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TITLE:

COLOR PSYCHOLOGY

054-CLR COLOR PSYCHOLOGY --- 20 Articles about psycho-physical effects of the visible light spectrum: male/female/racial color preferences..The Benham Disk (Apparent color from spinning black & white pattern)..Stereoscopic Vision Test..Baker-Miller Pink vs. violent behavior..Seasonal color therapy..Full-Spectrum Light.. & Much More!

Jan '38 Pop Sci

Colored Fly Paper Attracts Insects

FLY PAPER in blue and red, instead of the customary yellow, is the invention of William S. Kell, of Upper Darby, Pa. Moreover, the new paper contains blocks on which there is no sticky substance at all. These blocks are criss-crossed by paths of rough paper, leading towards sections treated with the adhesive. Kell based his invention on the knowledge that flies are attracted by certain colors—including blue and red—and repelled by others, and that they prefer to walk on rough, rather than on smooth, surfaces. The ordinarily wary house fly is attracted by the colored paper, alights on it and, if it lands on an untreated section, seeks out the rough paths which it follows to its doom.

Pop Sci Jan '38

Pop Sci Aug 37

We Glow in the Dark, New Tests Reveal

ALL human beings glow in the dark. You may never have noticed it, but that is simply because the strange luminous display lasts only a few seconds after exposure to sunlight or other illumination, according to two Stanford University, Calif., experimenters.

As long ago as the eighteenth century, an observer named Beccharі reported, "If a person shut up in a dark room puts one of his hands out into the sun's light for a short time and then retracts it, he will be able to see the hand distinctly and not the other." Apparently, no one investigated this curious phenomenon furth r until 1933, when a Japanese research worker, S. Hoshijima, found that human bones, nails, cartilage, and teeth "phosphoresced," or glowed, after exposure to light, just as the chemical materials in phosphorescent types of luminous paint have long been known to do.

Now A. C. Giese and P. A. Leighton of Stanford University have found that invisible ultra-violet rays in sunlight and artificial light produce this human phosphorescence most effectively. After exposure for ten seconds to the light of a lamp containing mercury and argon vapors, the palm and back of the human hand glow for from two to four seconds, and the fingernails for ten seconds or more. Teeth phosphoresce for a still longer time. Other phosphorescent materials included wood, leaves, several kinds of flowers, and bean seeds.

n the Pink

(over)

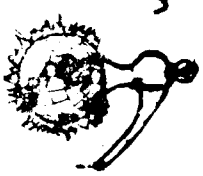
A few years ago, psychologists ported that placing a person in room painted pink generally erted a soothing effect, dimin- hing his aggressive tendencies. cordingly, mental hospitals d jails jumped on the band- agon and got out the brushes. But a new study by Dr. Robert Pelegrini of San Jose State University paints a different picture. The study, published in the Jour- al of Orthomolecular Psychiatry, valuated the difference in ag- ressive behavior between prison- s strip-searched in a pink ... ountry jail, and those strip- earched in a blue one. Turns out there is no difference. The next logical step? Wallpeper.

Red Best for Signals

RED, the traditional danger signal, proved itself to be the most easily distinguished of all colors at a distance, in recent tests for visibility of traffic signals conducted by the U. S. Bureau of Standards. Green came second, while blue ranked a poor third. Ordinary railroad yellow lights, it was found, often are mistaken for orange or red.

The observations were made at distances of 600, 900, and 1250 feet.

Rex Research



New Scientist 8 Nov '73

Blue light brings cell division to a halt

Cell division has been studied ever since microscopes have been available with sufficient resolution to follow it. The sequence of changes in morphology of the nucleus and chromosomes has been the main delight of cytologists for half a century. But we still know very little about the actual control processes which determine whether a cell will divide, whether it will pass through particular stages rapidly or slowly, whether it will undergo normal division (mitosis) or a more complex division (meiosis) to give rise to gametes which are involved in sexual reproduction. The growing cell must make its way past many junctions and traffic controls each controlled by cellular traffic lights, and we are not yet in a position to identify the components and mechanism of such control processes.

As a result, it is difficult to explain some quite simple experimental findings. At the University of California, San Diego, H. Ninnemann and B. Epel, now working in Tubingen and Tel-Aviv respectively, have been studying the controls acting on meiosis and mitosis in microsporocyte cells of lily flowers (Experimental Cell Research, vol 79, p 318). Normally these cells undergo meiosis and form pollen, but if they are explanted and reared in culture just before meiosis proper begins, they revert to a mitotic cycle. If such explanted cells are given brief daily periods of irradiation with blue light, all cell division is inhibited and the cells simply remain in interphase. The micrographs show that six days after explantation, the chromosomes of the control cells have segregated and division is about to occur, but the irradiated cells show no change. When the regular programme of irradiation stops, the cells start up and division occurs after a normal interval.

