

To emphasize the importance of specifying lamps correctly, the application summary for each type is preceded by wattage, bulb shape, and base data. Unless otherwise noted, all lamps are made for 115-, 120-, and 125-volt circuits. To realize their designed life and maximum efficiency, care must be taken in each locality to specify the lamp voltage corresponding to the voltage furnished by the local light and power company.

Lamp Type	Watts	Bulb	Base	General Application
General Lighting Service Lamps				
The standard inside-frosted lamps fill the greatest variety of home needs and are the least expensive MAZDA lamps.	15	A-15	Medium	Lighted ornaments, portable lamps for decoration only, decorative shaded wall brackets.
	25	A-19	Medium	
	40	A-19	Medium	Multiple-socket ceiling fixtures—shaded outdoor lanterns.
	60	A-19	Medium	Multiple-socket portable lamps and fixtures always shaded. Utility wall brackets, shaded. Closets.
	100	A-21	Medium	Single-socket portable lamps, 10" and 12" enclosing globes. Semi-and totally-indirect ceiling fixtures.
	150	PS-25	Medium	
	200	PS-30	Medium	Torchieres and ceiling fixtures of enclosing and indirect types.
	300	PS-35	Medium and Mogul	
				15–100-watt sizes in built-in elements.
Daylight Lamps				
These inside-frosted blue glass bulbs (the two larger sizes come also in clear blue glass) give a whiter light than other filament lamps—more nearly like daylight, but with lower light output per watt than the inside-frosted lamps.	60	A-19	Medium	Laundry and kitchen wall brackets (60- or 100-watt) and ceiling fixtures (150- and 200-watt)—the 150-watt in reading lamps where a more nearly daylight quality is preferred.
	100	A-23	Medium	
	150	PS-25	Medium	
	200	PS-30	Medium	
Silvered-Bowl Lamps				
The most efficient source of indirect light. Its mirrored silver bowl reflects from 92 to 96% of the light and cannot tarnish or collect dirt.	60	A-19	Medium	Indirect ceiling fixtures and adapter fixtures and shades. Special forms of ceiling downlights. 100-watt in bridge lamp adaptors.
	100	A-23	Medium	
	150	PS-25	Medium	
	200	PS-30	Medium	
Reflector and Projector Lamps				
An advance in lamp construction, making possible self-contained lighting units including within bulb efficient reflecting surfaces with either flood or spotlight distribution, in 150-watt sizes.	150	PAR-38 (Projector)	Medium	Reflector lamps for indoor and projector lamps for outdoor or indoor use where localized high footcandles desired as at workbench, over engines in garage, sewing machine, or for flood or spotlighting purposes in yard and garden. Louver shields available to clamp on bulb for eye protection as well as clamp and hanger socket attachments for simple installation. Color plates also available to clamp on projector lamps.
	150	R-40 (Reflector)	Medium	
	25	T-10, 5⅝" (Reflector)	Medium	For picture or shelf lighting.
Indirect and Three-Lite Lamps				
The three-lite lamps have two separate filaments, allowing flexibility, for each filament may be burned separately or in combination to produce three levels of illumination.	300①	G-30	Mogul	Floor and table lamps. Special wall urns, dining and breakfast room fixtures. Used primarily in combination with inner diffusing bowls.
	100–200–300①	G-30	Mogul	
	50–100–150	PS-25	Mogul	



The MAZDA lamps shown above are representative of the types which have greatest application in the home. The "bulb designations" with each may be helpful in identifying the characteristic shape of the types recommended for specific uses in the table below. The letters represent the bulb shape and the numerals refer to its maximum diameter in eighths of an inch. Three "PS-25" bulbs are included to show the three finishes, "inside frosted," "daylight clear," and "silvered bowl."

GENERAL ELECTRIC MAZDA LAMPS (Continued)

