NORTHWEST ARCHITECT

lume XI Published By Minnesota Association of Architects Number 4

SEE PAGE SEVEN

ERVEN JOURDAN
PHOTOGRAPHER
LOS ANGELES

ALMA CARROLL BUILDS IT HERSELF

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MINNEAPOLIS **MINNESOTA**

Northwest Architect

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HOLLYWOOD AND YOU

PEOPLE WHO WORK in Motion Pictures must survive a number of handicaps. One of the most troublesome rests on a case of mistaken identity. Try to clear this up! You begin to wonder that people like each other as well as they do.

Two acquaintances sit down for a quiet chat; six people at once crowd into the talk. Sounds just like Hollywood, doesn't it? Well, it always happens where you live, too.

"Always"! Who are these pushing persons?

A—The person you think you are.*
B—The person your friend thinks he is.

C—The person you think he is.
D—The person he thinks you are.

E—The person you really are.
F—The person he really is.

Six so different persons to misunderstand and be misunderstood can be confusing.

When we learned of Alma Carroll in dungarees digging, hoisting and hammering to get a home—all at once that better Self within the Person we really are, said in a small voice, can this be Hollywood!, that beautiful girl so remote from common labor actually building her own home:—

IF SHE CAN — SO CAN YOU!

*From "THE AUTOCRAT AT THE BREAKFAST TABLE" By the father of Judge Oliver Wendell Holmes Jr.

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NEstor 2641

MANY HANDS WANT LIGHT WORK!

So this seems to be the Spirit of 1948 . . . .

"If you want a thing done well--do it yourself"

BY WILLIAM GRAY PURCELL, ARCHITECT

"For it's . . .
Always fair weather
When good fellows get together."

FOLK SONGS have deep meanings; new meanings for new days. The economic sky in America is now bright—almost too bright. Against the brilliance of a whopping two billion dollar extra in national income (did you get yours?), 'way up yonder in the high price sky, the thunder heads are gathering. Can we give them a shot of dry ice and settle for a good steady rain? — or maybe a dust scorch and call it a day? — or must we take to the root cellar for another twister?

At any rate it won't be like 1932. If we knew what it would be like, we might prepare for it, if congress would let us. Already school teachers, widows, insurance beneficiaries, public payroll men and women and many other "whitecollars" know what this new depression *is* actually like. This time, full employment, plenty of dollars, but they won't buy much. Your 1939 $1 is now worth $.49 with the quality factor left out of what you buy.

GETTING TOGETHER ●

FOR MORE than a year now the NORTHWEST ARCHITECT has been saying that people cannot expect others to do for them what they can and should do for themselves. "The Government" — well, that's you and me! Any one of us might well find ourselves in Washington with some angry profiteer across our desk, demanding that we do what he says "or else"; and we knowing damn well that it may help him but not the nation. What would you do? Say no, and then find your voters walking out on you, in favor of some biscuit-passing mail order cowboy?

There are a good many ways for citizens to get together. Stocks and bonds are the practical evidence of one very successful method of getting together. Churches, Clubs, Fraternal Orders, The Grange, Mutual Insurance Companies, Rotary, Savings and Loan and Co-ops. are other good ways. Just what method will get you a house, reduce your grocery or motor fuel bill, or buy electricity at ¾c, as in Tacoma and Winnipeg, can only be determined by actually getting together. It's as simple as that, but you just have to move. The first step is the biggest step in any journey. You can't go any place without taking that first step.

"I THINK I CAN" ●

HERE IS SOMETHING that turned up while I was studying how-in-the-world one might find the answer for the houses we need so desperately. Don't be fooled by the statistics of 1947 increase in building construction, it is mostly in industrial, or racket business types. Increase in dwellings is very largely $12,000 and up plus the lot. "That will be $52 per month for 52 years," if the house will stand up that long! But to get back to base.

The following solid reading matter wasn't found in the song hit parade. It's a quote from a thinker's magazine—

Now take it easy:—

"We use our brains for thinking, but it is a mistake to suppose that the brain is primarily a thinking organ. Thinking is mainly, if not wholly, performed with words and other symbols. We know what parts of the brain are most concerned in thought and language — usually the left cerebral hemisphere IN THE NEIGHBORHOOD OF THE AREA WHICH CONTROLS THE RIGHT HAND."

"The human brain has two super-animal activities: MANUAL SKILL AND LOGICAL THOUGHT. Manual skill appears to be the earlier acquisition of the two, and THE CAPACITY FOR LANGUAGE AND THOUGHT has grown up around MANUAL SKILL."

"If we bred for qualities which involved the loss of manual ability, we should more likely evolve back to the apes than up to the angels."

Atlantic Monthly — March, 1947, Page 46 — Last Paragraph
"Evolution: Past and Future," By Professor J. B. S. Haldane
University College, London. World Famous Biologist.

I think I can?
To think about a problem you must begin to do it.

KITE-DOLLAR WORKERS ●

LABOR UNIONS, perhaps even to a greater extent than management corporations, tend to become executive monopolies embedded within economic monopolies. The power to direct others is a basic satisfaction and closed directorates build and rebuild rules for self-perpetuation. Vot-

ing procedures are geremandered to keep the same officers in the junta. This kind of get-together can also be worked to push melon slices to the upper end of the board before dividends are declared, indeed it's a habit.

I said to Ole Axtel, fixing my screen — one of the few remaining Swedish trained cabinet makers who came over here at the turn of the century: "Ole, carpenters' union president Hutchinson must be morticed into that job for keeps, been there since McKinley was shot?" Says Ole, "Y-bet, yu can't even get seen if yu stand on your feet in a meeting, let alone a chanct for votin' in another. It's all rigged in advance."

Secret ballot and free elections should be guaranteed as part of our American system not only for elections to public office, but in all organizations, formal and informal, that is to say, in labor unions, lodges, social clubs, cooperatives, joint stock companies, and "General" monopoly trusts. No corporation should be chartered unless nonrevisable by-laws have fully safeguarded all minority rights. The most public spirited co-op, or even charity corporation, may prove to be exactly the one which greedy self-interest will find to serve its evil purpose. The best and most democratic people are often men of wealth and well used power, and the bitterest tyrants are frequently those who escape from poverty only to turn their bad tempers upon the underprivileged. Consider the wealthy but humanitarian planters who wrote our nation's Charters for the benefit of the common man, and on the other side, that German inferiority who made himself the Taikun of Torture and World "Leader" of Mass Slaughter.

LIFE WITHOUT FATHER ●

THAT THIS IS NOT just a sort of preaching, good for somebody else, is well underlined by the largest voice now speaking in type to U.S.A. from border to border—10,000,000 and more readers every week. *Life,* in its June 9 issue, ran a full page analyzing the housing problem. The best brains they can buy and the best data they could bring together, finally came up with their best bet. Thank you for the compliment, *Life,* for your conclusion was what we have been urging for a year, that is to say:

CALL A MEETING

In "Fortune" this month it is proposed that U. S. industry undertake voluntary price cuts to bring about a "15% to 20% reduction in the U. S. internal price level. . . . Our primary job . . . is to carry the Industrial Revolution forward at home." But it is impossible to ask the scattered building industry for a 15% to 20% cut in nation-wide building costs. The building industry is small and local, not nation-wide. So why shouldn't the solution to low-priced private building be local?

A case in point occurred last week. Cardinal Spellman of New York had an order for $25 million worth of construction. A lot of that money had come from all over the country for the Al Smith hospital. He got together everybody from every side of the building industry he could find and told them that he was ready to shoot the works IF THEY AGREED "TO RENDER A DOLLAR'S WORTH OF SERVICE FOR A DOLLAR FAIRLY PAID." A thousand representatives of the metropolitan building and construction trades agreed. No more stagnating jurisdictional strikes, incomplete crews or shirking, pledged the workers' representatives. Higher production records, pledged the contractors. The cardinal is going ahead.

The New York solution admittedly does not cover all the ills of the building industry. But it does go to show that strong community leadership can get a few chips flying. After all, building in the U. S. has always been a community concern. In the days of barn-raising neighbors teamed their time and talent and, foregoing the profit of their labors for a day, saw to it that everybody got a barn—including themselves. Nearly every American town has bankers, a real-estate board, a building council, a chamber of commerce. WHY DON'T THEIR LEADERS CALL A MEETING, POOL THEIR THINKING, IRON OUT ALL THE WRINKLES THEY CAN IN THEIR OWN LOCAL HOUSING PROBLEM AND GET SOMETHING DONE? That's the way a hundred other community aspirations are fulfilled. There's nothing to lose. There's a better community to live in to be gained.

SHORT CHANGE FROM LABOR ●

WHY IS IT that with such high wages as are now paid it would appear that less and less production results. The contractor says he loses money. The man with a building lot is afraid to go ahead.