These experiments reveal two traffic controls. One is just before meiosis—in explanted cells the conditions are not correct and the route to meiosis is blocked. The second control is before the mitotic cell division—irradiation with blue light blocks progress through this control. Ninnemann and Epel tried unsuccessfully to identify the mechanism of this second control. The blue light causes no obvious inhibition of DNA, RNA, or protein synthesis. The target for the blue light must absorb radiation of about 400nm wavelength and we simply cannot identify what molecules might be involved in this. All we know is that, somehow, the blue light turns the traffic lights red.

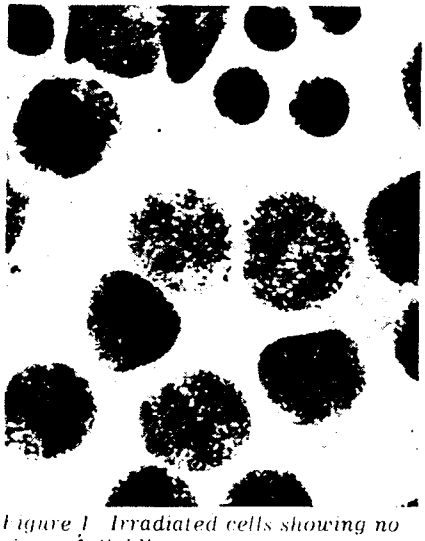


Figure 1 Irradiated cells showing no signs of dividing

Figure 2 Non-irradiated cells going into division

Lights can help the depressed

1/13/82

Chicago Tribune

People feeling depressed during the winter might need to lighten up, literally.

Preliminary studies have found that shining very bright lights on those with winter-time depression can improve their condition.

In a study conducted by a team of scientists at the National Institute of Mental Health, seven of 11 sufferers of depression found "profound relief" after they received exposure to bright lights three hours before dawn and after dusk.

The depressed subjects were exposed randomly to different forms of "light treatments" in their homes. Within a week, all subjects exposed to lights about six times brighter than regular fluorescent lights experienced some antidepressant effect. Only one person exposed to dimmer yellow lights noted significant improvement.

Dr. Norman Rosenthal, a principal researcher on the project, said preliminary results are encouraging and the federal scientists will repeat the tests, done last winter, under more rigorous conditions this winter.

"People definitely improved when they used this treatment," he said. "But the question we have to answer is whether the improvement is associated with light exposure or to sleep deprivation. It has already been well established that sleep deprivation will have an antidepressant effect."

In order to expose people to bright lights before dawn, it was necessary to awaken them.

The 11 subjects all met criteria for seasonal depression. Typically, they experience high energy levels and elation during the spring and summer, but by winter, they are sluggish, have an exaggerated appetite and sleep for long periods. The winter depression often causes problems in personal and work relationships.

number compared to all persons with depression," Rosenthal said, "but there are thousands of people who have this subgroup depression. We have received more than 3,000 letters here from such people."

Rosenthal, who did the research with Dr. Thomas Wehr, cautioned against people trying to treat themselves with different levels of bright light.

"We aren't certain that the light itself played a role," he said, "and we especially don't know what intensity or spectrum of light is best."

Since a federal research team led by Dr. Alfred Lewy discovered a few years ago that human production of the hormone melatonin is suppressed by sunlight and by bright artificial light, scientists have speculated as to the implications for human moods and body chemistry.

Melatonin is secreted by the pineal gland, sometimes called the "third eye," but only at night or in the dark. Earlier studies at the National Institute of Mental Health, Bethesda, Md., have found that manic-depressive patients are much more sensitive to light than are normal volunteers when it comes to suppression of melatonin.

...e same intensity of ...light could suppress twice as much melatonin production in a manic-depressive as in a normal subject, Lewy found.

Melatonin is thought to play a role in human reproductive cycles. In the north of Finland, for example, most human conceptions occur in the summer when the sun shines 20 hours a day and melatonin production is mostly suppressed.

A study of several hundred winter-depressives, who tend to be women, found that twice as many conceived in August as in January.

Mirroring a three-dimensional world

Combine an oscillating mirror with a special cathode ray tube, while relying on the same optical illusion that allows someone to watch movies or television, and the result is a glowing, three-dimensional image that shows parallax and depth. This new space-filling display may have a variety of applications, including air traffic control, seismic data analysis and computer-aided design.

The inventor, Lawrence D. Sher of Bolt Beranek and Newman Inc. in Cambridge, Mass., demonstrated his patented Space-Graph display at a recent symposium on perceptual research and military systems applications of three-dimensional displays, held in Washington, D.C.

