LIGHT

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LIGHT

Published in the interest of the progress of sound Lighting Practices

CONTENTS

COVER AND FRONTISPIECE
On the front cover, the painting created for LIGHT by Cleveland, Ohio, artist Tom Denny, depicts the demands of competitive sports for speed, agility, accuracy, and strict physical control. Lighting's importance to the full competitive realization of these capabilities can not be over-emphasized. No other single factor has greater importance in indoor sports environments — the subject is discussed on page 14. Also of importance that can not be over-emphasized is light's interaction with the colors and textures of surfaces, as in the flower petals illustrated at left. The subject is discussed on page 20.
Frontispiece photo by Nela Park photographer Vance Roth.

REGISTERED TRADEMARK NAMES are shown below for some types of General Electric lamps frequently referred to in LIGHT® magazine:
LUCALOX high intensity discharge lamps.
MULTI-VAPOR high intensity discharge lamps.
POWER GROOVE high light-output fluorescent lamps.
QUARTZLINE high efficiency tungsten halogen lamps.

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An Interview... WITH JOHN WATSON

LANDSCAPE ILLUMINATOR — DALLAS, HOUSTON, MEXICO CITY

The three city names represent the focus of John Watson's professional lighting design operations. His work scope is actually coast to coast; Saskatchewan to Mexico City. He has declined numerous commissions from abroad.

Watson, a landscape architect, authored the first master's thesis on record on the subject of landscape illumination, at Texas A&M in the 1940's. His illuminating engineering skills were developed during four years of intensive work in all phases of lighting at General Electric's Nela Park.

Each lighting commission is regarded by Watson as a personal challenge — in creativity and in interpretation of his client's tastes. Facing challenges is almost an obsession; he has speculated as to why our country's municipal parks are allowed to remain dark at night when professionally designed lighting could bring enough families outdoors every night to completely displace existing crime in public parks. Equally challenging are the knotty problems of of the architectural lighting field — a field in which recent work has won international recognition.

About his work, Watson points out, "I don't claim to be the prototype of landscape illuminators, I'm just trying to show what one person can do." He has carefully controlled the growth of his business on the basis that, "I've never designed a garden in which I have not personally supervised the precise location of every fixture — it can't be done otherwise. As designer I'm responsible to conceive, communicate and follow through the execution." (Editor's note)

Q. You've described yourself as a professional lighting designer, John, and I recall that during early years of your career you worked under the title "lighting engineer" — how are the two different?

A. As a fledgeling, I had the uncommon advantage of learning lighting engineering from some of the finest people in the business, at Nela Park, working on Monty Cutler's staff with Bob Dorsey — and, by the way, I'm glad to see Bob has put added emphasis on Monty's fine standards by including creative architectural and design people on his Lighting Development staff. Those years were the most important of my life. The experience has been invaluable. Had I not had it, I might never have become aware of the extent to which lighting design goes beyond knowing such things as accepted lighting techniques, available stock equipment, prescribed lighting levels, and considerations for acceptable job appearance.

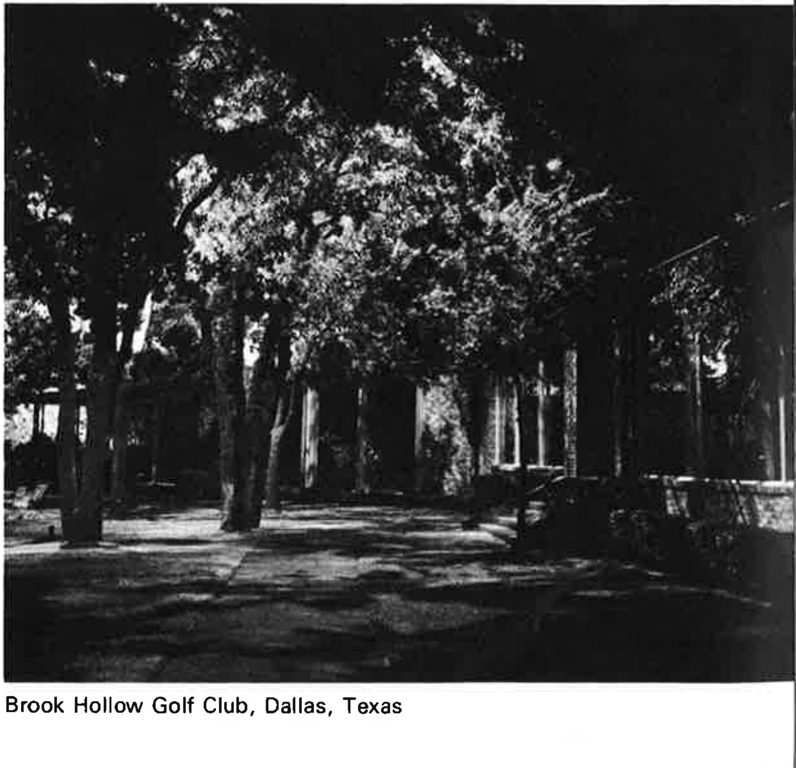
What has happened to me, over the years, as an independent lighting designer is that I have steadily increased my emphasis on creative visual design — I regard footcandle levels, functional visibility, fixture types, locations and mountings as definitely secondary considerations — important, but secondary.

My approach now starts with the visual elements of the scene — or the space, if you will. I visualize the elements as objects hidden in the darkness. Then, I visualize the illumination patterns I will weave through and between and around them to create a visually stimulating scene — or, more accurately, a series of continuously flowing visual impressions to be enjoyed by people passing through the scene or the space. I seldom work with stock plans and often use custom fixtures or modified stock items to create the visual impressions which are my primary concern.

To generalize, I see professional lighting designing as dealing principally in the visually creative uses of illumination, whereas, lighting engineering deals principally with the functional aspects of lighting systems.

Q. Do you intend to imply that lighting engineering is not a creative process?

A. No. But, it is most often creative on a technological level, and I'm saying that the excitement



Brook Hollow Golf Club, Dallas, Texas

and the potential that I see in the future of the lighting art on the application level lies not alone in how successful lighting is in terms of usefulness but also in terms of how it interprets surroundings visually — how it fits or is adaptable to the mood of the place or the occasion or the people who use it.

Private residence, Fort Worth, Texas

Q. Surely you aren't suggesting that lighting engineers are insensitive to those considerations?

A. Yes, I am suggesting that, but only to the extent that lighting engineers are not artists in lighting. In carrying out the interior lighting commissions I have accepted, I've found it increasingly true that I have to evaluate discrete differences in needs that exist for lighting and if I don't evaluate the needs accurately, the owner or his interior designer will dictate the lighting job — in which case, they're almost certain to decide they don't need my services, or at best need them only for specifying technology. I have to be at least as creative in developing the character of the space in terms of illumination as the interior designer is in terms of decorating.

Q. Do you consider yourself in competition with the interior designer?

A. Yes, if he specifically designs lighting. But, I'd rather talk about the interior designer's counterpart in my area of specialty — the landscape architect. I don't need to point out that landscape architecture and landscape illumination are both highly specialized fields, and that the person who is fully qualified in both is a rarity. I'm one of those rare birds — a graduate landscape architect with a master's degree in landscape illumination — and I know from experience that it is physically impossible to work in both areas of the business

Queen Victoria Park, Niagara Falls, Canada

without sacrificing my standards of excellence, and I won't do that. The landscape architects I collaborate with deal first with the visual image of the scene they are creating and second with the technology they have to employ to establish the scene. If I am unable to deal with lighting in the same way — that is, first in terms of the creative concept of the scene, second in terms of technology — I can't collaborate. And I can't claim to be a professional lighting designer no matter how creative I may be in terms of implementation technology. Furthermore, because most of my jobs are installed long after the landscaping work is finished, it is important that I be able to interpret the garden in terms of the client's tastes and the ways in which he enjoys his garden. And he doesn't give a hoot about technology.

Q. You talk about illumination and about the "visual scene", and I get the impression you are thinking of illumination in the same terms that an artist thinks of his paint.

A. Exactly!! Exactly!!

Q. Aren't the "visual scenes" where light can be used in that fashion rather rare and specialized?

A. Wherever lighting is used it becomes part of the visual scene. Anyone who works successfully in the lighting field is somewhat sensitive to the appearance of a lighting installation; that's the basis I used as a lighting engineer for selecting a particular lighting style from among the standard lighting techniques. But, I find few lighting jobs that can't be made better by the kind of artistry I now practice and like to call "planned aesthetic lighting." That is, lighting planned to be both functional and interpretive — carrying it beyond

Private garden, Fort Worth, Texas

the "attractive appearance" stage to make the lighting effects vital parts of the total visual experience. When lighting I have designed simply illuminates something, I've made a mistake, and I change it so that the illumination interprets that part of the scene — I make it emphasize the sweep of a branch or the texture of a tree trunk or pick up the color of the foliage. At any rate, I make it do something more than simply light up the subject. It shapes and molds and models subject elements into the scene; and the illumination is always secondary to the subject and its place in the total scene.

Functional lighting doesn't generate enthusiasm, visual experiences do — and the enthusiasm of my clients has been the biggest factor in building my reputation as a professional lighting designer. After all, by way of comparison, a plumbing system is expected to produce water and that's not exciting, but the artistically planned play of water from a fountain is a stimulating visual experience.

Q. Not all of us are fortunate enough to deal with clients who can afford artistic fountains — or even the luxury of custom lighting schemes.

A. Artistry and luxury aren't the same thing. Luxury has no bearing on the discussion. We've just established the fact that lighting, wherever it is used, becomes part of the visual scene — hence, artistry is at least a valid consideration if not essential to every lighting job. And because I personally find the combined practice of both landscape architecture and landscape illumination to be physically impossible, especially since I insist that high standards of excellence be maintained in both fields, I can't believe that other major contributors to a project can afford to jeopardize their reputations and standards of excellence by extending themselves beyond their conceptual and physical limitations. Thus, if a client decides to make a major investment in electrical equipment and installation contracting services the question is: can he afford *not* to retain competent professional design talent? I have been called in to do-over enough gardens that I can assure you the question is not academic. And, I contend, the same applies not only for outdoor lighting concept and design problems, but for interior lighting as well.

Q. But, you're talking about the discriminating client who can appreciate the value of professional design services. Doesn't that severely limit your market?