This week Van Evera Bailey, Architect, writes me from Portland, "One of the troubles with building today is that contracting builders, especially subcontractors, want to make a killing on each item. This pyramids the total cost. No one that is hardy enough to weather such price pressure seems to mind. Contractors and Builders are just taking the cream off the market, while the life-giving factors of long-range economy are tossed away. So honest Old-Timers like our foreman John just refuse to trv to do business in the building game. They don't realize that they can pass the robbery along for now, and add some for themselves. Those that do know it, love it."

AND SO WHAT ●

NEWS ABOUT PEOPLE and what they are actually doing today to help themselves does not easily pass the newspaper "city desk" unless tied to some advertiser's sales story. However, one way and another we have collected reports, East and West, and here are a few of them. We could fill our columns, and more.

But first, please compare the way the "special interests" talk to *themselves,* with the way "they talk to the *public* — that's us.

Read this very candid piece of reporting by Stanley E. Cohen in ADVERTISING AGE; *and we quote:—*

"WASHINGTON, D. C. Realtors are in good shape on the House side, where Representative Jesse Wolcott is ready to jam through a bill virtually killing the veterans' housing program. Wolcott, who is chairman of the Banking and Currency Committee, would scrap government power to channel materials to veterans and limit the amount of commercial construction."

Better not "wait, Soldiers, until you can see the whites of the enemies eyes;" that will be too late! Perhaps you know Mr. Herbert U. Nelson, Ex V. P., National Ass'n of Real Estate Boards. He former-

ly lived in Minneapolis. Now he pleads the cause of the "poverty-stricken property owners."

★ ★ ★ ★

MANY VERY PRACTICAL READERS ("a practical person is one who never wants to do anything the first time") will be writing me letters about this month's preachment; many more will intend to do so.

So I thought I'd save trouble and answer first.

"No Home, So What," was written last December. Things looked pretty bad for the veteran. Then for a while the situation looked hopeful. Now the picture is worse again. So what I have said is still good evangelism. But people want specifications, "WHAT EXACTLY SHALL WE DO?"

That is a large order because every one of you is obliged to deal with factors peculiar to his especial circumstances. But I can tell you some true stories that are to the point. All them show that thousands of people everywhere are actually moving to help themselves as I am urging you to do.

★ ★ ★ ★

FOR EXAMPLE, here is Vic Everhart, Navy veteran of Lewiston, Idaho—(his parents sure named him right). In his town no inexpensive canvas available and no slim poles for a tepee, but the Home Builders Supply stocked laminated, waterproof 1½"x4" wood "arches" in 6', 7' and 8' radii (as half circles) made up by the Potlach Lumber Co. Here were the ribs for a 16'x26' (416 sq. ft.) hogan. Built like an inverted boat, his house cost 300 hours of labor, $600 for structural material, $300 for plumbing and wiring materials. Vic already has a good home; complete story in WESTERN BUILDING, for April.

★ ★ ★ ★

OVER IN DALLAS, OREGON, Miss Mildred Benson ran across a lot of straight second growth fir, just right for six-inch peeled poles 8' long and no knots. She has worked out a very flexible and ingenious construction system; warm (and cool), quick built and cheap. $300 will buy enough poles for a 900 sq. ft. house, partitions and all. A paradoxical factor is that this closest-to-Nature building material makes it easy to plan and construct any kind of curved wall and even these ultra-ultra amoeba shaped rooms. Indeed there is an efficient stability to be easily had by using such curved wall rooms. ARCHITECTURAL FORUM, April, 1947.

★ ★ ★ ★

AS A PRACTICAL PROPHET in this cause we must not omit mention of Newton Holland down in Rochester, Minnesota: He answered with his idea a full twenty years before the call. One Saturday night, sitting up to read Whitman and Emerson, he was completely sold on the idea of beauty in common things. Next day he passed one of these ample, curved rib-rafter dairy barns. He fell in love with the form and had his architect plan a home on that base. His living room goes clear up to the dusky places where the little barn owls would like to blink—and all that was way back in 1927. Prophet indeed!

★ ★ ★ ★

OR TAKE CLIFF NELSON out in Portland, Oregon. Cliff is quoted as saying (International News Service 2-14-47) "If a log cabin was good enough for Abraham Lincoln, it's good enough for me." So like "Step-on-it" for Neolite heels, as broadcast on the night air—"He's *buildin'* one!"

★ ★ ★ ★

Let me add the warning that log cabins are not inexpensive. They are a luxury, unless you have a lot of time, lots of working friends and nothing else to do. Log cabins mean labor, labor, from the time you chop the first tree.

★ ★ ★ ★

I SAW AN EXCELLENT HOUSE in New York made out of miniature bales of hay. In Alaska I saw one made of beer bottles set in mortar. That one beats the glass brick boys by forty years. The Nebraska pioneers used sod for walls and roof. Old codgers will tell you what comfortable houses they were.

★ ★ ★ ★

A SEATTLE ARCHITECT built an excellent house out of cord wood, square cut to exactly 12" and 6" long, and "piled" with mortar between to make exterior walls one foot thick and 6" partitions. I also experimented with this idea in 1926. The very profitable side-line that came out of this Seattle fire-wood house was the use of 4" slices of large round logs, with the bark on, as paving for patios, terraces and court yards. This delightful material is now in use everywhere on the Pacific Coast. The resulting outdoor "floor" is more comfortable and satisfactory in most ways than cement.

Again the lathed cores, resulting from shaving continuous sheet plywood, provide smooth perfectly round billets, four feet long, just waiting for Miss Mildred Benson to put them to use.

★ ★ ★ ★

WAY DOWN EAST in Stratford, Connecticut, Mr. James L. Stryker, age 79, with Dick Eddington of World War II to help him, have just finished a very nice home — 950 square feet with full basement, concrete foundation and attic. The two did the whole job by themselves in six weeks' time!

Writes Mr. Stryker: "What we have done may put a little courage in some younger folks to take a chance. Pathe News have given the finished building national publicity. It has four rooms and bath, fireplace, hotwater heat, and hardwood floors." Congratulations to Mr. Stryker and Mrs. Stryker!

★ ★ ★ ★

WE SCOOP WINCHELL ●

☆ ☆ ☆ HERE IS A BIT of the real Hollywood that Hedda Hopper doesn't report — stars and artists as basic Americans.

★ Alma Carroll of Columbia Studios, was "Miss America of National Defense." Glamour? We'll say so — she's a top fashion model in *Vogue, Harper's, Mademoiselle* — look for her. But in Hollywood look for her on the building job mixing cement, passing up the lumber to her warflyer husband, George Giroux.

★ George was an artist with Walt Disney before the war and had plenty of excitement in the air east of the Rhine. He was a B-17 pilot. On one mission over Germany the mechanic who worked on his plane, for some unknown reason, put an extra steel plate under his seat which no other B-17 had. Flak hit his plane, and later when it was checked, they found flak lodged in the steel plate which had saved him from being killed.

* Here is one G.I. veteran who just isn't going into debt for a place to live, so after business hours at Technicolor he and Alma work from four p.m. to sundown, and all day Saturday and Sunday on their new house. Evenings he writes scripts and stories. She makes garden between times and at this writing has green corn and vegetables ready to eat. One begins to see that these boys and girls who really get some place expect to work, and work, and have fun! The good money Alma earns because she's also beautiful, is rushed to the material dealer for building supplies. Their home will have five rooms and a bath and a half. It is now going fine — and no mortgage; 433 South Catalina in Burbank if you wish to join the Sidewalk Superintendents Club over there and give them a cheer.

* The conclusion is plain. If you want to go some place and haven't the price of a ticket, take yourself there. It's been done since the Greeks first walked all the way to the Arctic and the Egyptians of 3500 B.C. first went to Ireland in a rowboat. "I WILL" is not just something that you say. George and Alma know it's *how* to plan their time. And they know that the journey is most of the fun so they "live on the way."

BACK TO THE GRASS ROOTS ●

IF YOU THINK all this reporting a bit wild and rather off the the useful issues let me report that the Engineering Department of the University of Michigan, financed by and in co-operation with the U. S. Government, has made a thorough study of waste products available for building construction. They tested and have provided laboratory indexes for the technical character and quality of *two hundred and fifty* now neglected waste products which can be used for buildings. These run the alphabet and include peanut shells, corn stalks, sawdust, manufacturing scrap of many kinds, and hundreds you'd never even imagine. "Properties of Assorted Light Weight Aggregate Materials," by Corwin D. Willson, Office of Production Research and Development, War Production Board, Washington, D. C.

KEEP IT SIMPLE ●

SO THE IDEA seems to be—look around your own town and try to find something that would serve for a roof—find some simple way to hold it up—then get underneath and make yourself comfortable.