Several people can view the display at the same time, without wearing special glasses, and see the object as it would appear from their particular viewpoints. The display also faithfully reproduces parallax effects so viewers can look over, under and around the image simply by moving their heads.

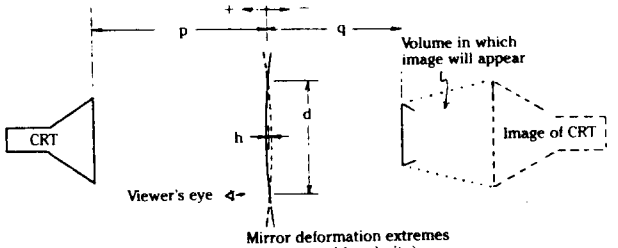
The display uses a computer-driven cathode ray tube, similar to a television picture tube but coated with a special phosphor that glows only when electrons strike, to present pictures of successively deeper layers of the desired image. A circular, aluminized acrylic mirror, facing the screen and driven by a 15-centimeter woofer at 30 hertz, oscillates from concave to convex and back again. Thus, when the mirror is synchronized with the cathode ray tube, each image layer appears farther away from the viewer than the one preceding. This occurs rapidly enough so that the eye is able to fuse the entire series into a single, flicker-free, three-dimensional image that occupies a volume equivalent to two basketballs.

One advantage of space-filling displays over conventional flat ones is in recognizing patterns and regularities in data, such as those involving earthquake zones. "Patterns may lurk in ... se space-filling data plots, but finding them can be difficult to impossible when their display is confined to a surface," says Sher. "From experience to date, a major value of these images is in the exploitation of eye and brain to find these patterns." Even the brightness of the individual dots that make up a display image can be adjusted to add a further dimension to data display.

A space-filling display can also show the vertical separation of airplanes in a holding pattern over an airport. At present, air traffic controllers see a stack of aircraft as a superimposed set of vectors and labels, while the height of each airplane is not displayed directly.

"The technology is already capable of doing a lot of things that people now struggle with," says Sher. He expects his display system will be useful for the analysis of all kinds of natural and man-made structures, like molecules and bridges or buildings. "We're looking now at the first instance of this technology, and it will certainly have lots of development in the next few years as it becomes more and more capable of handling certain specific applications," Sher says. —*I. Peterson*

A true three-dimensional display can be achieved by using a deforming mirror and a special cathode ray tube in the arrangement shown.



Bolt Beranek and Newman Inc.

Seasonal Color Theory Causes Hue and Cry Among Females

By Gayle Orcas

NEW YORK—American women are increasingly turning to "seasonal color theorists" for help in choosing their wardrobes.

Seasonal Color Theory was developed by Bauhaus artist Johannes Itten in the 1930s, but did not attract mass public attention until 1982, when hordes of California women began to "have their colors done." Today, it is estimated that one out of every 15 California women has consulted with a seasonal color theorist.

The theory is that each human being's skin has either warm, yellow undertones or cool blue undertones, and that only certain shades of dress are appropriate for each tone.

Shady Operation

In conjunction with hair and eye color, skin tone helps to categorize each woman into a specific season with a "personal palette" of 20 complimentary colors. The seasons, not unexpectedly, are spring, summer, autumn and winter (though not a few people running around these days look more like mid-March or very, very late Indian Summer.)

SCT's burgeoning popularity is due in part to the efforts of Claire Revelli, a consultant to Clairol, for whom she has developed a line of seasonal hair colorings. Revelli, authoress of the best-selling book "Color and You" provides these descriptions of the four seasonal cycles:

• Springs are characterized by the clear, vivid colors of fresh flowers. Those fitting the bill should wear light blues, corals, apricots, and peaches—but no blacks.

• Summers should avoid colors with yellow undertones, like orange, and should only wear black away from the face, as it is too overpowering for a fair complexion.

• Autumn-skinned women, whose skin evokes the rich, earthen tones of fall, can wear either muted or vivid colors, but should avoid yellow. Revelli says that autumnal skin tone is by far the most desirable.

• Winters make a powerful impression in strongly contrasting and primary colors, such as "true" red and navy blue. Winter, says Revelli, is "the only season that can carry off the drama of black and pure white."

Women interested in having their colors done can do it via questionnaire for $20, or use the following quickie test:

1. Look at the underside of your wrist. Compare its color with a friend's while holding a piece of white paper under each wrist. Does your skin show blue or pinkish tones? If it does, you are probably a cool winter or summer. If your skin has a golden cast or looks peachy, you're either a spring or autumn.

But make sure that you don't mistake a sallow skin for a yellow undertone, cautions Revelli. "Any season can be sallow" she says, "and sallowness often develops with age."