A. NOT SO!! Those highly discriminating, and in some cases affluent, clients may be the first to employ a fully developed professional lighting design talent, but market size is not limited to the few individuals who can afford highly skilled workmanship for their private personal enjoyment. Market scope in the outdoor lighting field is more closely related to the numbers of people who can be served by the work produced. The exterior settings for large commercial buildings are a case in point. When I create, as I have, a distinguishing setting or architectural lighting design for a building which thousands of potential customers will see and enjoy, the cost per viewer is infinitesimal per favorable impression; and since favorable impressions are the prime purpose of the company's advertising and promotional function, the total cost of the job can be written off against the advertising budget.

Another major outdoor market area — also involving the numbers of people who see and enjoy the work of a creative lighting design craftsman — is that of municipal lighting for public facilities. Practically every community lights a ball diamond which is actively used by only a very small percentage of the community's population, counting both players and spectators. In fact, ball diamond lighting serves only a small percentage of the people who use the park. The primary use of

Southwestern Life Building, Dallas, Texas

Municipal park, Highland Park Township, Texas

public parks is by people who walk or drive through them for pleasure. The far greater numbers of people for whom a public park can be made more enjoyable will amply justify investment by the community in installations of lighting designed specifically for landscape illumination. Furthermore, lighted walkways, picnic areas, and shelter houses could conceivably make park facilities useable for greater numbers of people during much-extended portions of the year. And it goes almost without saying that the cost of lighting monuments and small civic beautification areas is almost nil per viewer when prorated against a heavy flow of passing traffic, and the payoff to the city is in enhancement of its image.

It's inconceivable to me that there is justification for building any structure or creating any environment for people to see or enjoy without professional consideration of illumination in the initial planning stages and in all the various subsequent stages of project development. If a public property is worth the cost to build and maintain, it should have a place in the community at night — by virtue of professionally designed lighting — *if* it will be seen and enjoyed by enough people to justify the cost.

When the investment in lighting is to be justified by the large numbers of people who enjoy it or are influenced by it, the importance of retaining a highly skilled professional lighting designer becomes great for several reasons: (1) The electrical installation must be thoroughly dependable and safe — avoiding hazards, of course. (2) Loss of favorable impressions through system failure, imperfect conception, poor design, or improper installation must of course be avoided — otherwise, the investment is not fully justifiable. (3) Of prime importance, and much more difficult to insure, is the satisfaction of the viewers, which has to be stimulated on an "Oh!! Ah!! Isn't it beautiful" basis, not just an "It's nice they put lights in" basis. A bland response doesn't really pay off in excitement for the taxpayers, and doesn't inspire the memorable impression the commercial user wants; so, in either case, whole-hearted justification of the investment may be lacking unless the installation incorporates important elements of lighting creativity.

Q. Outdoor lighting is a tremendously large field, but you must agree that most outdoor lighting that is done calls for treatments that serve strictly utilitarian purposes, and that only a very small percentage of it calls for the creative services of a professional lighting designer.

A. I can only partly agree with that. The lighting needs of the City of Dallas are pretty similar to those of most other cities, yet Dallas is the best outdoor-lighted city in the country largely because of the influence of the extensive creative work initiated by me, the Dallas Power and Light Company, and other people with professional interest in lighting. Most of the lighting that makes Dallas distinctive was not "called for" in utilitarian terms. Our downtown skyline demonstrates the kind of commercial response that creative lighting design can generate in the outdoor lighting field. Below the skyline, we can show you other distinctive jobs: the garden type lighting on the street corner plaza of the South-western Life Building in downtown Dallas is unique: the First National Bank of Dallas took a forward step in the community when

First National Bank of Dallas, Texas. Designed by George L. Dahl in association with Thomas E. Stanley.

they put lighting on their building facade that made possible the elimination of street lighting poles on their block, and incidentally, eliminated some street lighting expense to the city. Outside the downtown area there are many creative jobs — one, which I did on the Empire Central Building, has gained recognition internationally in magazine publicity largely because the lighting design was created specifically to interpret the handsome architecture. And the Empire Central Building

Empire Central Building, Dallas, Texas

and the City of Dallas have both been accorded more favorable impressions from that job than any client would reasonably expect from an outdoor lighting installation. And the interest in outdoor lighting is growing impressively. A Light-and-Sound show that is currently being planned as a free public performance for the Summer of 1968 in Lee Park on Turtle Creek, will further justify the

Skyline, Dallas, Texas

Dallas epigraph "best outdoor-lighted city." Public spirited citizens, the Dallas Symphony Orchestra, and the City of Dallas will cooperatively create and produce the show. Even now — in just the planning stage — the project is drawing international attention among both recreational and lighting interests.

Looking into the future, the new urban planning and redevelopment concepts that are rapidly changing and developing both old and new city areas call for more and more open spaces in the central city, more and more public areas in the suburbs, so, the potential for urban outdoor lighting in high-traffic areas for the enjoyment of large populations is growing into a field of major importance.

On second thought, I don't think I can even agree partly with the premise of your question — that most outdoor lighting is for utilitarian purposes, and that only a small percentage calls for professional lighting design services. I am convinced that the professional lighting designer's creative services are nearly always "called for" and can be immensely contributory. Basically I'm making the same point your company makes in the Lighting Institute at Nela Park about the prime importance of the visual quality of lighting design — emphasizing almost exclusively the effects that have been achieved; very rarely stressing the techniques utilized or invented to bring about the results.

I would emphasize that mere utilitarian function is hardly ever the ultimate goal of outdoor or indoor lighting design. No lighting jobs need be limited to the obvious and accepted lighting techniques and practices.

New at
Nela
Park

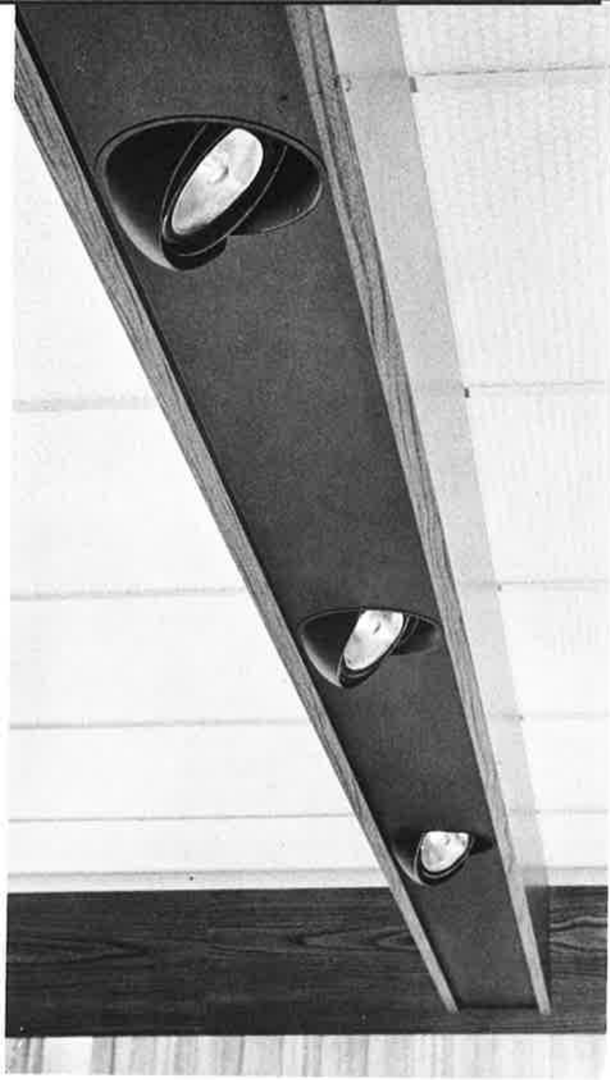
One Step Beyond

by **H. G. Williams**
Lighting Development, Nela Park

A step into the forseeable future of lighting design has been traditional with Nela Park's Commercial and Industrial Market Planning Managers. For the past thirty years they have occupied the same office in the Application Engineering Building. Three different lighting systems have been involved. Each has been well ahead of its time.

The step beyond in 1936 was a solution to the often objectionable ceiling brightness of indirect incandescent lighting systems (small photo, left). An ingenious design located lamps at the focal point of ceiling vaults shaped to form parabolic reflectors. The result was an almost-unheard-of 60 footcandle level of horizontal illumination with undreamed-of comfort in terms of ceiling brightness at the usual viewing angles.

In the 1940's the step was into the forseeable future of fully lighted ceilings (small photo, right) using the new fluorescent lamps behind plastic diffusers - the forerunner of many such installations and the precursor of many of today's sophisticated variations. The need for proper room surface reflectances to achieve brightness balance and visual comfort was also introduced as part of 1940's significant one step beyond.



50-watt PAR36 V-12 spot lamps in adjustable-aiming units recessed in a ceiling beam light points of interest in the room.

Occupant's view includes many visually interesting details highlighted by 50-watt PAR36 V-12 spot lamps. With the highlighting turned off and only the overhead lighting remaining, the room loses both interest and visual comfort.

Stepping into tomorrow today, the same office (large color photo) has new sources, new concepts, contemporary design, control of radiant heat energy, and advanced applications of brightness controls—all built into a total environment where unity and variety (See, Unity with Variety, R. T. Dorsey, LIGHT, Vol. 36, No. 2, 1967.) add refreshing visual stimulus to complete working comfort.

Four different lamp types come into play. Lucalox and Deluxe Cool White fluorescent lamps are combined to produce a pleasing 250 footcandles on the desk area, about half the optimum value for office work; fluorescent lighting illuminates the remainder of the room's horizontal surfaces to 60 to 100 footcandles; V-12 lamps highlight a painting, sculpture, planter and pottery with the dual purpose of

At his desk, Mr. R. J. Diefenthaler, GE Large Lamp C&I Market Planning Manager, works with 250 footcandles from two 400-watt Lucalox lamps and twenty 40-watt Deluxe Cool White fluorescent lamps. 50-watt R-20 lamps light the draperies.

A view of the lighting cavity over the desk, with the parabolic wedge louvers removed, shows the combination of 400-watt Lucalox and F40 Deluxe Cool White lamps. All of the light from the Lucalox lamps is reflected from the cavity ceiling to minimize shadows and reflections on the seeing tasks. Room air is drawn through the louvers and through the perforations in the cavity ceiling. The air picks up part of the lighting heat, reduces the cavity temperature and prevents the development of uncomfortable radiant heating effects.

giving the occupant both balanced brightnesses and interest within his field of view; 50-watt R-20 lamps illuminate the draperies.