"Well, such talk just isn't going to produce any houses to use." Isn't it? Take a look at the interesting and economical San Francisco house in the April Architectural Forum. It meets the above definition precisely. And the same basic approach can be very effectively used with other simple materials such as can be handled with greater opportunity for personal labor and at less first cost than steel and glass.

That will about cover the best of the current news from the world of natural "self-starter" citizens. And, yes, you are right, in the final analysis the answer to the problem of a million houses a year can't be lifted from these pages. But IT IS FROM THESE ROOTS THAT THE BIG ANSWER IS GOING TO GROW, AND THESE ARE SOME OF THE WAYS IN WHICH THE NECESSARY EXPERIMENTAL FACTORS MUST FIRST BE DEMONSTRATED.

Celotex and Cemesto, those god-sends to American Building, grew out of a St. Paul Swedish gadget-whittler trying to figure how he might use the piled up mountains of Louisiana bagasse (sugar cane waste); and what a headache *he* had before he learned how to keep it from sticking to the press.

I hear you say "OK then, and maybe a man should follow his own good advice"; meaning me? Well, remember that pre-fab I told you about in NORTHWESTERN ARCHITECT, Vol. X, No. 4, "50,000 Carpenters"? Since the first one a year ago over fifty of them have been built in and around Pasadena, and more now going up. But since last fall the cost to build has gone up another $2,500 so that they are now in too high a price bracket to help the man who can pay only $60 a month rent. So this summer we have been busy constructing in Portland, Oregon, two "laboratory houses" using, by a new construction method, one of those waste products Uncle Sam found out about in the Michigan study.

Good night! Now you tell one!—W.G.P.

"Ladies and Gentlemen! . . . Alma Carroll and George Giroux—"

THE TRUEST DEFINITION of a gentleman is that he is a man who loves his work. This is also the truest definition of a poet. The man who loves his work is a poet because he expresses delight in that work. He is a gentleman because his delight in that work makes him his own employer. No matter how many men are over him, or how many men pay him, or fail to pay him, he stands under the wide heaven the one man who is master of the earth. He is the one infallibly overpaid man on it. The man who loves his work has the single thing the world affords that can make a man free, that can make him his own employer, that admits him to the ranks of gentlemen, that pays him, or is rich enough to pay him, what a gentleman's work is worth.

THE POETS OF THE WORLD are the men who pour their passions into it, the men who make the world over with their passions. Everything that these men touch, as with some strange and immortal joy from out of them, has the thrill of beauty in it, and exultation and wonder. They cannot have it otherwise even if they would. A true man is the autobiography of some great delight mastering his heart for him, possessing his brain, making his hands beautiful.

LOOKING AT THE MATTER IN THIS WAY, in proportion to the number employed, there are more gentlemen running locomotives today than there are teaching in colleges. In proportion as we are more creative in creating machines at present, than we are in creating anything else, there are more poets in the mechanical arts than there are in the fine arts; and while many of the men who are engaged in the machine-shops can hardly be said to be gentlemen (that is, they would rather be preachers or lawyers!) these can be more than offset by the much larger proportion of men (and women) in the fine arts, who if they were gentlemen in the truest sense, would turn mechanics, at once; that is, they would do the thing they were born to do, AND THEY WOULD RESPECT THAT THING, AND MAKE EVERYONE ELSE RESPECT IT.

From "THE VOICE OF THE MACHINES" by Gerald Stanley Lee, 1906

Doubleday, Page and Co., N. Y., Out of print.

MERRILL BUILDING HAS LARGEST RADIANT SYSTEM

Perhaps the largest multi-story structure in the Middle West to incorporate a radiant heating system is the new American Procurate building erected for the Sisters of Mercy of the Holy Cross at Merrill, Wisconsin, by the Walter Butler Construction Co., St. Paul, Minnesota, and Detroit, Michigan.

The building is constructed of reinforced concrete with a stone facing and is in the form of a huge cross. The arms of the cross contain the dormitories, offices and school rooms and are three stories in height, 42′ x 130′. The middle portion of the arms is four stories in height and 90′ wide. Connected to the center portion of the building is the chapel portion which forms the stem of the cross. This portion of the building extends at right angles 150′ from the offices and administrative part of the building.

The chapel is in a modern Gothic style and the administrative portion of the building in a modern design.

Nearly nine miles—47,000 lineal feet—of wrought iron pipe was installed in the floor of the first story chapel and lobby entrance and in the ceiling of the administrative and residential wings in the construction of the radiant heating system. The problem of adequately heating the structure was complicated not only by the large size of rooms and high ceilings but also by the fact that Merrill is located in a cold zone with average temperatures lower than those of Duluth and St. Paul. Thus the system, unlike those employed in many other structures throughout much of the United States, was designed to meet a minimum outdoor temperature of 32° F. below zero as compared with the customary 0° F. minimum.

A novel feature of the heating system is the fact that pipe grids also were installed under each section, or pitch, of the stairways, to control downdraft cold air currents in the stairwells.

The architect was Ray R. Gauger, Chief Architect, Walter Butler Construction Company; general contractor, Walter Butler Construction Company; designers of the radiant heating system and ventilation, Samuel R. Lewis & Associates; chief engineer in charge of construction, C. W. Oslund, Walter Butler Construction Company, and heating contractors, the J. McClure-Kelly & Company.

ILLUMINATION STANDARDS*

By Miles A. Tinker, Ph.D.

Professor of Psychology, University of Minnesota, Minneapolis, Minn.

NORTHWEST ARCHITECT is most fortunate to have permission to reprint the article "Illumination Standards" which was written especially by Dr. Miles A. Tinker for the *American Bulletin of Public Health.*

For the past 10 years, lighting standards, as published by lighting fixture manufacturers and power companies, have called for increasingly higher levels of foot candle illumination. Every architect should read Dr. Tinker's article carefully and then analyze his own viewpoint to see whether or not we architects have not greatly increased the cost of illumination in our buildings by reason of following published recommendations which may have been founded on popular misconceptions of what constitutes good lighting.

Physicists have treated light intensities as purely quantitative factors assuming that if a certain intensity is good that more light is necessarily better. They completely ignore the physical qualities of the human eye in the relationship between lighting and good seeing.

None of the standard authorities take into account the tremendous difference in the quality of artificial light in comparison with natural light, particularly in so far as any consideration of glare. Recent practical experiments under actual working conditions rather than in a laboratory, to determine efficient lighting would indicate the entire correctness of Dr. Tinker's theory. We are indebted to Dr. Tinker for not only his realistic but carefully analytical application to this very important problem.

THE problem of comfortable, healthful, and efficient functioning of the eyes is of prime importance whether one is working in the school, the home, the office, or industry. Faulty illumination frequently leads to eyestrain which is often accompanied by reflex functional disturbances of other organs. Hygienic illumination is, therefore, intimately related to visual function. Since a large amount of one's visual work is ordinarily done under artificial illumination, the recommended practice of lighting for various kinds of visual work is of concern to all.

During the past decade a lighting consciousness has been forced upon most of those who perform visual tasks and upon those who control the environments in which visual work is performed. Although interest in lighting has been stimulated by popular articles, and by reports written by educators and medical men, the more fundamental information has appeared in the experimental literature. This literature is not readily available to nor easily interpreted by most people. The tendency, therefore, is to consult pamphlets on recommended practice when lighting specifications are needed for a particular situation.

Beginning in 1915, the Illuminating Engineering Society began issuing codes on lighting. The more recent codes are known as *Recommended Practice of Home Lighting, Office Lighting, etc.* They have been prepared by the Illumination Engineering Society either alone or jointly with the American Institute of Architects usually under the rules of procedure of the American Standards Association. Although the American Psychological Association has been in existence for over 50 years, and even though applied psychologists have been interested in the field and have been making experimental contributions to the hygiene of vision for over 40 years, neither psychology nor psychologists are represented in the group specifying recommended practices. Furthermore, a large body of psychological literature has been ignored, either because the illuminating engineers were not familiar with it or because they chose not to use it. The consequence has been an emphasis upon the engineering aspects of lighting with inadequate attention to certain psychological factors. More recently there has been some attempt to consider more of the psychological factors. Perhaps because engineers lack a psychological background, interpretations are frequently at fault. It would seem that the most satisfactory approach to hygienic lighting might be achieved by co-ordinating the work of engineers, physiologists, and psychologists.

Examination of recent reports on recommended practice reveals an increased emphasis upon control of direct and reflected glare, brightness contrast, and the distribution of light. The tendency to specify relatively very intense light for many tasks is especially prominent. The purpose of this paper is to review specifications in the more recent editions of recommended practice of lighting and some of the data from which the recommendations are derived.