2. Look at your hair and eye colors. When considering hair color, remember that the best clue to your season is the shade of your hair when you were a child.

In an informal poll of East Coast professional women, Better Living found a certain bewilderment at the popularity of the SCT concept.

"Women already know what colors suit them," said one executive.

"I can see talking to a clothing consultant about style," said another. "Some women don't know that they shouldn't wear frilly collars or ruffles. But colors women know."

Not a Fad

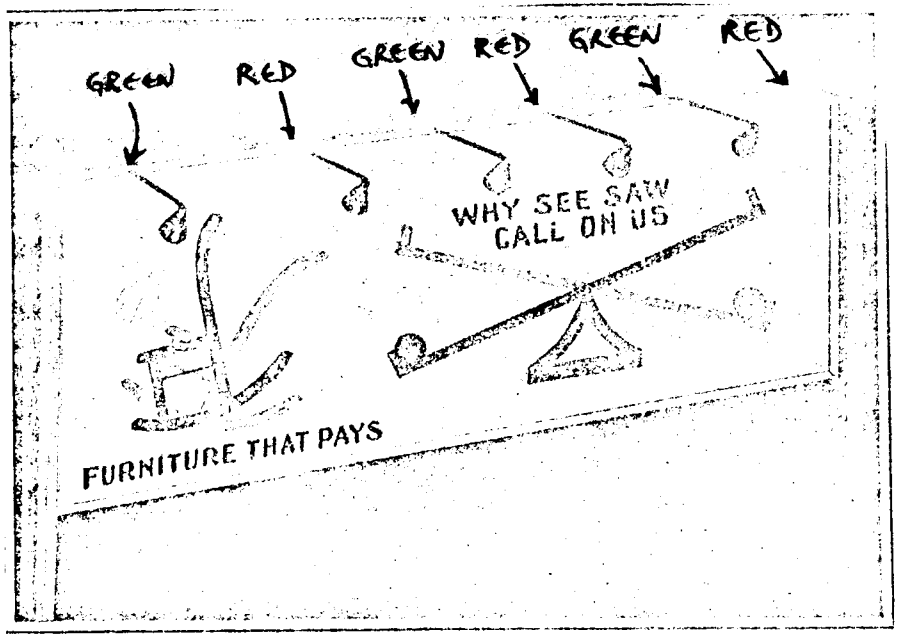
"If I showed the average woman two different colors, of course she'd be able to tell which one most suited her," counters Revelli publicist Sherry Goldman. "But SCT provides a complete color palette of the colors that most suit you. And not all women would know that." She adds, "This is not just a West Coast fad."

SCI. AMER 1919

Animating Stationary Signs by Means of Colored Lights

THERE is nothing new in the principle of the absorption of light rays by complementary colors. Indeed, M. Luckiesh, a recognized authority on color and illumination and a frequent contributor to these columns, demonstrated some years ago the effect on paintings of various colored illumination with the resultant altered appearance of the pictures to a marked degree. But there is distinct novelty to the practical application of this principle to advertising signs, which is covered in a patent recently granted to Richard M. Craig of San Antonio, Texas.

According to the specifications of his patent, Mr. Craig paints the subject matter of his sign in two positions, one position being shown in red and the other in green. Then he arranges both red and green lights for illuminating the sign, and alternately switches the current from one group of lamps to the other by means of a motor-driven switch. In the accompanying illustration, for example, is depicted an animated sign consisting of a rocking chair and a see-saw. These articles are each painted in two colors—in red for the first extreme position and in green for the second extreme position. In broad daylight, the two positions in red and green show plainly; but when illuminated alternately with red and green lights, the sign becomes animated in a most startling and convincing manner.



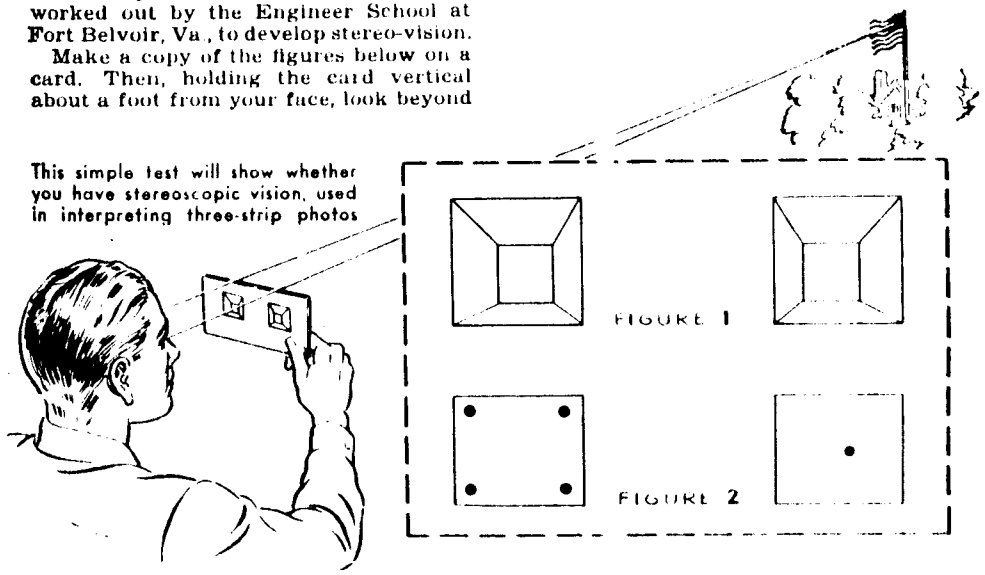
By painting signs in red and green and using alternately a red and a green light, startling animation may be secured