Over the desk, on which the illumination approaches optimum quantity, parabolic wedge louvers provide the optical control necessary for comfortable luminaire brightness. Plastic louvers are used in other ceiling areas. One aspect of Electrical Space Conditioning is employed in the form of air return through that portion of the lighting cavity over the desk, which is most heavily loaded. This keeps much of the lighting heat out of the occupied space preventing discomfort from radiant effects.

This is a total-interior design. It involves controls that have been applied to create non-uniform brightnesses within the acceptable range of visual comfort. It involves highlight and shadowing effects that reveal textures and surfaces. It involves a visually satisfying composite of various source-color effects. The source-color effects, the brightness controls, the directional controls, are all inseparable from the interior designer's usual concerns with materials, colors and styling. The total effect created here combines Nela Park lighting engineering skills with the visually-creative skills of interior designer Leon Gordon Miller — a kind of synthesis of visual-environment-creating skills that will be of key importance to interior/lighting design of the future.

Vital to the visual quality of this interior design is the part that lighting has been designed to play in revealing the textures, colors and finishes of the surfaces and decorative objects.

The locomotive at left has just pushed the last of a string of cars over the "hump," the key physical feature of the new N&W Bellevue, Ohio, classification yard. Down far side of "hump" cars roll into one of forty classification tracks. Track choice, rolling speed, switching, coupling speed, are among computer choices based on data that computer "knows" or can "learn" about car, load, shipper, weights, destination, train make-up.

Acres of Light...

AN INNOVATION ON THE N&W

by **R. L. Henderson**
Special Lamp Applications, Nela Park

Computers and automated mechanized systems are blind. They can function without light. Even so, the new automated computer-operated freight classification yard of the Norfolk and Western Railway at Bellevue, Ohio has been equipped with good lighting generously distributed throughout. The N&W's objectives are: customer services, with speed and efficiency; and safety, for the people who work in the yard.

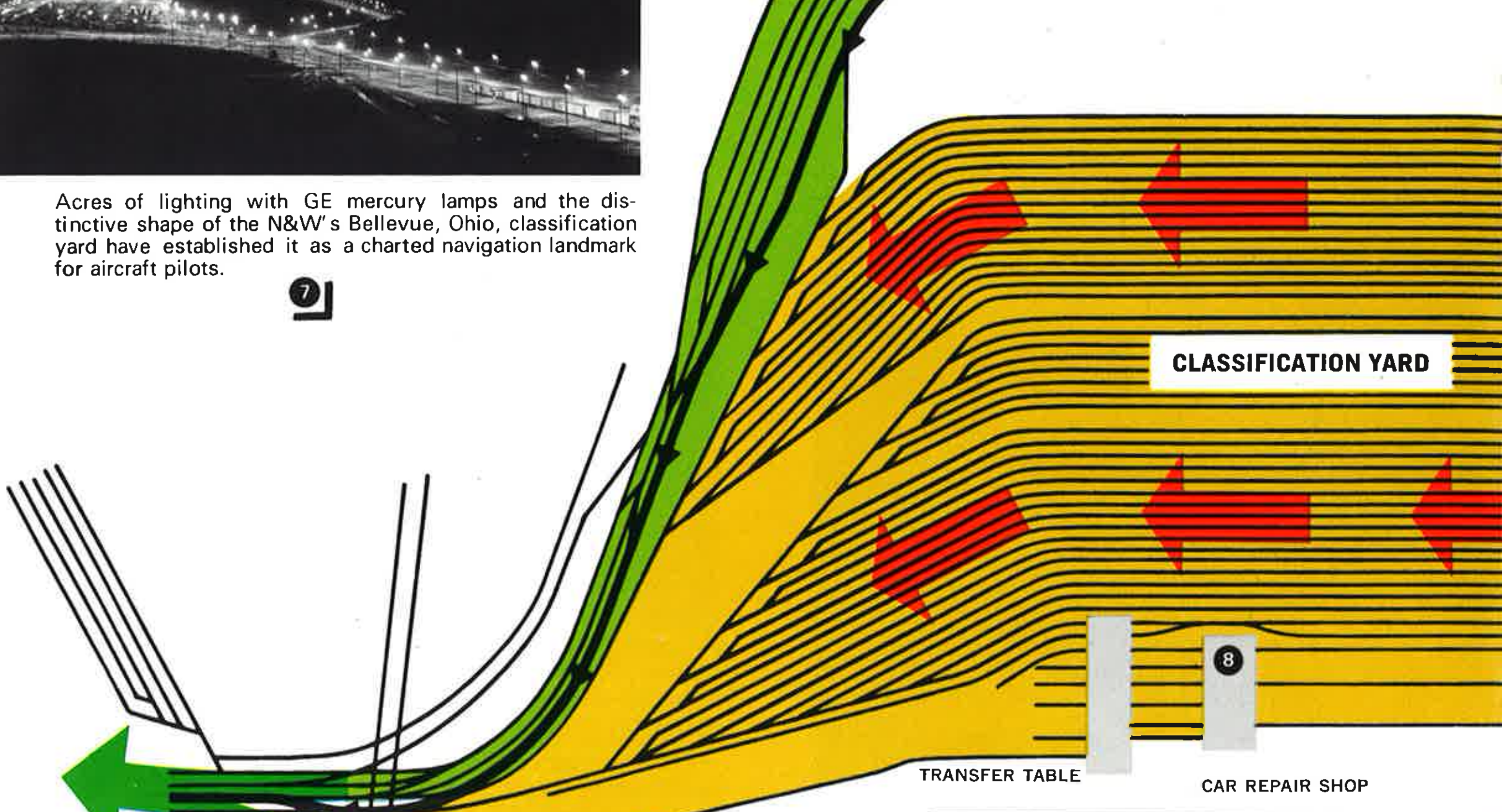
The unification in 1964 of three roads — the Nickel Plate, Wabash and Norfolk and Western — increased by about 26% the freight traffic through the Nickel Plate's old yard adjacent to the new N&W yard. Lines of the three combined roads converge on the yard from seven directions. The Nickel Plate's old yard was strained far beyond its potential for modernization when it became the hub for the N&W's movement of more traffic in more directions with emphasis on more speed, more efficiency and more safety.

On a 3½-mile-long 450-acre site, the new N&W yard more than doubles the former Nickel Plate yard facilities. Eighty-one miles of new track include 40 new classification tracks holding 50 cars each; new departure yards for 1,000 cars westbound, 400 cars eastbound; new running tracks east- and westbound; plus new holding tracks for incoming cars. And more than 1400 1,000-watt mercury lighting units, installed on average 150-ft. centers, light all trackage areas to average levels ranging from 1 to 20 footcandles depending on seeing tasks.

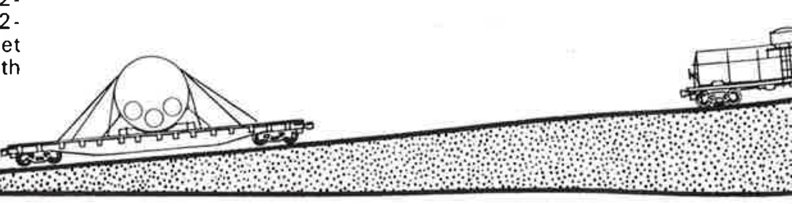
The freight classification yard — where incoming cars are sorted according to destination for make-up into new outbound trains — is the point to which shippers most often trace delays; where the carrier's reputation with the shipper is most often made or lost. A total of ten thousand cars is daily handled through the new N&W yard, with frequently more than 3000 of them requiring classification. The N&W's objective is always to cut as many hours as possible off the terminal time per car for two reasons: to perform a successful operation for the customer by making earliest-possible delivery of his shipment, and, to get foreign-line cars off N&W lines and reduce per diem charges.

Some railroad yard operations will probably always remain beyond the limits of practical automation because they require human skills, judgments, and visual supervision. As yards grow bigger and traffic heavier, the automated performance of regularly repeated routine chores becomes an in-

Acres of lighting with GE mercury lamps and the distinctive shape of the N&W's Bellevue, Ohio, classification yard have established it as a charted navigation landmark for aircraft pilots. 7