SPECTRAL QUALITY OF LIGHT

This, in general, receives adequate treatment in recommended practices.[27-30] It is stated that with equal foot candles of illumination, variations in color quality of light found in common illuminants have little or no effect upon the visual discrimination involved. When color is to be discriminated it should be viewed under as close an approximation of daylight as possible. Luckiesh[8] has a valuable discussion of light and color.

QUALITY OF LIGHTING

Recommendations[27-30] concerning control of glare, diffusion, direction, and distribution of light, light reflection value, and effects of finishes on ceilings and wall are ordinarily quite satisfactory. Visual discrimination is improved by moving the glare source from the line of vision and by reducing the brightness of the light source and the amount of light emitted by the light source toward the eye. Brightness of luminaries should be low in value. High brightness contrasts within the field of vision should be avoided whether on the work surface or in other parts of the visual field. Proper diffusion of light helps to eliminate undesirable shadows. For this reason, purely local lighting is unsatisfactory. Since the reflection factors of objects in the visual environment play an important role in illumination, the finish of ceilings, walls, floors, and furnishings is important. These surfaces should provide reflecting surfaces to help spread the light about the room. Furthermore they should be such that undesirable brightness contrast does not occur within the field of vision. Shiny or glossy finishes should be avoided to prevent specular glare.

In the recommended practices, informative discussions on classification of lighting systems are usually included. Also illustrations of fixtures and installations are sometimes given. Some attention is given to daylight illumination and the need of co-ordinating artificial with daylight lighting.

INTENSITY OF ILLUMINATION

Intensity of illumination receives by far the greatest emphasis in specifications. With each revision of a lighting code prepared by illuminating engineers, the foot candle recommendations rise. One may well question whether this trend has a scientific

*Special Review Article prepared at the request of the Editorial Board.

basis, or whether the consumer has been educated to accept the higher intensities. In 1934, Luckiesh and Moss[9] presented general recommendations which they considered to be very conservative. These are repeated with slight changes in Luckiesh's recent book.[8] He adds that these are inadequate in many cases where hundreds and even thousands of foot candles are desirable. Examination of recommended practices of lighting reveals that, for the most part, they are based upon researches done and interpretations made by Luckiesh and his coworkers, or on researches inspired by them. Let us turn first, therefore, to these reports.

In the *New Science of Seeing*, Luckiesh and Moss,[9] and in *Light, Vision and Seeing*, Luckiesh[8] make the following foot candle recommendations for common tasks of the work-world:

1. 100 foot candles or more are specified for severe and prolonged visual work. Examples include fine needle work, pen work, engraving and assembly, and discrimination of fine details involving low contrast.
2. 50 to 100 foot candles should be used for proofreading, difficult reading, watch repairing, and average sewing.
3. 20 to 50 foot candles are listed for such visual tasks as clerical work, ordinary reading, and average sewing on light goods.
4. 10 to 20 foot candles are proposed for ordinary reading and sewing on light goods when the task is not prolonged.
5. 5 to 10 foot candles are needed for visual work which is more or less interrupted or casual.
6. 1 to 5 foot candles are sufficient for perceiving large objects.

Luckiesh[8] states that these are minimum foot candle recommendations and that he considers them to be very conservative from the viewpoint of ease of seeing. Furthermore these foot candles, according to Luckiesh and Moss,[9] are far below the intensities of illumination which new knowledge indicates to be ideal.

These recommendations are derived from various sets of data which will be discussed in turn.

Preferences for light intensity—Luckiesh and Moss[9] cite data on preferences for light intensities to support their contentions that high intensities are necessary for adequate seeing. The mean choice was about 100 foot candles but the median was 50 foot candles when up to 1,000 foot candles were available. Tinker's analysis[16] of light preference studies indicated that visual adaptation plays an important role in determining the preferences. In an experimental check, Tinker[20] found that when readers were adapted to 8 foot candles, the median choice for comfortable reading was about 12 foot candles. But when adapted to 52 foot candles, the median choice was 52 foot candles. It is obvious that the intensity of illumination to which the reader is adapted plays a dominant role in his illumination preference. The conclusion is, therefore, that preference for illumination intensity is not a satisfactory method for determining the intensity of light needed for efficient visual work.

Visual acuity—Luckiesh and Moss[9] and Luckiesh[8] list visual acuity as a basic factor in reading (and presumably in other visual work). It is true enough that visual discrimination does depend somewhat upon visual acuity. But is visual acuity an adequate criterion for prescribing appropriate lighting? Luckiesh and Moss[11] admit that, in many tasks the criterion of visual acuity is relatively inappropriate, i.e., in tasks involving low contrasts. But they point out that for black test objects on a white background, visual acuity improves up to 100 foot candles. As a matter of fact Lythgoe[13] has shown that under certain conditions of measurement, visual acuity improves up to and beyond 1,000 foot candles. Inspection of the data reveals that the knee of the curve of improvement is at about 10 foot candles and that beyond about 20 foot candles the gains are slight. It must be kept in mind that in measuring visual acuity, one is dealing with threshold values. It is highly questionable whether the almost microscopic gains in visual acuity obtained under the high foot candles justify their application to visual tasks where supra-threshold visibility is involved as in most everyday situations. Furthermore, data reveal that the visual acuity curve is practically horizontal from 50 foot candles to the higher levels.

Luckiesh and Moss[9] and Luckiesh[8] cite data on visual acuity for 1, 10, and 100 foot candles only. If they really desired to find the foot candle level beyond which no *practical* gains in visual acuity occur, they should have investigated the range between 10 and 100 foot candles. As shown in Tinker's reviews,[23,25] this criticism may be aimed at all the basic data presented by Luckiesh.[8] In some instances (decrease in heart rate, decrease in convergence reserve of ocular muscles), data for only 1 and 100 foot candles are presented. It appears then, that visual acuity data are of only slight use for prescribing illumination intensities for visual discrimination in supra-threshold tasks. If accepted, there is no justification for suggesting that more than 40 to 50 foot candles are necessary for adequate discrimination even for tasks that approach threshold discrimination.

Visibility measurements—Luckiesh[8] states that "After establishing a standard of visibility or desirable see-level to be attained if possible for all tasks, it is seen that specifications

of light and lighting and other aids to seeing can be based upon visibility measurements." The measurements are to be made by the Luckiesh-Moss Visibility Meter. This is a device consisting of two identical circular gradients which are rotated before the eyes to alter the brightness contrast of the object whose visibility when both are barely visible; (b) "Two objects are to threshold visibility. It is the threshold which is measured. Three assumptions are made: (a) Two objects are equal in visibility when both are barely visible; (b) "Two objects are equally above threshold visibility when their visibility has been increased by the same increase" in size, brightness, brightness contrast or time; (c) "The visibility of an object, or degree of supra-threshold visibility, is proportional to the decrease in any one of the fundamental factors necessary to reduce the object to threshold visibility." These assumptions are considered to be *axiomatic* and arguments against them are considered to be *futile*. Nevertheless, since recommended standards are based upon visibility measurements to a large degree, it seems desirable to examine the matter further. Things are not axiomatic just because someone says they are.

Since visibility measurements are in terms of threshold values, they are analogous to visual acuity measurements. They are subject, therefore, to the same criticisms as visual acuity measurements as criteria for prescribing illumination standards.

Luckiesh[8] emphasizes foot candles for equal visibility in prescribing illumination intensities. For example, to make newspaper text matter equivalent in visibility to 8 point book type on white paper under 10 foot candles of light, it is necessary to use 30 foot candles. And to make the 1/64 divisions on a steel scale equal to this visibility level, 180 foot candles are needed. Are these levels of illumination intensity required for efficient and comfortable seeing? Luckiesh[8] assumes that this is a conservative standard. On his empirical scale, the 8 point type with 10 foot candles has 48 per cent maximum visibility. (Maximum visibility is obtained from a test-object whose critical detail has a visual size of 20 minutes; a critical detail of 1 minute is the smallest visible by persons with normal vision under 10 foot candles of light.) But no adequate experimental check is made of performance of these tasks under various levels of illumination. Tinker[21] found that the critical illumination level (the intensity beyond which no further change in reading performance occurs as the intensity is increased) for reading 7 point newspaper type to be approximately 7 foot candles. It is difficult to conceive the need of going above 20 foot candles to provide a margin of safety above the critical level. It is highly probable that an experimental check will reveal that other visual tasks, like discriminating the divisions on a steel scale, do not require the 180 foot candles indicated for efficient vision by the *computations* of Luckiesh. Related to this is the question of comfortable vision. Harrison,[6] in discussing the difficulty of using high intensities because of the introduction of glare factors states "Visibility and comfort are two separate factors which do not always overlap completely."