MARCH 42

Can You Qualify On This Army Test?

STEREOSCOPIC interpretation of aerial photographs is one of the newest things in air observation. When viewed this way, three-strip overlapping pictures reveal tanks, guns, and other military objectives in relief, contrasted with natural and artificial cover which might hide them in an ordinary two-dimensional view. To speed the study of such photographs, the Army is training men to use stereoscopic vision with the unaided eyes. Here is a simple exercise worked out by the Engineer School at Fort Belvoir, Va., to develop stereo-vision.

Make a copy of the figures below on a card. Then, holding the card vertical about a foot from your face, look beyond it at so e distant object for about 30 seconds. Without changing the focus of your eyes, move the card in front of them and look at the upper figures. You will probably see three truncated prisms, with the center one showing the effect of relief. Similarly, try shifting your eyes from the distant object to the squares and dots. After practice you should be able to see a third square with one dot in the center and one at each corner.

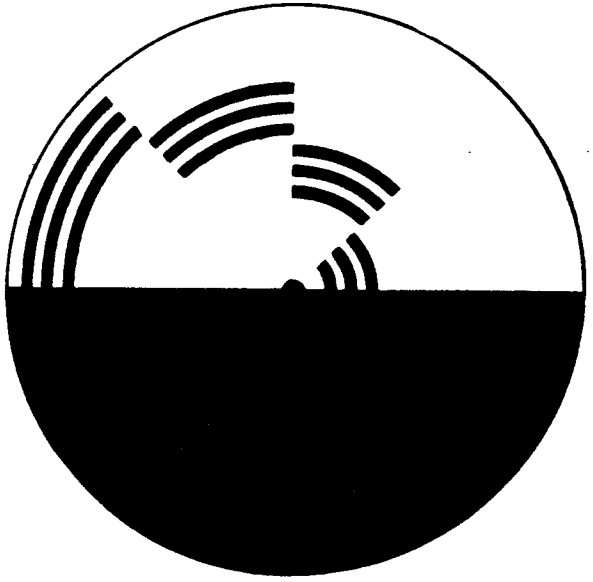


This simple test will show whether you have stereoscopic vision, used in interpreting three-strip photos

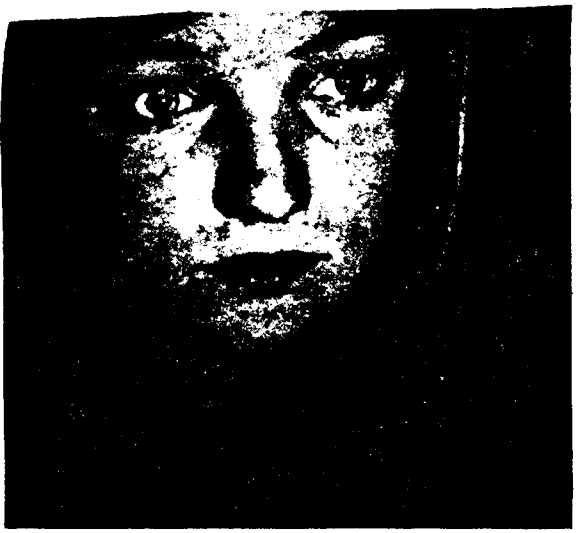
Black Lines Show Color as Benham Disk Revolves

C. E. BENHAM started something when he discovered this optical effect back in the 1890's. The disk at the right is ready for your scissors. Snip out the pattern, glue it on a piece of stiff cardboard, and mount it on a nail or pin so that you can spin it at a moderate speed, like a slow top. (Don't spin it as fast as you can, since the illusion is weakened and ultimately disappears at high speeds.)

As it turns, the black lines take on colors. When spun clockwise, the disk shows a reddish-brown inner circle, with concentric lines of greenish yellow, gray, and brown. Reverse the rotation and the colors reverse. Benham didn't explain this. Readers who think they have a sound, scientific explanation are invited to share it.