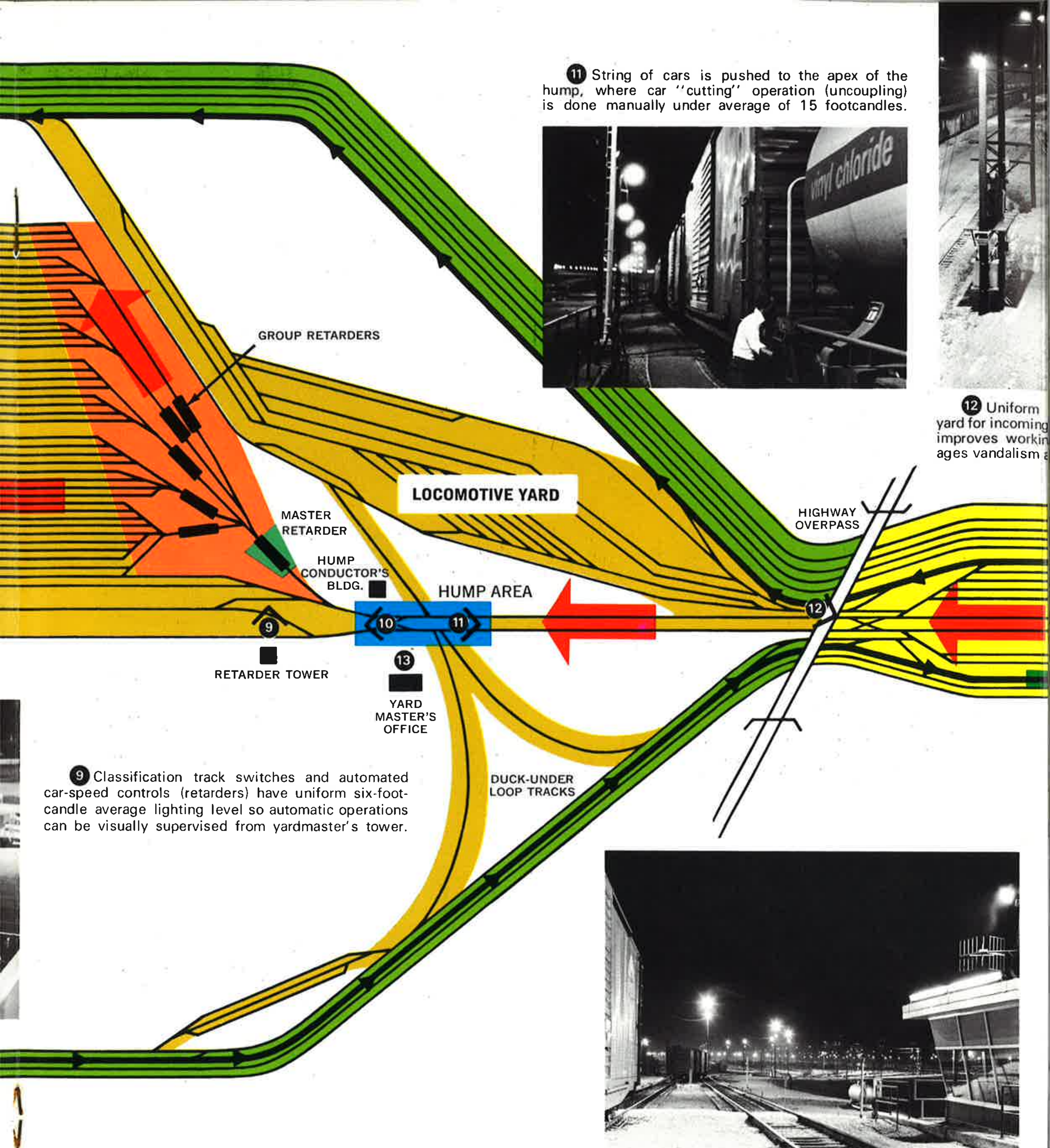


8 General lighting in car repair shop is 100 footcandles with 2-lamp units for 8-ft Power Groove lamps in continuous rows at 32-ft height on 25-ft centers. Two-lamp units on side walls are 12 feet up. Pit lighting (inset) is 100 footcandles on underside of car with 300-watt PS30 lamps in wall recessed units.



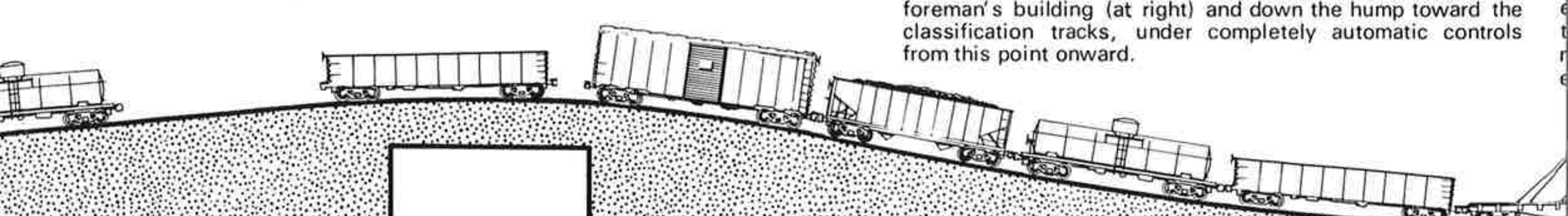
⓫ String of cars is pushed to the apex of the hump, where car "cutting" operation (uncoupling) is done manually under average of 15 footcandles.

⓬ Uniform
yard for incoming
improves workin
ages vandalism



❾ Classification track switches and automated car-speed controls (retarders) have uniform six-foot-candle average lighting level so automatic operations can be visually supervised from yardmaster's tower.

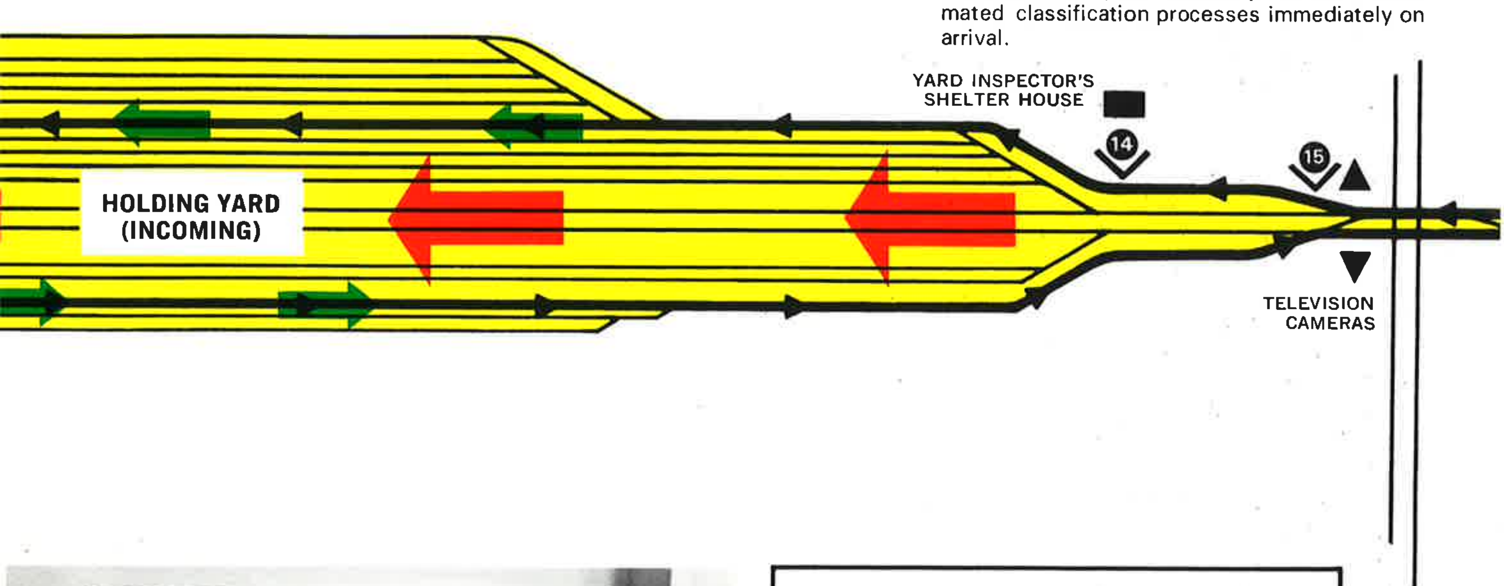
❿ Cars "cut" from a car string roll past the hump foreman's building (at right) and down the hump toward the classification tracks, under completely automatic controls from this point onward.

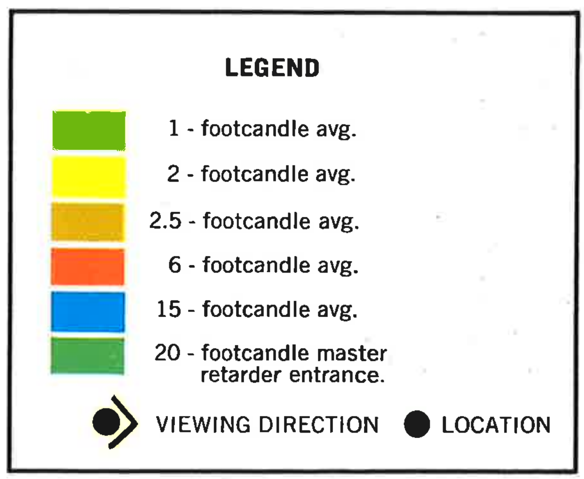


overall lighting in holding
g cars increases yard safety,
ng efficiency, and discour-
and pilferage.

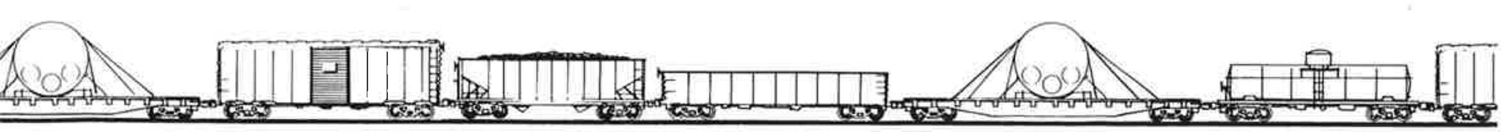
14 Detection of bad-order equipment avoids undue customer delays. Three 500-watt GE Quartzline lamps light car underside rigging from track-level mountings on 10-ft centers. Nearest track gets 50 footcandles; second track gets 25 ftc.

15 Lights. Camera. Action. Scene: yard entry point. Subject: numbers on incoming cars. Closed-circuit TV camera is on pole just below lighting units. Cars are number-checked into yard inventory to start automated classification processes immediately on arrival.





13 Incoming car numbers are transmitted from east and west yard entrances by closed-circuit TV. Immediate checking against advance train-consist list starts classification process and speeds car movement. Video tape recorder, in foreground, records one of simultaneous dual arrivals for replaying at clerk's convenience.

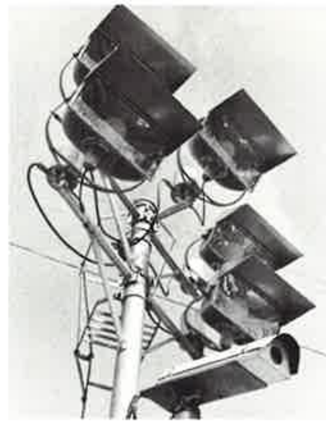


The new 3½-mile-long portion of the N&W Bellevue, Ohio, classification yard encompasses space, within eastbound running-track loop to right, to permit doubling present number of classification tracks.

creasingly necessary economy. Automation inevitably brings with it a need for more and better lighting for a number of reasons: to make operations clearly visible from supervision points, even at some distance away; to avoid errors, especially of the very costly domino-chain type which tends to multiply and rapidly diffuse throughout automated operations; to make free-rolling cars and remote controlled equipment clearly visible to yard workers; to make malfunctioning equipment readily detectable.

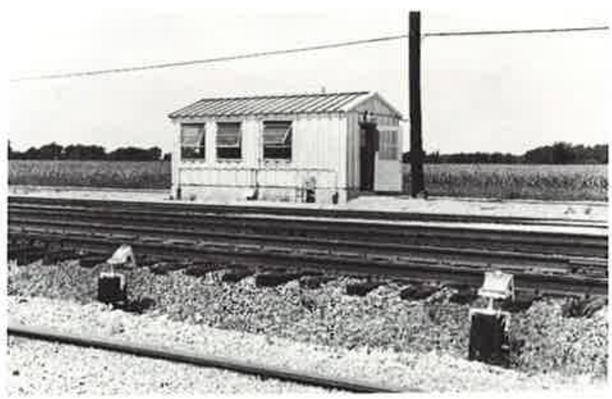
At Bellevue, the N&W has found that their electric energy demand for the large and extensive lighting system has given them the advantage of a low base rate per KWH for additional power requirements. The low-cost additional power converts easily into high-value operational efficiency: for example, electric heaters for snow and ice melting installed on all yard switches release countless man hours for more skilled work, and more effectively keep switches operational in cold weather.