No one will deny that visibility is an important factor in ease of seeing. But to prescribe standards in terms of scores derived from measurements made with the Visibility Meter is open to serious question. The basic data are threshold scores. While the derived scores may appear logical, supra-threshold seeing is not the same situation as threshold seeing. Apparently, as illumination intensity is increased, one soon reaches a level of diminishing returns where further increase is of no practical importance or may introduce harmful factors from the viewpoint of easy and comfortable seeing.

Nervous muscular tension—Luckiesh and Moss[9,10] place great stress upon the apparent decrease in nervous muscular tension during reading as the illumination intensity is increased from 1 to 10 to 100 foot candles. Tinker's[16] analysis of their data reveals that the method employed to present their results magnifies minute differences so that they appear large. Interpolation shows only gradual changes from 10 to 20 to 25 foot candles and very slight changes from there on to 100 foot candles. The conclusion that high foot candles are needed for ordinary reading is not valid. In a comparable situation, Tinker[19] found that for reading 10 point type, the critical intensity was about 3 foot candles. Below this level rate of reading was retarded and fatigue increased, but for higher intensities there was no change. For people with normal vision, 10 to 15 foot candles should provide a satisfactory margin of safety for reading legible print.

Frequency of blinking—Another favorite criterion employed by Luckiesh and Moss[9,10] and Luckiesh[8] as a basis for prescribing illumination intensities for visual work is frequency of blinking. The typical experiment is to measure the rate of involuntary blinking for the first and for the last five minutes for an hour's reading under 1, under 10, and under 100 foot

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Keep Name Up Front, St. Paul Corrugating Believes

An aggressive advertising campaign aimed at keeping its name "up front," where home builders, construction engineers and others vitally interested in its products can be repeatedly reminded of them, is the keynote of promotional work by the St. Paul Corrugating Company, makers of area walls, culverts, roofing, ventilators, etc.

The 62-year-old firm was started in the days of fine hand craftsmanship and has sought to retain the same quality which gave it a good start through all its operations as machines eased the laborious work of manufacturing metals.

Founders of the firm were Louis T. LeFebvre and Philip A. Deslauriers, two French-Canadian cornice makers who opened their first shop at 182 E. Eighth Street in St. Paul and started advertising campaigns with a pink insert in the city directory of that year. The idea of keeping the firm and its products before users' eyes never was allowed to lapse since then.

Firm name of LeFebvre and Deslauriers was changed in 1887 to St. Paul Roofing and Cornice Works and in 1893 when the firm was incorporated the "Inc." was added to the name but otherwise it was not changed. Mr. Deslauriers was the company's first president and Allan K. Pruden, secretary-treasurer. In 1894 the name was changed to St. Paul Roofing, Cornice and Ornament Co.

Mr. Pruden became president in 1901 and served the firm until 1923, when N. V. Lux was selected president and general manager. He suggested the change in name to the one which exists today—the St. Paul Corrugating Co.

The firm reportedly had the first hot-dip galvanizing tanks in the Northwest and today this department is an important part of the company's operations. Manufacture of metal buildings reached its highest level during the Pruden administration and many of the buildings are still standing as lake cottages and garages around the Northwest.

A constant adaptation of the company's products to current trends in building is noticeable. When ornamental, pressed metal ceilings were the vogue, St. Paul Corrugating made these decorative items. Now, with streamlining taking the modern building into new channels, items like the Lux-Rite Areawalls improve the appearance of basements. Improved steel roofing is made under the name But-N-Tite Steel Roofing, buttoning as it does into a sturdy roofing panel.

Mr. Lux died in 1943 and was succeeded by the present president, Robert Adler. Others in the company include Lawrence A. Koch, general manager, and Harry C. Nord, general sales manager. Mr. Adler has been in the steel business all his business life and was a vice president before becoming head of the company. Both Mr. Koch and Mr. Nord have long service records, having given more than 30 years to development of St. Paul Corrugating.

In addition to Lux-Rite Areawalls and But-N-Tite Roofing, other products being pushed by the firm's campaign include Yellow-End Culverts, skylights, ventilators, rain-carrying equipment and special sheet steel fabrications.

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candles of light. They note that the blink rate is greater under the 1 than under 10, and greater than under 10 than under 100 foot candles. Therefore it is concluded that relatively high intensities are desirable for reading. Even if these data are accepted as valid, we do not know where between 10 and 100 foot candles the curve of increased efficiency flattens out since intermediate intensity values were not studied. But there are several sources of information which suggest that blink rate is not a valid criterion of ease of seeing: (a) McFarland, Holway, and Hurvich,[14a] after a searching analysis of their own extensive experiments and of other studies, state: "A high blink-rate need mean neither an increase in fatigue nor an increase in difficulty of seeing." They conclude that "the rate of blinking can hardly be considered as a valid index of visual fatigue." (b) Tinker,[26] in a study that has some bearing on the subject, found that frequency of blinking is an inadequate criterion of readability of print. (c) Bitterman,[1] working with 3 and 91 foot candles of light, found that when subjects read for 40 minutes, there was no significant difference in rate of blinking. In fact, the frequency of blinking was slightly greater under the 93 foot candles. Incidentally, Bitterman also found no significant difference in blink rate for reading large type vs. small type. His results, therefore, indicate that rate of blinking cannot be employed as an index of ease of visual work. (d) The statistical treatment employed by Luckiesh and Moss[9,10,12] to treat their data is open to severe criticism. Tinker[22,23] has questioned the appropriateness of the geometric mean which they employ in most comparisons.

The same criticism is raised by Hoffman.[7] In a searching analysis, Hoffman[7] severely criticizes the use of the percentage technique employed by Luckiesh and Moss for presenting data, and for basing conclusions on percentage differences rather than on raw score differences. Percentage scores are notoriously unreliable. Furthermore, if the raw scores are below 100 (as most of them are), percentages magnify the differences. When percentages are used, therefore, the observed differences may be largely an effect of the derivation. Insignificant raw score differences may seem large when put into percentages. For instance, a typical average of 30 blinks during 5 minutes of reading is increased 10 per cent by a change of 3 blinks. Hoffman further points out that work decrement may be a more important variable than illumination changes in the results of Luckiesh and Moss. In general, he found little support for the contention that relatively high intensities are needed for effective and easy seeing. (d) Eames[3] criticizes Luckiesh and Moss[12] for using relatively few subjects in their experiments (including blink rate studies) and for employing "test wise" subjects. As pointed out by Eames, "People who take tests repeatedly in a given field gradually learn what is expected of them" and are unintentionally influenced by this. Results obtained under such conditions cannot be representative of the reactions of the general population.

The accumulated evidence indicates that rate of blinking cannot be accepted as a criterion for specifying intensities of light for visual work.

Decrease in heart rate—Luckiesh[8] and Luckiesh and Moss [9,10,12] cite data on change of heart rate while reading for one hour under 1 foot candle and under 100 foot candles of light. No data are presented for intermediate levels of illumination. It is stated that heart rate decreased 10 per cent under the 1 foot candle and 2 per cent under 100 foot candles. The conclusion was that from the viewpoint of ease of seeing the 100 foot candle level is desirable. An experiment by McFarland, Knehr, and Berens[14] was designed to check the findings obtained in Luckiesh's laboratory. The results led to the conclusion that "It is questionable whether reliable criteria for determining adequate levels of illumination for tasks such as reading during short periods of time (approximately 2 hours) can be obtained in terms of . . . heart rate. . . ." Another check experiment was carried out by Bitterman.[1] He recorded heart rate while reading under 3 and under 91 foot candles of light. "The results do not support the conclusions of Luckiesh and Moss with respect to the value of heart rate" as an index "of the ease of visual work." In view of the above evidence we must reject heart rate as a criterion for prescribing illumination intensities for visual work.

Decrease in convergence reserve—Luckiesh and Moss[9,10,12] and Luckiesh[8] cite data on decrease in convergence reserve of ocular muscles after reading for one hour under 1 and under 100 foot candles of light. The decrease was less under the 100 foot candles. No data are given for the range between 10 and 100 foot candles. We do not know, therefore, whether the 100 foot candles level is significantly better than such levels as 20 or 30 foot candles.

Visual adaptation—Throughout their writings, Luckiesh and

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Alvar Aalto, the distinguished Finnish architect and industrial designer, told this story at the recent Princeton University conference of Architects: "Humanizing Mass Production?—I think you mean the flexibility of the houses in my country. . . . I think I tell it better if I just tell the short story, without philosophy, of how it first came out. . . . We had two years of not doing much reconstruction, so much the war guns were going. . . . So we used human power for mass production, as we had not steam or electricity. . . . One regiment of our soldiers at the fighting front, with axe and adz whittled out of logs in the forest 240 complete houses; enough trees right there to make them all. So in this case the raw material was actually growing within the factory itself. In this way we made standardized houses, and then moved them down to the cities by truck or railroad, sometimes 1,000 miles."