Secrets of Color

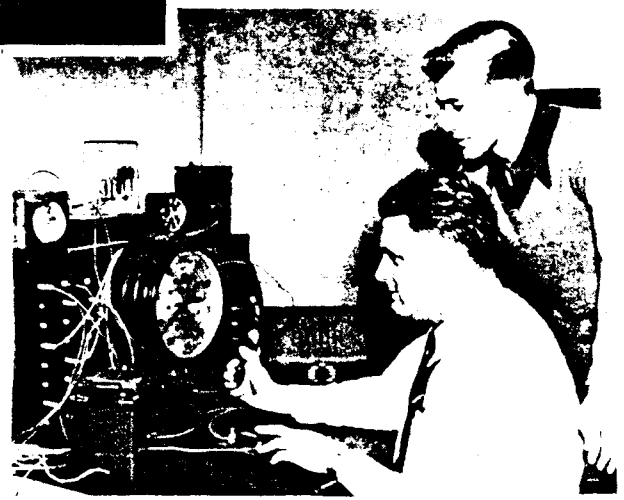


Jean Warren under the red spotlight in a test of the effect of lights of different colors on her reactions

QUIRKS OF COLOR

Men prefer blue, women green. Poor children are attracted by red; richer ones by green. Red lights speed up human responses. Green lights retard them.

POP. SCI. APRIL '41



Dr. Gilbert Brighouse, of Occidental College, Los Angeles, sounds a signal to be answered by Jean as soon as she can after hearing it. The electric chronometer times her

Jean is in another room with the spotlight throwing beams of changing colors upon her face. Under each color, as she hears the signal, she answers by pressing on a key

Here is Jean in the green light. Her head is in a metal frame so she won't move out of the beam. Her reactions were quickest under the red light

HUMAN reactions to colors are being studied at various universities and other institutions. When the scientists have the data on which to base opinions, their findings will be influential in lighting and decorating schemes. Certain basic facts have emerged already. It has been determined that red is a stimulus and blue is soothing to most of the subjects.

In general, men seem to prefer blue, and women green. Children of poor parents find red the most appealing color, while those from wealthier homes like green better. Individual reactions, of course, are multitudinous in their variety and still largely inexplicable. Yellow may be the favorite color of one woman, while another finds exposure to yellow light nauseating.

Dr. Gilbert Brighouse, associate professor of psychology at Occidental College in Los Angeles, has been conducting tests there with hundreds of students of both sexes in a black-walled basement room, exposing their eyes and faces to various colors while recording measured responses. Eventually, he expects to test them with their faces shielded and other areas exposed to colors.

One test was repeated 455 times with each of 17 students. A spotlight sent a beam, first of one color and then of another, to the face of the subject. Dr. Brighouse sat in a room above. On his desk was a key which sounded a signal in the room below. He pressed the key; each student, as soon as he heard the signal, pressed a similar key, and an electric chronometer timed the action.

The quickest responses came when the red spotlight was on. Dr. Brighouse calculated that they came one-eighth faster than when untinted light was turned on. In the case of one youth, only one five-hundredth of a second elapsed between impulse and response; the time under normal light was sixteen one-hundredths of a second. A blue light retarded response to almost exactly the same degree as the red stimulated it.

Psychologists of Harvard University and the University of Chicago tested 2,500 children with six spectral colors and found that blue was the favorite. The second choice, green, was considerably behind blue, but red was a close third. Violet, yellow, and orange were chosen in that order. Similar tests were made with somewhat older children and it was found that green now was the favorite color, with blue, violet, orange, and yellow chosen in that order. It was during this experiment that the fact emerged that poorer children preferred red, while wealthier ones chose green first.

At the University of Kansas 343 students were tested to determine their preference in colors. Spots of blue, green, red, amber, and clear light were thrown on a ground-glass screen in succession, and then in combinations of two colors each. In the single colors men chose blue, and women green. Red was the second choice of both. In the combinations the men preferred red and blue and the women chose the clear light with the green.

In an effort to make the surroundings of patients at the New York Psychiatric Institute and Hospital as pleasant as possible, Dr. S. E. Katz examined them as to their color preferences and found that the men chose green, and the women red. Carrying the examination to those who had been inmates of an asylum for three years, Dr. Katz found that blue was chosen by the majority of both sexes. Among patients of still longer standing, orange was the favorite color.

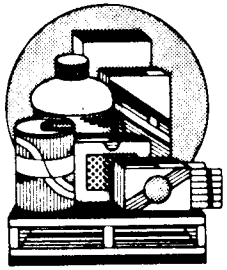
Color Grows More Important In Catching Consumers' Eyes

NOV 29 '84
WALL ST. J.