Because freight rates are under tariff regulations, rail freight operating cost increases are often met successfully with increases in operating efficiency. And for the same reason, rail freight competition focuses not on rate charges, but on the efficient performance of services to customers. And Mr. J. M. Hesser, Asst. Mgr., Signals and Communications, has said about the N&W Bellevue Yard, " . . . . the high level of illumination has undoubtedly contributed to over-all efficiency."



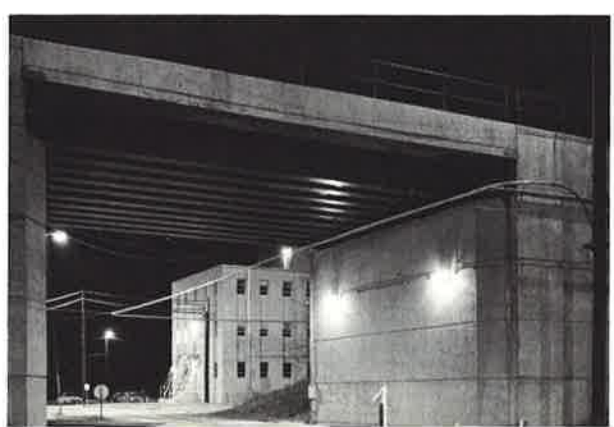
Five 1,000-watt mercury lamp fixtures clustered above a closed-circuit TV camera put 200 foot-candles on sides of incoming cars for video transmission of car numbers to yard master's office from both east and west yard entrances.

Standard floodlighting fixtures are used for general area lighting. Street lighting types of fixtures are used in perimeter areas to control light distribution, avoid excessive spill. General mounting height of fixtures is 50 feet.



In foreground are two of three lighting units mounted at track level for under-car inspection of moving cars. Mountings are offset from unit mountings in background (at base of building), so inspectors don't face opposing inspection lights.

Units for underpass and building-exterior lighting (at building entrances and stairways) are for 175-watt GE mercury lamps, selected for efficiency and long life.



The fast-moving game of hockey required more light than the former incandescent lighting system provided on this rink at Brown University. Half of the incandescent fixtures were replaced with Deluxe White Mercury units to produce over three times the illumination.

Sports Indoors...

IN THE THIRD AGE OF LIGHT

by **H. G. Williams**
Lighting Development, Nela Park

Players aren't much different from spectators in the sports world today. Players in one sport are fans of another; and fans are often players in the same sport on a different level. With increasing leisure time, fans are increasing in numbers and increasing their indulgence. And TV has extended the spectator's stands from the edge of the field across the face of the earth. Fans are more sophisticated, the watching audiences are larger, the seeing requirements are more critical, and lighting is far more important than ever before to the operation of sports facilities.

Now is a good time for a hard look at the ways in which indoor sports lighting can better serve a sporting public grown larger and more demanding. The advantages that the new Third Age of Light sources and techniques offer are perhaps greater for indoor sports than for any other area of lighting application.

The new high intensity discharge (H.I.D.) lamps — Lucalox, Multi-Vapor, Deluxe White Mercury — as well as Quartzline lamps, can effectively project light down from high ceilings. The more efficient sources now make it economical to supply the quantities of illumination needed for the fast play found in many sports, benefiting players and spectators alike. Games can now be televised in color with relative ease using the newer sources. Where a variety of events may be held, modern lighting techniques can provide the lighting flexibility for any situation.

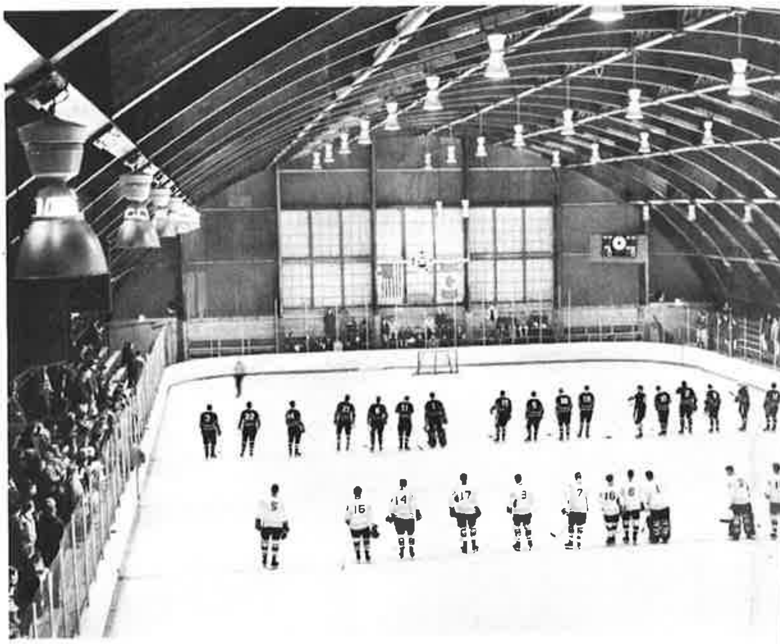
The Large Arena

The arena may have a basketball game one night, a track meet the next; on other nights a boxing match, an ice show, a hockey game, a rock and roll concert. At still other times, exhibits may be set up for trade shows. So, versatility is an important consideration.

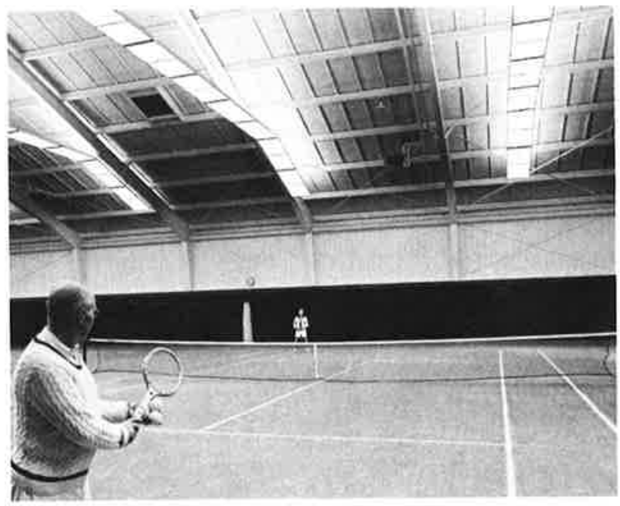
The playing area should be treated as a stage, with the lighting planned to highlight any event taking place. Narrow-beam lighting equipment can be used and switched in patterns to permit localized lighting on the court, ring, or track. Fixtures may also be equipped so they can be lowered to light smaller areas — and, incidentally, the lowering feature is handy for maintenance. If narrow beam reflectors are used, some of them should be angled in 30° to 45° from the vertical to build up vertical surface illumination both for television coverage and spectators' visibility. When using this approach, be sure to appraise the spectators' viewing angles to avoid glare.

A combination of high intensity discharge lighting plus Quartzline lighting on dimmer control can provide flexibility for nearly any lighting requirement. Follow spots and other stage lighting equipment can always be added for additional needs. A high intensity discharge lighting system should include some incandescent or fluorescent lighting, at least over spectator areas, because HID lamps do not restart immediately when power is restored after an interruption (See Table). The restart time should also be considered if HID lamps are to be switched off for half-time activities.

High intensity discharge lamps in suspended industrial luminaires will usually work well for arena lighting. They will do a good job if the source is shielded to at least 30° from horizontal and if there is at least 10% uplighting. Better shielding and more uplight would be desirable since the line of sight for the players of many arena sports is often above horizontal. If there is a suspended ceiling, HID equipment is available for recessing.



In the Middlebury College fieldhouse Lucalox lamps in industrial equipment unitized with the ballast replaced 500-watt incandescent units, raising the illumination level from 20 to 85 footcandles without necessitating complete rewiring.



Four-lamp Power Groove louvered equipment lights these indoor tennis courts to 100 footcandles. While fluorescent lighting, with its low brightness, will generally not bother the player when serving or when following high lobs, the luminaires should ideally be located at the sides of the court. Greater care is required in choosing locations for direct high intensity discharge lighting equipment. Indirect lighting should also be considered for indoor tennis — particularly with Lucalox lamps or combinations of different high intensity discharge lamps.

Lighting appropriate for any occasion is practically guaranteed in this gym-auditorium by the various lighting systems installed here. High Output and Power Groove fluorescent lamps in recessed equipment supply the quantities of light needed for sports events and physical education. Cove lighting and dimmer-controlled downlights are brought into use during stage presentations or on other occasions when low-level lighting is needed.

Arena events are usually billed as spectaculars. Levels of illumination much higher than IES minimum recommendations are, therefore, appropriate. And, because arena seating usually extends to a great distance from the action, more light will make seeing easier and more enjoyable from the more distant seats.

The Gymnasium

The school gymnasium is typically the place for basketball games, assemblies, dances, and daily physical education instruction. Television pickup from the high school and college gymnasium is becoming common. This variety of activities, as in the arena, requires attention to lighting flexibility.

Fluorescent lighting or high intensity discharge lamps in wide spread reflectors (which can be industrial types in either case) are appropriate for the basic lighting system in the gymnasium. Often the gymnasium size and scope of activities approach those of the arena, in which case the arena lighting considerations mentioned above should be observed.

Two levels of general lighting may be found very useful — one for spectator sports, the other for physical education and assemblies. Separate switching of every third or fourth lamp will work if the system has been planned for uniform coverage with just one-third or one-fourth of the lamps operating. A good solution with fluorescent lighting is Power Groove lamps on Hi-low ballasts. The next step is to add well-shielded incandescent downlights on dimmer control for use during movie or slide projection or for such occasions as the school dance.

Televising Indoor Sports

If color television pickup can be expected in the arena, fieldhouse, or gymnasium — which usually seems likely — illumination levels on the order of 150 to 250 footcandles *in the vertical plane* are presently being called for. Produced by overhead lighting alone, this would result in horizontal illumination somewhere between 300 and 600 footcandles. While incandescent lighting of 3000K to 3200K color temperature is currently preferred by the television industry for best color rendering, both the heat and operating costs resulting from an incandescent system producing these levels would probably be excessive.