CHANGES IN FEDERAL HOUSING AGENCIES

All principal permanent federal housing organizations are now merged into one body known as the Housing and Home Finance Agency. President Truman has appointed six men to head this new agency.

Constituent parts in the new agency are (1) A Home Loan Bank Board to administer the former work of the Federal Savings and Loan Corporation, the Home Owners' Loan Corporation, and the functions of the Federal Home Loan Bank Board; (2) A Federal Housing Administration with the same functions as now provided by law for that agency; and (3) A Public Housing Administration which takes over the functions of the old United States Housing Authority and certain emergency housing activities now being liquidated.

Raymond M. Foley is appointed administrator of the top agency. Franklin D. Richards of Utah is commissioner of the new FHA. Dillion S. Meyer of Ohio, an agronomist, is President, heading PHA.

Members of the Home Loan Bank board are: John H. Fahey of Massachusetts, chairman; Nathaniel Dyke, Jr., of Arkansas; and J. Alston Adams of New Jersey.

"THE GREAT TIME SAVER" is the title of a unique 12-page brochure just released by The Autocall Company, manufacturers of electrical signal and control equipment.

Action photographs taken under representative business conditions make up almost the entire "text" of the booklet to demonstrate exactly how "Autocall" Paging Service locates key personnel for callers, phone calls, emergencies, etc., by means of chimes, mellow-toned bells, resonant gongs, and other "Autocall" audible signals.

Locating the watchman for an after-hours delivery, or when a policeman discovers something that requires immediate attention, is another service illustrated by this booklet, as is the service of automatically sounding "start" and "stop" work and "rest period" signals.

Still another service depicted by "THE GREAT TIME SAVER" Booklet is that of automatically and simultaneously locating a group of executives, without disturbing others at their work, for important conferences.

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Moss[8,9,10,12] emphasize that the eyes evolved under daylight levels of illumination and suggest the desirability of competing with daylight by artificial means. They consistently ignore the fact that the eyes readily adapt to easy and effective seeing over a wide range of illumination intensities.

Summary statement—Examination of the data employed by Luckiesh and Moss as a basis for specifying foot candle levels for visual work reveals a general lack of validity of these results as criteria for ease of seeing. The data from visual acuity, muscular tension, and visibility measurements are misinterpreted or misapplied. The blink technique and rate of heart beat must be rejected because of lack of confirmation by independent workers. Furthermore, the methods of statistical analyses employed are frequently at fault. Any science of seeing based upon such an unstable foundation, therefore, must lack validity. Since these data have been the justification for specifying what appear to be excessively high levels of illumination intensity, we must reject such specifications unless justified by valid evidence from new experimentation.

LIGHTING CODES

School lighting—The American Recommended Practice of School Lighting[27] specifies the following minimum foot candles in service: 15 for classrooms, shops, and offices, 25 for sewing and drafting rooms, and 30 for sight-saving classes. There is a general agreement on the importance of hygienic illumination in reading and study situations. The recommended foot candle levels seem satisfactory in view of research findings other than those cited in the code. There should be, of course, a sound experimental basis for recommendations of this kind. Tinker[17] has pointed out that the recommended practice for school lighting is based upon conclusions derived from misinterpreted experimental results. Fortunately, the recommended practice is adequate in spite of inferences from inadequate data.

In a later publication by Sturrock,[15] the foot candle levels are not in an approved code but are listed as the levels found desirable in the experience of successful business institutions, i.e., good present-day practice. For schools the foot candles listed include: 30 for study halls, classrooms, general laboratories, general manual training; 50 for drawing room, close work in laboratory, sight-saving classes; 100 (considered especially low) for close work in manual training, in sewing rooms. It is obvious to the impartial person who knows the field that these suggestions represent more intense illumination than is necessary for adequate seeing in the school situation. Data summarized by Tinker[18] and additional experimental evidence[19,21] indicate that about 15 foot candles are adequate for ordinary schoolroom tasks, and that 25 to 30 foot candles are satisfactory for the more severe tasks. Justification for the higher intensities is sought in the discussions of Luckiesh and Moss[10,12] and Luckiesh.[8] These have been evaluated above.

Office lighting—The Recommended Practice of Office Lighting[28] includes the following foot candle levels: 50 for difficult seeing tasks such as accounting, bookkeeping, and drafting; 25 for ordinary seeing tasks such as general office work, private office work, mail rooms; 10 for casual seeing tasks such as reception rooms and washrooms; 5 for simple seeing tasks such as halls and stairways. Considering the severity of the tasks performed by some workers in general offices and special (as accounting) offices, the above recommendations are satisfactory. The 50 foot candles, however, should be considered liberal even for the difficult seeing tasks. The statement that "Higher values will contribute to accuracy, speed and ease" cannot be accepted as valid.

Sturrock's[15] summary of good present-day practice does not deviate markedly from the recommended practice except that typing and prolonged reading of shorthand notes are listed at 50 foot candles and intermittent reading and writing at 30 foot candles. Each of these is about twice what is needed in terms of the visual task. The basis for the higher intensities is in terms of the discussions of Luckiesh and Moss.[10,12] The inadequacy of these data has been pointed out above.

Industrial lighting—A wide range of illumination intensities is recommended for various tasks in industry.[29] Among the higher foot candle recommendations are: over 100 foot candles for such operations as extra fine assembly, automobile finishing, and inspecting, cutting and sewing dark goods, engraving, proofreading, final inspection of tire casings, grading and sorting tobacco products, and certain inspection work in textiles; 50 to 100 foot candles for such operations as automobile assembly line, glass works inspection, fine inspection, bookkeeping, font assembly—sorting in printing industry, tin plate inspection, and stitching dark leather. With regard to all the recommendations, one is cautioned that the foot candles are minimum operating values and that in almost every instance higher values may be used with greater benefit.

It is stated that the recommendations are taken from a series of studies on the illumination needs of specific industries, or if not available there, from current good practice. Examination of these studies (listed on page 23 of report) indicates that in the main they are surveys rather than experiments. Furthermore, there is a lack of adequate descriptions of techniques employed. In a few instances a general description of methods was given. Apparently what happened was first to make a survey of practice. This was followed by some sort of job analysis to determine what has to be discriminated. Then by reference to research studies (as those reported by Luckiesh and Moss in their books), to deduce the intensity level of illumination presumably needed for the specific job. This method has some virtue providing sound data are referred to, which was not done in these cases. In a few instances it is stated that visibility measurements were made. Occasionally installations to achieve the recommendations were made, the effect observed and additional modifications made. In no case was there experimental determination of the light intensity needed.

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There are no valid experimental data which indicate that more than 50 candles are needed even for those practical visual tasks which approach threshold discrimination. Furthermore, as pointed out by Harrison,[6] visual comfort may decrease under high intensities.

Home lighting—The most recent recommended practice for home lighting[30] specifies intensities ranging from 10 foot candles on card tables to 100 and more for sewing on dark goods. Forty foot candles are recommended for such situations as children's study table, kitchen work counter, laundry, and for prolonged reading. There is no valid reason for going above 25 to 30 foot candles for the more severe visual tasks in the home.[18] Approximately 15 foot candles is adequate for many of these visual tasks. Figure 1 in the *Recommended Practice*[30] is misleading. "This chart shows the extent to which occupations and poor seeing conditions leave their mark on eyesight." The implication is that poor illumination causes ocular disability. There are no valid data which indicate this to be so. This chart represents an unjustified form of propaganda.

Present-day practice—Sturrock[15] has assembled foot candle levels of illumination which are labeled "good present-day practice." The tables are preceded by a classification (after Luckiesh and Moss) of foot candle needs for visual discrimination of tasks varying in difficulty. The material is apparently designed as a guide but is not necessarily in the form of recommendations. This sort of thing is valuable in many ways. But since it is based to a considerable degree upon the material presented by Luckiesh and Moss[10,12] and by Luckiesh,[8] the illumination intensities are excessively high in some instances, as 100 foot candles for sewing and proofreading, and 50 foot candles for reading small type and for kitchen counters. It should be pointed out, however, that much of the material is fairly satisfactory.

Summary—intensity standards—Recommended practice prior to 1940[27] is fairly adequate, but as new codes are issued at later dates the apparent tendency has been to recommend as intense lighting as the traffic will bear. This is justified by referring to the work of engineers (largely Luckiesh and Moss) who state that these high intensities are still less than adequate for easy seeing. As pointed out above, both the experiments and the conclusions which are cited as fundamental are frequently invalid. Furthermore, the data are out of line with other independent experimental results.