Lamp Type	Watts	Bulb	Base	General Application
Lumiline Lamps Specially designed sockets and housings make possible the use of this type of lamp to form continuous lines of light.	30 40 60	T-8, 18" T-8, 12" T-8, 18"	Disc Disc Disc	Available in clear and white only②. Tubular shape and 1" diameter make these lamps suitable for cove, mirror lighting, under-shelf units for kitchen work areas, and special built-in elements.
Fluorescent MAZDA Lamps Not an incandescent-filament lamp but an "electric discharge" source, it must be used with specially designed auxiliary equipment to produce proper electrical values.	8 14 15 20 30 40 100	T-5, 12" T-12, 15" T-8, 18" or T-12, 18" T-12, 24" T-8, 36" T-12, 48" T-17, 60"	Min. Bipin Med. Bipin Med. Bipin Med. Bipin Med. Bipin Med. Bipin Mog. Bipin	Similar applications to the above, and preferable where higher efficiencies and coolness are important. Daylight quality particularly suited to kitchens, laundries, workbenches, and baths. Available in white and daylight③. The 14- and 15-watt sizes, usually in pairs, for desk and bridge lamps, and as supplementary lighting in semi-indirect floor lamps. 15- and 20-watt sizes for bathroom mirror brackets. 20-, 30- and 40-watt sizes in ceiling fixtures (in pairs). The single 100-watt for kitchens.
Other Tubular Lamps These lamps meet special demands for lineal shape with standard sockets.	25 25 40	T-6½, 5½" T-10, 5⅝" T-8, 11⅞"	Intermediate Medium Medium	Special fixtures for picture lighting or other specialized decorative lighting. T-8 in some bathroom tubular brackets and T-10 in kitchen cabinets. Available in clear and inside frosted.
Lamps for Decorative and Miscellaneous Uses	6 7④ 7½ 10	S-6 C-7 S-11 S-14	Candelabra Candelabra Medium Medium	Clear only Clear and white only White only Clear, white and inside frosted (some colors in 120-volt only)	Night lights, lighted house numbers, decorative ornaments, radio and range lights.
	15	F-10	Candelabra	White only	Wall brackets and candelabra fixtures.
	25	A-19	Medium	White (Some colors in 120-volt only)	25-watt white for shaded wall brackets and candelabra fixtures, and 60-watt white for multiple-socket table lamps and shaded fixtures, when appearance dictates a lower brightness lamp than the standard inside frosted.
	60	A-21	Medium	White (Some colors in 120-volt only)	
	No. 5 Photoflash	B-11	Single Contact Bayonet	Operated by flashlight battery	For use in home photography.
	500 No. 2 Photoflood	PS-25	Medium	115-volt only	

① Base-down burning only.
② Inside-frosted and colored finishes discontinued in compliance with WPB Order L-28-a.
③ Soft-white and all colors discontinued in compliance with WPB Order L-28-a.
④ Available in 120-volt only.

When the men of our armed forces have the time and opportunity to work on their postwar careers, they usually enroll in the study courses made available for this purpose. This story concerns a Master Sergeant who decided to prepare himself for the time he returns to North Carolina by taking the Armed Forces Institute Course in illumination. Pictured above are the texts used in the course. They were specially prepared for the armed forces by International Correspondence Schools. The student in this case noted that the author of the nine texts is C. E. Weitz, Illuminating Engineer at Nela Park. A resume of the correspondence inspired by the course follows.

GI's Are Training for POSTWAR LIGHTING JOBS

Correspondence with M. Sgt. Stephenson discloses keen interest

The first letter from Corsica to General Electric, Schenectady.

SOME time back, while in the United States, I noticed you published a very helpful catalogue on "Lighting." As I am now studying "Electrical Illumination" through Armed Forces Institute such a book would be very helpful as supplementary study material. If you have any more for distribution I would greatly appreciate one. Also, if you have any material which would be helpful to a student of lighting I would be very grateful to receive it.

Incidentally, the text material on this course was written by your Mr. C. E. Weitz of the Nela Park Engineering Division. In my opinion no one could be better qualified.

The next letter from Corsica was addressed to Mr. Weitz.

I am honored to receive your letter of October 30th and wish to thank you greatly for your cooperation and interest in sending me helpful literature in my study of illumination. It may be interesting to you to know that I have recently completed the Armed Forces Institute Course in that subject with a final average of 88 per cent. I feel that I have benefited greatly from it.

The correspondence presently included Mrs. Stephenson.

New Bern, N. C.

About two months ago I ordered a candlefoot lightmeter for my husband. I didn't know there were two different types of these meters, so I just ordered and purchased one. Since then I've written my husband that I was able to get it. He writes back that he hopes it isn't the "pocket size." I'm mighty much afraid that it is. However, he said if it was it will be alright. I paid something like $11.00 for it. Now he wants some attachments. If they will work with his lightmeter, please let me know the cost.

The Master Sergeant's next letter tells about his lightmeter.

Corsica

My wife writes me that she has the monogrammed G-E lightmeter she ordered for me from you people. I am proud to possess it as I intend to find much real use for it after the war. Strange perhaps but my wife seems to be just as interested as I am in the subject of lighting. She tells me that the meter tells her that her household lighting is very inadequate. She'll attend to that "toute suite," as they say over here, very quickly.

An inquiry to International Correspondence Schools produced the following:

A letter from I.C.S., to Mr. Weitz.

Scranton, Pa.