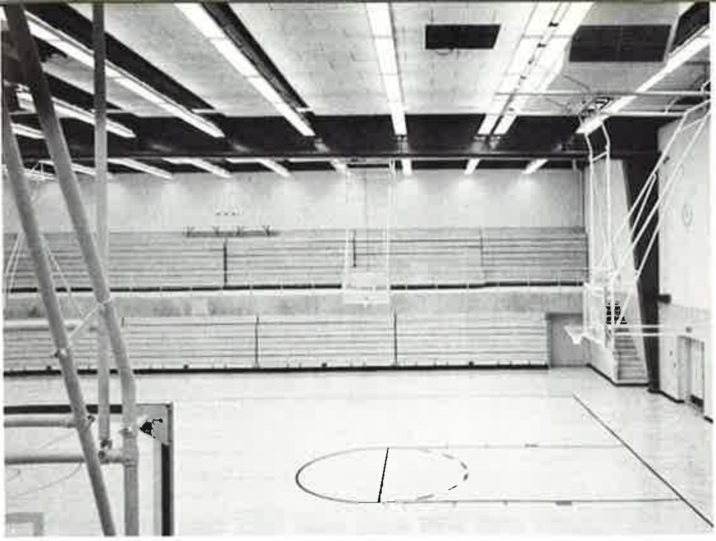
Television tests have been conducted using high intensity discharge (H.I.D.) lamps showing that indoor sports can be successfully televised under any of the H.I.D. sources — Lucalox, Multi-Vapor, Deluxe White Mercury — under combinations of them, or under combinations with Quartz-

1. Two-level switching of the fluorescent lamps in this gymnasium can meet the lighting requirements both for spectator sports and for the physical education classes. The high level is 250 footcandles, low is 75 footcandles. Note the double row of luminaires at the basket to supply extra light where the most action is.

2. In today's sports arena the effect of the lighting on television pickup capability should be considered. Vertical surface illumination becomes very important — especially for the camera on the floor.

3. A cross-section of a basketball court lighted for color-television camera pick-up. High intensity discharge lighting overhead is supplemented by Quartzline lighting at 45° angle to fill in shadows and raise vertical surface illumination levels.

4. Freedom Hall in Louisville, Kentucky, is lighted by a new system of 1000-watt PAR64 Quartzline lamps in recessed, baffled downlights (small circles in ceiling) plus the original lighting system of standard 1000-watt lamps in recessed reflectors (larger circles). The Quartzline system provides 150 footcandles; the old system — usable for practice — gives 30 footcandles. Because of its ability to project light down efficiently from the 60-foot-high ceiling, Quartzline lighting is a low initial-cost system.



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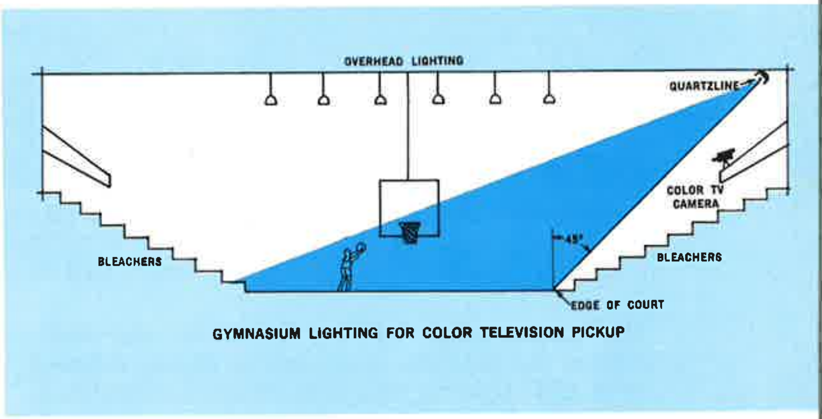

3

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The University of Georgia Coliseum uses 1000-watt Mercury vapor lamps in the circular and diamond-shaped units over the arena. Linear Quartzline and fluorescent lamps provide the indirect lighting at the perimeter. Appropriate switching of these systems can produce lighting for a great variety of events.

line supplementary lighting. While the color rendition on the television screen may be slightly different with HID lighting than with incandescent lighting, the color is generally acceptable for sports events. Where color rendition is critical, the network or local television people should be consulted on light-source choice.

The television color resulting from fluorescent lighting can be expected to be at least as acceptable as from the HID sources, since the spectral distributions of fluorescent lamps are more continuous than those of HID lamps.

The conclusion to be drawn, since the color rendition from discharge sources is generally acceptable, is that greater economy and more tolerable heat levels are obtained with a discharge lighting system; probably making it a more logical choice than incandescent lighting for indoor sports.

Lighting schemes for televising indoor sports could take several forms — depending on the sport, the structure in which it takes place and the amount of televising expected.

If color television pickup is only occasional, the following solution should be considered (see sketch): Use conventional overhead HID lighting in good industrial equipment — Lucalox will probably be most economical — to produce 150 to 200 footcandles of horizontal illumination, 50 to 100 footcandles vertically. Quartzline incandescent lighting from the side is then added to fill in with an additional 100 to 150 vertical footcandles. The side-lighting can be linear Quartzline lamps in outdoor floodlighting units, Quartzline PAR lamps in conventional housings, or portable television lighting equipment. In any case, the lamps should be shielded from the view of the spectators on the opposite side.

If a great deal of color television is expected, a complete HID installation should be considered, including HID luminaires for the side lighting aimed in toward the event. Here again, Lucalox lamps would ordinarily be most economical.

The Future of Indoor Sports

Such traditional outdoor sports as tennis, baseball, and football are moving indoors because of the controlled environments that provide comfort and good visibility for players and spectators. The Third Age of Light is bringing new tools and new techniques that will help speed this move.

CREDITS

LIGHTING DESIGNERS:

Jason H. Cohen, Brown University rink, Pg. 14

Willard Thompson, Middlebury College fieldhouse, P. 15 top. Gymnasium, Pg. 17 top left. Dartmouth College, Leverone Field House, Pg. 19 top right.

Kirk M. Reid, tennis courts, Pg. 15 bottom.

Alfred A. Binder, gym-auditorium, Pg. 16.

I. K. Isaacs, Freedom Hall, Louisville, Ky., Pg. 17 bottom left and right

Bush, May, Williams and Associates, University of Georgia Coliseum, Pg. 18.

Sylvan R. Shemitz, Yale University exhibition pool, Pg. 19 top left.

The exhibition pool at Yale University is lighted generally by 1500.watt linear Quartzline lamps in standard outdoor floodlight units recessed in what was formerly a skylight. 500-watt Quartzline PAR56 narrow-spot lamps highlight the diving boards and the ends of the pool. Three-level selection of 208, 240 and 277 volts on the 240-volt linear Quartzline lamps supplies lighting for practice, exhibition, and television purposes, respectively. Note the good visibility of the bottom of the pool with underwater lighting.

Quartzline and Power Groove lighting are used together in Dartmouth College's Leverone Field House to give the lighting flexibility for a variety of activities.

Some of the considerations involved in light source selection for indoor sports lighting are listed below. The relative cost figures will change for conditions other than those assumed. For example, fluorescent lighting will cost less when used at lower mounting heights, Quartzline will cost relatively less at higher mountings.

LAMP	Relative Annual Cost* Owning	Operating	Total	Control Capability	Restart Time†	Color Acceptance
Lucalox	1.0	1.0	1.0	Switching Only	1 minute	Fair
Multi-Vapor	1.2	1.4	1.3	Switching Only	10 minutes	Good
Deluxe White Mercury	1.1	1.6	1.4	Switching Only	7 minutes	Good
FLUORESCENT	1.0	1.6	1.3	Hi-low (F40&PG) Dimming (F40)	Immediate	Good to Excellent
QUARTZLINE	1.2	3.5	2.6	Dimming	Immediate	Excellent

*Based on following assumptions:
Equal horizontal footcandles for each system.
Cost of all wiring for the lighting is included.
Room cavity ratio = 1.0
Ceiling, wall, floor reflectances = .70, .50, .20, respectively.
Electricity at 2¢ per KWH.
2500 burning hours per year.

HID sources are all 400-watt in industrial luminaires.
Fluorescent system uses Power Groove lamps in industrial luminaires.
Quartzline system uses Q1000PAR64 lamps.
Group relamping and annual fixture cleaning.
†Approximate time elapsed before the arc restrikes after a momentary power interruption.

Seeing Texture

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

From experience you know a lot about the things you see about you: you know how smooth and soft a child's cheek is without touching it; you know wood is not so hard and cold as marble; and you know that the touch of fine silk is more pleasant than the touch of coarse tweed. We get accustomed to painted surfaces fading under intense light. Yet flower petals retain their brilliant colors even under intense sunlight. While our eye can detect bold changes in shape, size and texture of the things we see, it is often the microscopic structure which the eye cannot see that determines the final appearance of the surface.

Designers of lighting and interiors learn to select materials that have known-and-accepted appearance qualities. Through experience they also learn the type and position of the light sources which will produce the most desirable visual effect. In interior design, however, there is a growing use of synthetic materials for either floor covering or surface laminates. For the most parts these materials are designed to duplicate the overall visual appearance of known materials. Because these materials have either better qualities or are lower in cost than the natural materials which they replace, their use is bound to increase. We are, therefore, faced with the opportunity of designing materials for specific surface qualities. Not only in creating a final visual appearance but also in controlling the way in which they reflect light. The actual surface structure can, therefore, be designed either to match closely the appearance of a natural material, or to have specific properties of its own. This will be done by controlling the geometry and light reflecting characteristics of the surface to conform specifically to the requirement of the visual effect.

So far, however, many imitations of natural materials have fallen short of duplicating exactly the materials that they were intended to imitate. This is mainly because they don't reflect light in the same way as the natural surface. Light and surfaces react to each other in different ways depending on the type of light source and the specific nature of the reflecting surface. Microscopic examination can very often show why. For instance, there is a good reason why flower-petal colors stay bright, and vibrant even in the intensity of direct sunlight while colors of painted surfaces seem to weaken and fade as the illumination level is increased. A flower petal's surface is made up of a pattern of circular lenses or prisms too small to be seen without magnification. They are shown in the accompanying diagram (Fig. 1) and the photograph magnified about 30 times. Surprisingly, despite the fact that a flower petal may look richly colored, each prism has very little visible color with which to affect the light that enters it. All of the light that strikes a flower petal either enters the prisms or the spaces between the prisms and is reflected repeatedly within the petal's structure. Each of these reflections strengthens the color resulting in the bright colors we see. The brighter the sunlight, therefore, the brighter will be the flower's color, since the flower petal is designed specifically to produce bright colors under direct sunlight. Because of the nature of the surface geometry there is very little area on the surface of the petal that is capable of reflecting light directly. This is the main difference between the surface of a flower petal and a flat painted surface, and is the reason why painted surfaces tend to wash out. Light reflected directly off the surface is not modified by the surface's color, hence it tends to dilute the color reflected from within the surface.