By Ronald Alsop
Staff Reporter of The Wall Street Journal

THE RITZ CRACKER BOX celebrated a milestone this year: It turned 50. And like many fading beauties of that vintage, the box got a face lift. The new package is redder and trimmed with a thin gold band.

"We tried to make Ritz look ritzier," says John Lister, whose firm did the redesign for Nabisco Brands Inc. "We want it to speak to young, affluent consumers."



The colors of packages, logos and signs have always been important in marketing consumer goods, but these days companies like Nabisco are taking color more seriously than ever. In the past, colors were chosen quite subjectively. The famous Campbell soup can, for example, was the inspiration of a company executive who liked the Cornell University football team's red and white uniforms.

But in this era of market segmentation with menthol, caffeine-free, sugar-free and low-salt versions of many products, companies are paying consultants thousands of dollars for advice on which colors will stand out most on cluttered shelves and in advertising. Perception researchers flash slides of package displays, while a camera and computer track consumers' eye movements to detect what they see first.

"Color isn't the most important thing; it's the only thing," declares Alvin Schechter, a New York package designer. "Color goes immediately to the psyche and can be a direct sales stimulus."

SOME NEW INDUSTRIES are just starting to use color strategically. Microsoft Corp., for example, is counting on zippy new crimson red and royal blue packages to help it compete in the crowded computer software market. The company's old forest green packages weren't very eye catching. What's more, color consultants note, green connotes frozen vegetables and chewing gum, not high tech. Says Patricia McGinnis, Microsoft's design director: "Packaging is where the software war may be won or lost."

But color affects food marketing even more because people taste with their eyes. When designers at Berni Corp. changed the background hue on Barrelhead Sugar-Free Root Beer cans to beige from blue, people swore it tasted more like old-fashioned root beer served in frosty mugs. No matter that the beverage itself remained exactly the same. Similarly, consumers ascribe a sweeter taste to orange drinks the darker the orange shade of the can or bottle.

It's difficult to correlate color with product sales. But Berni claims that when it changed Canada Dry's sugar-free ginger ale can to green and white from red, sales shot up more than 25%. The red can had sent a misleading cola message to consumers.

Changing package colors is harder than it looks. Consultant Thomas Paul says Campbell Soup Co. executives agonized before dumping the turquoise triangle on Swanson frozen dinners this year. "Turquoise is a dated '50s color," says Mr. Paul, "but the company felt it was too important to the brand identity to lose it. I reminded them that consumers no longer liked the old identity."

THE DIET COKE CAN seems like a simple enough color design: It has red lettering on a white backdrop, just the reverse of the regular Coke can. But Mr. Schechter, the package designer, spent six months and created more than 150 different cans before finding a winner. At first, he says, red on white looked too sterile and lacked taste appeal. Ultimately, the red letters were fattened and "a gray pinstripe" was added, resulting in what Mr. Schechter calls "an active, richer can." Coca-Cola Co. executives thought Mr. Schechter was a heretic when he suggested at one point a blue can, the trademark of arch-enemy PepsiCo. Inc.

Consumer-product companies often try originality to get attention. The successful Mrs. Fields cookie-store chain chose red for its stores, even though brown and tan suggest cookies and chocolate better. "It was a risky gamble not looking like grandma's kitchen," says Michael Purvis, senior vice president of S&O Consultants Inc. "But most cookie purchases are made on impulse by young women, and we felt they would respond to a more stylish look."

Sometimes, though, marketers are bound by a traditional color vocabulary that cues consumers to the product being sold. It's unwise to sell whole milk in anything but a red carton or to stray from blue labels for club soda. And thanks to McDonald's, many consumers don't believe a restaurant serves fast food if its signs don't have at least a smidgen of red and yellow.

ALTHOUGH NOT AS FADDISH as fashion colors, package colors can be fickle, too. White is losing popularity even though it's a symbol of purity. That's partly because companies don't want brand-name goods to be confused with the generic products that come in plain white wrappers. Black, in contrast, is coming on strong after years of being taboo because of its funereal symbolism. Minute Maid orange juice was a pioneer; now black is turning up on cigarette packs, Heinz vinegar bottles and frozen Armour Dinner Classics to suggest quality and elegance.

Legally, companies can't claim exclusive rights to a color, but sometimes they can stop competitors from mimicking a certain combination of colors or a color used along with a specific design. Eastman Kodak Co. has successfully prevented companies from copying its yellow, black and red "trade dress," but courts have refused to extend such protection to the striped Life Savers wrapper and Campbell soup can. Says trademark attorney Jerome Gilson: "The courts' view is that there are only so many colors in the rainbow. They tend to limit the use of color only when the public might be confused about what brand they're buying."