It is a pleasure to be able to inform you that the sale of our units on lighting, of which you are the author, are *among the few highest* sales

M. Sgt. Stephenson is a veteran soldier who plans to cap his army career with one in lighting.

of groups of instruction units to the Army. Originally, a few prerequisite instruction units were included with the entire lighting group. At present, the lighting group of instruction papers or lessons is considered as a unit by itself. The entire group of lighting lessons is packed by us as a unit and with thousands of similar units are shipped at one time to an Army Headquarters. From there, the individual units are shipped practically all over the world to other Army Headquarters or camps, from where the units are distributed to interested personnel of the Army, both commissioned and private members.

It seems safe to assume that the soldier in Corsica, to whom you refer, had completed our group of lighting instruction units which is listed by the Army under the general title, ILLUMINATION.

★

Lighting . . . Design for Seeing

(*Continued from page 14*)

many applications of artificial light of an entirely different interest; colored light, for example, is truly a new tool for the architects just as was structural steel a generation ago. With colored light, the designer can create effects that greatly enhance the attractiveness of a hotel foyer, a cocktail lounge, or a retail store. In such applications I regard it as the function of the architect or decorator to sketch out the broad picture and then depend upon lighting technicians to work out this picture into a practical reality. And finally, as I said earlier, this whole discussion is not intended to furnish you with a solution of many illuminating engineering problems or even of a few of them. Its primary purpose has been to point out some of the factors which must be given careful consideration by your own engineer or by your engineering consultant in the lighting field; to help you to recognize the physical and psychological limitations of his art; to bespeak your sympathetic viewpoint toward his work; and last but not least to urge you to insist upon lighting which is both adequate and comfortable, and not to succumb at the last moment to the plausible but not necessarily factual story of some fixture salesman of the high pressure school, who fortunately represent but a minority of the industry.

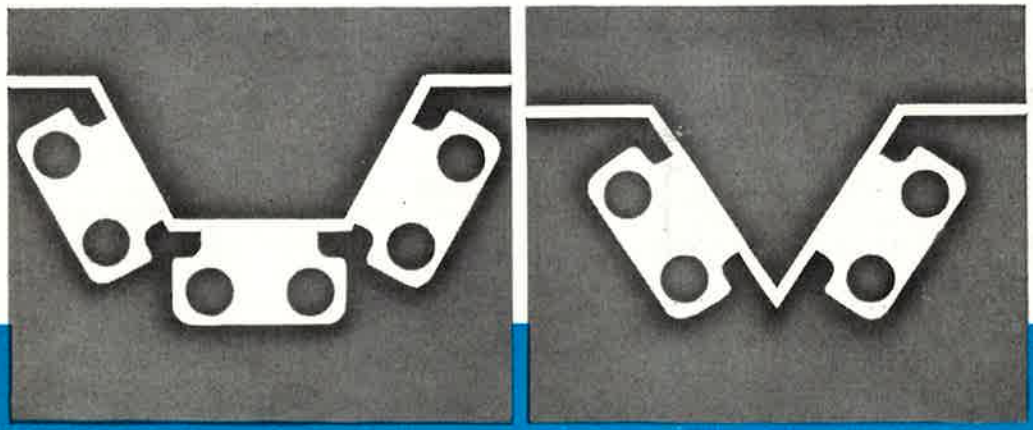
Another step ahead... Twin Turret

HIGH-POWER Factor Ballasts . . . Watch Dog Starters . . . Slimline Lamps . . . and now General Electric introduces the new G-E Twin Turret Lampholder. The Twin Turret represents another result of G.E.'s constant effort to provide more efficient and dependable lighting service.

The General Electric's Twin Turret Lampholder is designed for 40-watt fluorescent lamps. It is constructed of sturdy metal. Starter receptacles are located between lamps to accommodate either FS-40 G-E Watch Dogs or the standard FS-4 starters. The Twin Turret is available only in white.

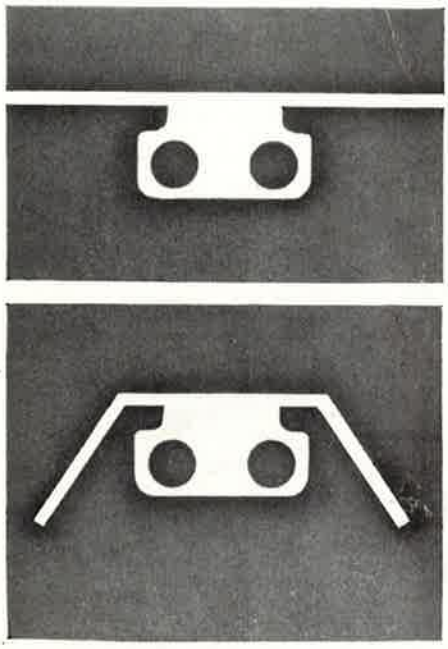
HOW THE TURRET WORKS

Fluorescent lamps are inserted by depressing either face of the Twin Turret with one end of the lamp until the other end clears the opposite face and slips in place. The Twin Turret holds the lamps securely in contact.