A variation of the flower petal structure is used in the reflective sheeting made for highway signs (Fig. 2). Small transparent glass beads are embedded in a layer of pigment. Light enters through the bead, is reflected off the pigment, and due to the optical nature of the bead is retroreflected (reflected back in the direction from which it came). The reflected light comes from both the back side of the bead and the coloration in the pigment directly in contact with it.

The specially useful property of a reflective sheeting material is its retrodirective characteristic; it reflects light back in the direction of the source in greater amounts than other types of materials. Unlike the flower petal, there is relatively little interreflection within the surface.

One way of avoiding the high degree of specular reflection from flat-surface finishes is to introduce some configuration to reduce the amount of flat-plane area. One approach which is used to create a velvet appearing surface is the use of paint consisting of millions of microscopic colored beads (Fig. 3). These are mixed into a liquid binder. When the binder dries a pebbled surface is formed; its color is dependent on the mixture of colored beads. The beads are roughly similar in size and

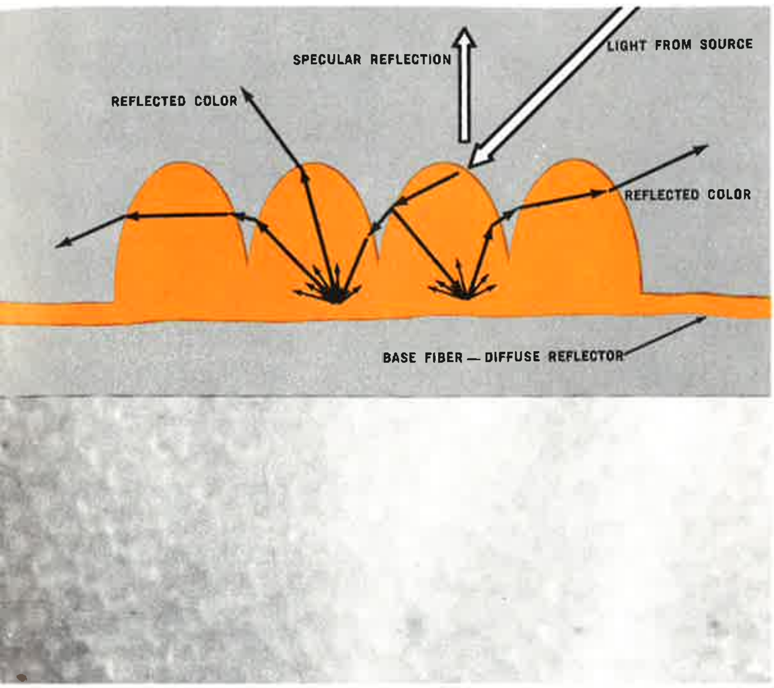


Fig. 1

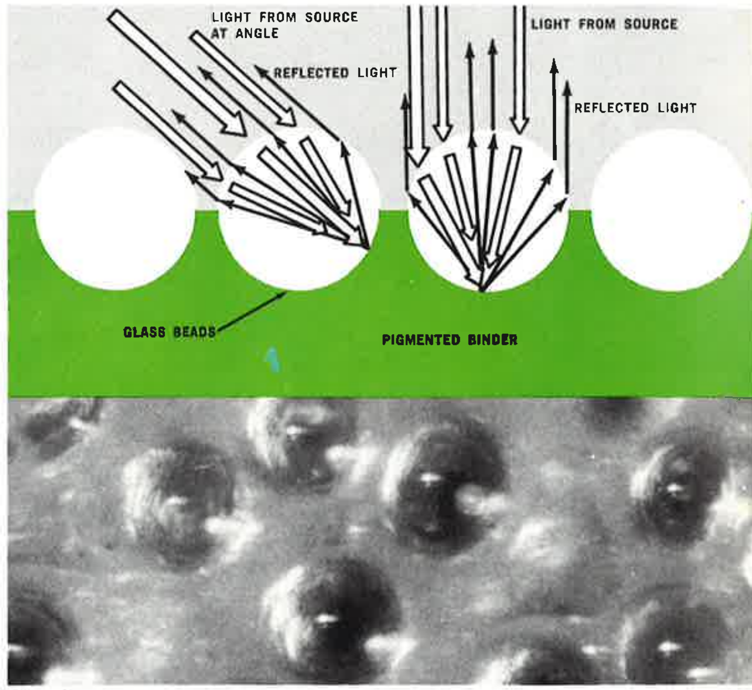


Fig. 2

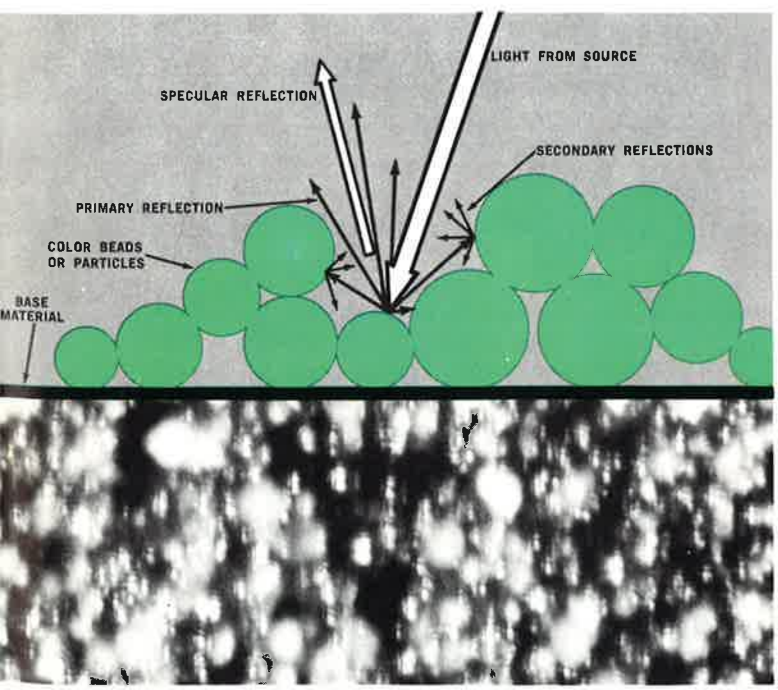


Fig. 3

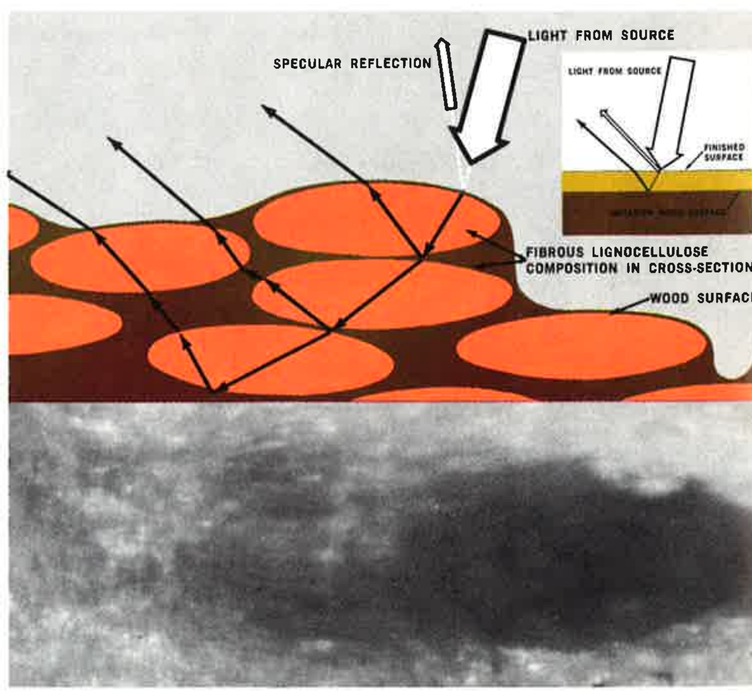


Fig. 4

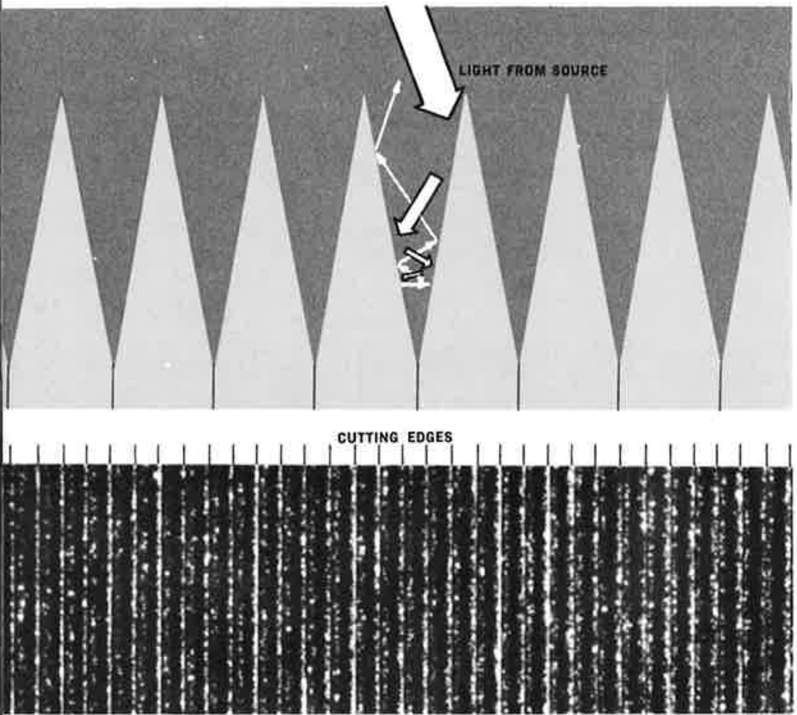


Fig. 5

shape to the lenses of the flower petal but differ in that they are not very transparent. Light enters only the outer surface of the bead and is diffused and reflected within the spaces between the bead helping to produce the blending and saturation of the color. Also, because the beads are round there is only a very small portion of the top of the bead that reflects light directly back from the surface. This not only creates the velvety appearance but also substantially enriches the colors that can be produced.