VISUAL FACTORS

Eye disabilities—It is generally accepted that eyes with disabilities, even when corrected by glasses, need brighter light that normal eyes for adequate visual discrimination. Ferree and Rand[4] and Ferree, Rand, and Lewis[5] are usually cited as supporting evidence. In the first study,[4] it was found that apparent diopters of accommodation increased more for 14 presbyopes than for normal eyes in going from 1 to 5 to 25 foot candles of light. Interpolation indicates that for the normal eyes the curve of improvement shows little rise after about 8-10 foot candles; for the presbyopes, after about 15 foot candles. In addition *one* myope, and *one* presbyope were compared with a normal subject by measuring apparent diopters of accommodation at 13 intensities from 0.5 to 100 foot candles. The curve of efficiency for the normal person improved rapidly to 5 foot candles, then more slowly to about 20 and very gradually thereafter; for the myope there was considerable improvement to about 20 foot candles and little thereafter; for the presbyope there was considerable improvement to about 38 foot candles, and then slower improvement to 100 foot candles. It is, of course, impossible to generalize from *one case,* but apparently those with eye disabilities need somewhat brighter light than normals for clear seeing. This does not mean that they need 100 foot candles or more as some people wish to imply.

In the other study[5] Ferree and Rand were concerned with distant (20 feet) vision. The visual acuity for 4 presbyopes was compared with acuity for 3 normal people. The presbyopes continued to gain in visual acuity from 25 to 100 foot candles while the normal eye made little gain within this range. Since there is little or no relation between acuity of distant vision and acuity at near vision, these results have no bearing upon visual discrimination at the work surface (desk, work bench, etc.). Furthermore, one should not prescribe illumination for supra-threshold tasks in terms of threshold measurements (visual acuity). There is no evidence from these studies which implies that excessively high foot candles are necessary for those with ordinary visual disabilities. Rather, they suggest a moderate increase for those with corrected vision as compared with normal eyes.

Visual adaptation—It is well established that the eyes readily adapt to easy and effective seeing over a wide range of illumination intensities. This adaptation is rather slow in going from bright to dimmer illumination (for practical purposes, 15-20 minutes), and rapid in going from dim to bright illumination (1-3 minutes). Tinker[19] has demonstrated that when adaptation is incomplete on shifting to a lower level of illumination, speed of perception is retarded. When adaptation is adequate, however, visual perception in reading is fully effective from 3 foot candles up for normal eyes in reading legible print. In another study, Tinker[20] showed that subjects tend to prefer for reading approximately the illumination intensity to which they have been adapted, whether it be 8 or 52 foot candles. These data indicate that readers tend to consider comfortable for easy reading any one of a wide range of illumination intensities provided such intensities are above critical levels and provided visual adaptation is adequate. Codes of lighting have consistently ignored the role of visual adaptation in seeing. They carefully point out that the eye has evolved under the bright illumination of daylight, but do not mention that the eye also evolved to see adequately at low as well as at high intensities of light.

ILLUMINATION FOR ADEQUATE SEEING

Critical levels of illumination—The critical level of illumination is the intensity beyond which there is no further increase in efficiency of performance as the foot candles become greater. Tinker[18] has summarized the data for critical levels of illumination: for reading of legible print (about 10 point on good paper) by adults, it is approximately 3 to 4 foot candles; for reading and study of children, 4 to 6 foot candles; for arithmetical computations, less than 9.6 foot candles; for sorting mail 8 to 10 foot candles; for the exacting task of setting 6 point type by hand, 20-22 foot candles; and for very fine discrimination required to thread a needle, 30 foot candles. In a later study, Tinker[21] found the critical level of illumination for reading newspaper print to be about 7 foot candles.

Adequate levels of illumination—It is obvious that visual work should not be done at critical levels of illumination. There should be an adequate margin of safety to provide for individual variation and the like. For such visual tasks as reading good-sized print (10 to 11 point) on a good quality paper, i.e., print of good legibility, 10 to 15 foot candles should provide hygienic conditions when one's eyes are normal. For situations comparable to the reading of newsprint, 15 to 20 foot candles should be adequate. In situations involving the reading of handwriting and other comparable tasks, 20 to 30 foot candles seem desirable. For tasks comparable to discrimination of 6 point type, there should be 30 to 40 foot candles. And for the most severe tasks encountered in workday situations, 40 to 50 foot candles will be found adequate. There is no valid experimental work now available that indicates a need for over 50 foot candles intensity for adequate visual discrimination. The intensity values from 10 to 20 should be increased somewhat (5 to 10 foot candles) for eyes

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Where Is It All Going?

"Why can't I get more sinks?" "Why can't I get more bathtubs?" "What has happened to all the fittings?" "Somebody must be hoarding the stuff for higher prices!" Such questions and remarks as these are made hundreds of times every day by home builders and plumbers in every village, town and city in the country. But shortages are not indications that somebody is hoarding or building up stocks or that manufacturers are holding down production waiting for prices to get higher. Manufacturers are shipping material out as fast as they can. Many wholesalers are loading fixtures directly on trucks for delivery, before they get a chance to bring the items inside their own doors. The truth of the matter is that *demand passed up supply several years back, and supply has never since been able to catch up.*

The plumbing industry is manufacturing most items at an unprecedented rate, as U. S. Department of Commerce figures show. According to this agency, production rates of such items as soil pipe, bathtubs, sinks, lavatories and water closets had reached all-time highs by December of 1946. But the shortages that still exist are real and undeniable. A look at some actual figures will reveal why the shortages are there in the face of industry's tremendous production.

Let us look at the soil-pipe situation. In January, 1946, soil-pipe manufacturers had on hand orders for 272,473 tons of soil pipe and fittings. This backlog kept getting higher until it reached a peak of 356,636 tons in October. Since then the manufacturers have been steadily chopping away at these orders, reducing the unfilled order totals by 2,900 tons in November, 4,100 tons in December, 6,400 tons in January, and 17,000 tons in February! In March the reduction in unfilled orders dropped off to 6,700 tons. But January and March soil-pipe shipment figures showed greater production of this material than at any other time in history—52,339 tons in January, 51,827 tons in March; February, a short month, was slightly lower.

Shipments of soil pipe at the end of March, 1947, were running almost 70 per cent higher than in 1939, taken as a "normal" year. Yet, in March there were still unfilled orders for 319,434 tons. The only consolation for the builder or plumber who is pacing the floor for lack of this vital item is that the manufacturers have, since October, 1946, been making it somewhat faster than the additional orders have been coming in. Orders have been coming in in the neighborhood of 40,000 tons a month. If this continues, and if industry continues to produce soil pipe and fittings at the present rate of about 50,000 tons a month, thereby whittling off roughly 10,000 tons a month from the backlog, it can, by November of 1949, reduce that terrifically thick back-order book to zero! There is the story of your shortage in soil pipe. Should production records increase even further, and new orders come in at a slower rate, there may be possibilities of getting up to date several months earlier, but sometime in 1949 looks like a fairly safe date for the end of the soil-pipe shortage. Those years of war, while choking off supply, actually accelerated demand. Demand kept piling up; now we must bring it back to normal inch by inch.

The same is true of other plumbing items. Production is at an all-time high, yet we are soaking it up day by day, just as fast as we can make it. The Department of Commerce has given us index figures by which present production can be compared roughly with prewar production. The production index for all items in 1939, taken as the basic and normal year, is 100. Increases in production can be seen quickly by looking at the latest available index figures, those for February, 1947: for bathtubs, 158.1; for sinks, 221.1; for lavatories, 172.3; for water closets, 137.1. How encouraging that looks! And we *can* be encouraged by these figures to a certain extent, too, because now we find that many scattered items *are* in plentiful supply—for instance, lavatories, steel enameled baths, brass fixture trim and brass valves. Sinks are in fair supply. But still hard to get are water-closet combinations, enameled-*iron* baths, hospital fixtures, steel cabinets for sinks, boilers and radiation, steel pipe and malleable fittings. It's that old glutton "demand" creeping in again.

Estimates are that the U. S. will require 2,031,000 lavatories in 1947. In 1946 our total shipments of lavatories were only 1,093,000. But for the first quarter of 1947, 654,000 lavatories were produced. Production at this rate for the remainder of the year would total over 2,600,000. This shows up in the fact that lavatories are not now very difficult for the home builder or plumber to obtain.

The fact that the supply situation on sinks has eased somewhat is explained by production figures here also. Estimated requirements for 1947 are 2,101,000. The industry produced 913,000 in the first quarter. At this rate we have a potential of 3,752,000 sinks for this year. When the back-order file has been cleaned out, it appears that by year's end nobody will hunger for sinks.

Closet combinations are a problem. We need 2,343,500 in 1947. First quarter production of 594,000 closet bowls show that we are now manufacturing slightly over the requirement—almost every closet, as it comes out of the kiln, has its destination already decided—nothing left for stock or inventory—which means that frequently you have to wait for just the closet you want.