Suggested arrangements of the G-E Twin Turret Lampholders

Lampholders



TURRET FEATURES

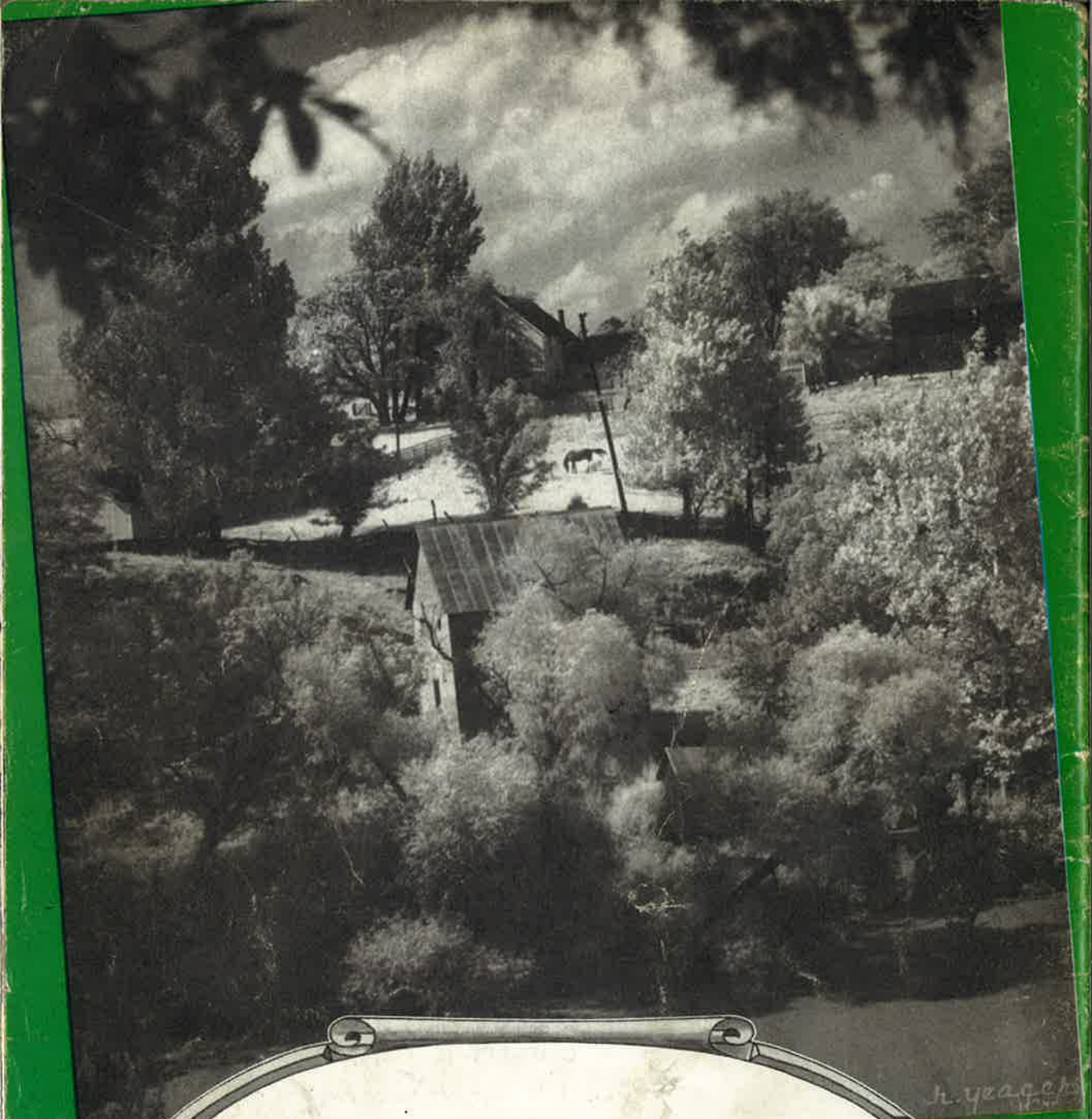
- The Turret eliminates the costly replacement of broken lampholders once and for all.
- It provides maximum protection against the hazard of lamps falling out of fixtures.
- Maintenance men need no longer waste time fussing with safety gadgets.
- The Turret's pleasing design will add to the appearance and value of any fluorescent lighting fixture.

For additional information write to Section Q355-39, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn.

BUY WAR BONDS AND KEEP THEM

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "G-E House Party" Monday through Friday 4:00 P.M. EWT, CBS.

GENERAL ELECTRIC



Your Purchases of More War Bonds
During the Seventh War Loan Drive
Will Speed the Day Our Veteran
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★ VIEW of VICTORY ★