In recent years, many manufactured surfaces have been made which duplicate the appearance of wood. Surface laminate materials, such as Textolite, have improved steadily over the years. Sometimes close examination is necessary to see the difference between this material and natural wood. The main problem, however, is the basic way wood reflects light. Wood is a combination of translucent cellulose fibers and a natural binder (Fig. 4). The light readily penetrates the wood grain surface. Reflections from sub-surface structure combine with surface reflections to give the luster and warmth that we associate with wood. Imitation wood surfaces are smooth or lightly textured and practically opaque. Under much of interior general lighting the subtle differences in the way that natural wood and laminated surfaces reflect light is lost. When lighting techniques are used specifically to emphasize the grain of the wood, the differences become much more obvious. Some effort has been made to use wood veneer instead of manufactured finishes on outer surfaces of laminates because of its rich visual qualities. However, the damaging effects of heat, stains and bruises have been a major problem.

Surface sheen is a dead giveaway in many manufactured surfaces; as we have mentioned, it can be reduced by changing the geometry of the surface to reduce the percentage of flat surface area. At the extreme, an example of a surface that has no flat area is produced by a stack of new razor blades when viewed against the edge (Fig. 5). Since the edge of a new razor blade is microscopically small, the eye can not perceive any light reflected directly off its surface. All light reflected from the stack of razor blades is reflected from within the V-slot between individual blades. As can be seen in the diagram, light returns only after multiple reflections within the V-shaped space. Since steel reflects only 60% of the light that strikes it, most of the light is absorbed within the cavity producing an extremely black surface. The only place where it appears bright is where the edges have been damaged. This is the method used in the factory to inspect blades. While it would be impractical to make a surface by laminating sharp-edged pieces, this example suggests that prisms or V-shaped slots cut or molded into an otherwise flat surface can be used for control of the direct surface reflection.

A substantial amount of work has been done in the textile industry to control the ways in which fibers reflect light. Cross-section configurations and light transmission characteristics of fibers control the amounts of sheen or brilliance associated with the various fibers. By changing cross-sections and altering transmission characteristics of fibers, it is possible to manufacture one type of fiber with a high sheen suitable for stockings, and another fiber with a low-sheen soft appearance desirable for carpeting. While the basic fiber material may be the same, the visual appearance is quite different. Fibers used for stockings are circular with a relatively broad reflected highlight running the length of the fiber, and the fibers are quite transparent to enhance color properties and sheen by retrodirective reflection. A special fiber developed for carpeting has a trilobal cross-section, roughly similar in shape to a three-leaf clover, which reduces the breadth of the reflected highlight to a very narrow band relative to the size of the fiber and markedly reduces retrodirective reflections. Control of the size and brightness of the reflections through the control of fiber shape alone gives one fiber a soft lustre, the other a crisp sheen.

Early technology in the creation of manufactured surfaces was largely limited to creating "pictures," for example, of wood grain on surfaces to simulate wood appearance. Various methods for applying many kinds of texture in combination with "picture" impressions have improved surface simulations; so have the processes for applying and controlling pigmentation. Still open to exploration by concerned manufacturers is a tremendous range of possibilities for further development of specific textures, surfaces and finishes through alterations in surface geometry, control of light diffusion and refraction from the surfaces, and use of materials with specific light and color transmission.

New Products

STAYBRIGHT* and MAINLIGHTER* NEW 40-WATT FLUORESCENTS

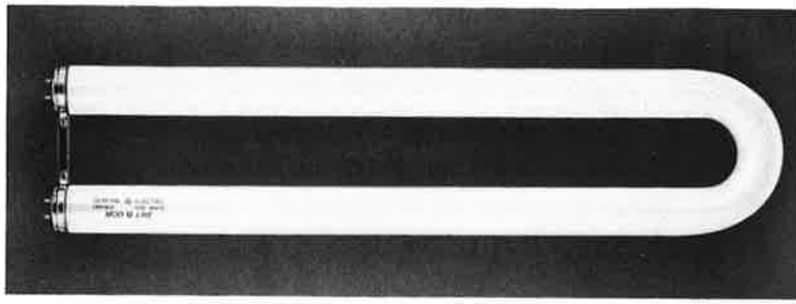
MAINLIGHTER FLUORESCENT LAMPS, the new standard 40-watt lamps, combine the high light output characteristics of 3 PLUS lamps with the long life and economy-of-operation features of /54 lamps offering: more light initially than any *standard* 40-watt fluorescent; lowest operating cost; wattage consumption that is at least as low as any other 40-watt fluorescent; and the same low standard-lamp list prices — $1.12 for Cool White, ranging to $1.30 depending on color choice.

STAYBRIGHT PREMIUM-TYPE FLUORESCENT LAMPS offer even higher light output (3200 lumens initially); better lumen maintenance (95% at 3000 hours); about 3% lower cost of light in typical applications; plus clean sparkling appearance because new internal design electrostatically collects 90% of the particles that normally cause bulb blackening. Bulb walls stay cleaner, and end-blackening is ended. List prices, depending on color choice, are $1.29, $1.45.

TUFF-SKIN LAMPS

New Tuff-Skin lamps have silicone rubber coated glass bulbs that greatly increase resistance to thermal and mechanical shocks. Eleven types available in regular- and rough-service designs, 25- to 200-watts. Silicone rubber jacket retention of glass-breakage splinters makes Tuff-Skin lamps ideally useful where foods, beverages, drugs are graded,

handled, processed. New thermal shock resistance makes them ideal exposed to liquids or welding spatter indoors or out. Uses are in construction, ship building, food processing, mining, oil industries and others, used car lots, amusement parks, decorative lighting, other exposed conditions, and in the home.



MOD-U-LINE† FLUORESCENTS

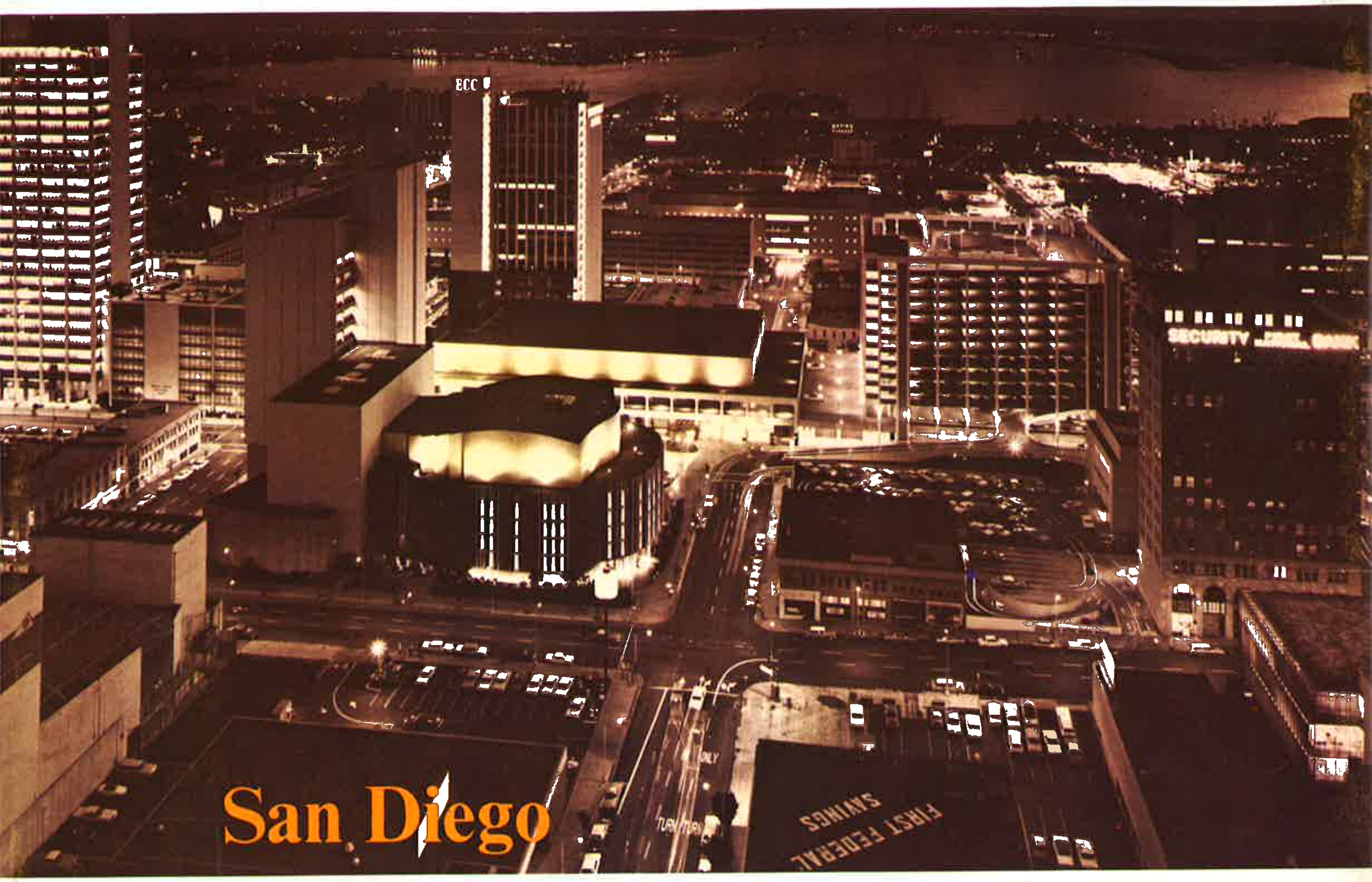
A new "U" shaped 40-watt fluorescent lamp (in Warm White and Cool White colors), only 23½" overall. Applications are in offices, commercial and residential areas where fixtures no longer than 24" are desired. For such locales, the 40-watt Mod-U-Line is a more efficient and more economical source of light than a pair of straight 20-w fluorescent lamps — or, incandescent lamps, for that matter. Mod-U-Line lamps do *not* compete favorably with regular 40-watt fluorescents, where fixtures longer than 24" are permissible. The compact 3-5/8" centers between legs permit 3 lamps uniformly spaced in a 24" square fixture.

CHROMA LINE FLUORESCENTS

Two new fluorescent lamp colors: Chroma 55, at 5500°K apparent color temperature, simulating natural daylight; Chroma 70, at 7000°K, more nearly simulating skylight. Applications for these lamps are color inspection and grading in numerous industries, as in the paint, dye, ink, ceramic and textile industries and in the grading of agricultural products. Designers will find the visual "coolness," with rather good rendition of complexions, of these new sources applicable to many interiors where good color rendition is desired.

† Made in West Germany

* Trademark, General Electric Company



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