Certain types of bathtubs are hard to get. U. S. 1947 total requirements are estimated at 1,261,500. First quarter production came to 418,000, an indication that before the end of the year the bathtub situation should not be critical.

Radiation, cast-iron or convection, and plumbing pipe and fittings remain the hardest nuts to crack. Shortages of pig iron have made it almost impossible to bring production of radiation equipment up to normal. This is evidenced by the index figure of 84 at the end of February, 1947. The 1941 index for cast-iron radiation was all the way up to 140. With production slowed down to this extent, we can see how impossible it is for anyone to accumulate an inventory.

According to the American Iron and Steel Institute, last year over 4¼ million tons of butt-weld, lap-weld, electric-weld and seamless pipe and tube were produced for direct use. In the first two months of 1947, 775,260 tons were produced for direct use (for use as pipe, not for assembly into other manufactured items). At this rate 1947 production could surpass 1946 by considerably more than ½ million tons. Sounds like tremendous

production—and it is—but requirements are even more tremendous. American Iron and Steel Institute records show that every major manufacturer of pipe has his order books full all the way to 1950. In other words, even if no additional orders came in from now on, it would take until 1950 to supply all of the pipe *already* ordered.

We could cover numerous other items, but the story would be the same. Production is high, but things don't seem to be available. When we analyze production and consumption figures, we find that they are running very close, with production behind consumer needs in many instances. But a year ago consumer needs were running far ahead of production on most counts. A limited amount of finished product is being exported. Certain types or designs are more in demand than others, so that, although the overall production figures for a particular class of fixture or equipment are approaching the encouraging side, the type that you are trying to obtain may not be available in quantity—sometimes may not be available at all.

At present the outlook is good. Order backlogs are being whittled down a little more each month. It is hoped that by the end of 1947 most items will be in full (although still not plentiful) supply, so that plumbing dealers will be able to order "out of stock" instead of from "next month's production" or from production quotas two, three or more months away.—From the Crane Company.

"If you think you have a serious housing shortage because of four years of war. just consider that England had six years cessation of building and over three million homes destroyed."

—C. Howard Crane, Architect, London & Detroit.

An American construction firm has just started building a 3,000 unit housing project at San Juan, Puerto Rico, that will cost $18,000,000 and may eventually be extended to include 9,000 units at a total cost of $30,000,000. The houses will be flat-roofed, bungalow-type, built of concrete block, with concrete roofs and girders, and floors surfaced with native tile.

DR. M. A. TINKER (Concluded)

with slight disabilities or for those with corrections. For the higher values, however, no practical gain will be achieved for these people by increasing the intensity. The above suggestions hold for school children as well as for adults. In general, the child has much less severe visual tasks than adults.

Intensity of illumination cannot be prescribed without coordinating it with other factors such as distribution of light and brightness contrast. A good example of the uselessness of excessively bright light is found in the study by Darley and Ickis.[2] They were concerned with vision in the drafting room, a very severe visual task. In comparing 30 with 75 foot candles of indirect light, they found the efficiency ratings for the two to be only slightly different. When they compared 40 with 80 foot candles of direct light (troffer) under conditions of no reflected glare, they also found no significant differences in the efficiency ratings. The observations of Harrison[6] are relevant here. He points out the dangers of glare with installations of 50 foot candles and above of artificial illumination.

SUMMARY REMARKS

Examination of the literature upon which lighting recommendations are based reveals that some technique of experimentation are invalid, and that interpretations from certain other data are unwarranted. Some of the recommendations are adequate, others are not. The trend seems to be to specify as high intensities as the traffic will bear and at the same time warn the consumer that if he uses still higher intensities, he will improve his ease of seeing. All will agree that there should be sufficient light for adequate seeing. It is high time, however, that the consumer know what is adequate and what is surplus.

In general the recommended practice concerning distribution of light, brightness contrast and color of light is satisfactory.

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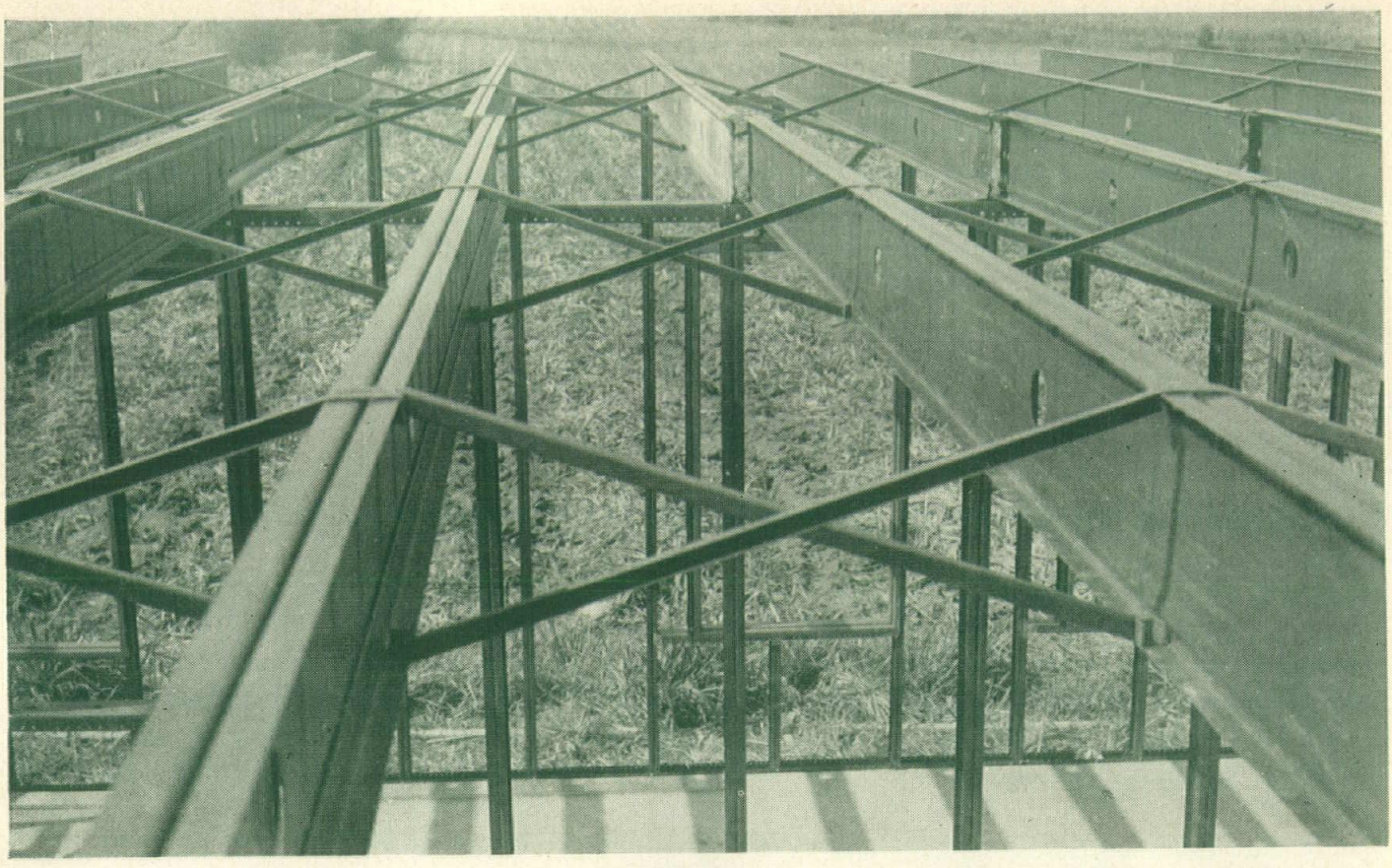

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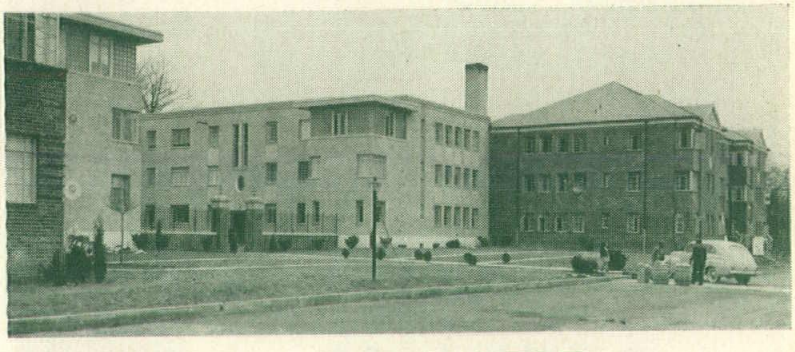

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