THE COLORS OF BEHAVIOR

The color (wavelength) of light is another aspect that seems to influence behavior, but the effects are often hard to pin down. While most people, for example, think that colors such as red or orange are more warming than others, their judgments have proved inconsistent. Psychologist Corwin Bennett from Kansas State University asked 21 volunteers to wear goggles of different colors and sit in a room in which the temperature was raised from 60 to 100 degrees Fahrenheit and back again. He found that the color of the goggles "simply did not produce any observable effect on thermal comfort judgments." Bennett thinks that although people believe they are warmer in a red room and cooler in a blue room, they really do not feel any difference in temperature and are no more comfortable.

The color of a room's lighting does, however, affect how large it appears. When Bennett asked people to guess how far away from a wall a cutout figure of a woman had been placed, most overestimated the distance for white walls and underestimated the distance for black ones. Colored walls had a similar effect: Blue seemed farther away from most of the subjects he studied, while red seemed closer. Bennett calls blue a "receding" color and red an "advancing" color.

"Eye-ease green" was developed to have a specific effect in a particular setting, worked well there and then was used widely elsewhere without any real justification. Lighting and color consultant Faber Birren notes that the color was originally developed during the 1930s for use in hospitals in Great Britain. Surgeons looking at red blood and tissue for a period of time saw disconcerting green (red's complementary color) afterimages when they glanced up at white walls, sheets, towels and garments.

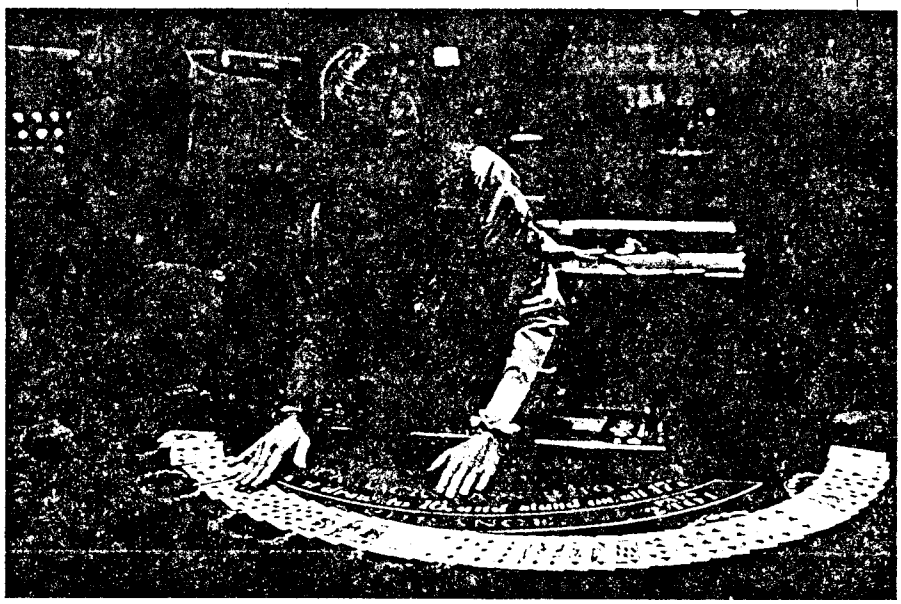
To solve the problem, the walls, clothing and towels in the operating arena were all colored green. This seemed to help the surgeons concentrate and allayed their worries about visual difficulties while operating. While there was no reason to believe that "eye-ease green" would be valuable in other situations, it since has been used in everything from industrial cafeterias and schoolrooms to writing tablets.

"Baker-Miller Pink" is another color whose performance has underwhelmed expectations. Touted to reduce aggression among prison inmates, it has been painted in cells around the country, with inconsistent results. "People love to see a magic bullet," environmental psychologist Richard Wener says. "It strikes me as very unlikely that we will find such a simple solution to complex problems."

Despite these shortcomings, researchers have been able to pinpoint some specific behavior responses to color. In research conducted at Plymouth Polytechnic, British psychologists Gary Stark, Daniel Saunders and Philip Wookey found a difference in risk-taking behavior of 28 students they studied: Those who sat under red lights gambled more and selected "riskier" bets than those who sat under blue lights.

The effects of red and blue lights on people's performance and behavior were also compared in another situation. Aboard submarines, where no daylight reaches the sailors for weeks at a time, artificial white light is used most of the time. But during each 24-hour cycle, there is a period of simulated night during which dimmer illumination is needed. "More through habit than anything else," dim red light is spread throughout the ship's living spaces, which allows sailors both on and off duty to experience "dark times," according to experimental psychologist Saul Luria of the Naval Submarine Medical Research Laboratory in Groton, Connecticut.

Swedish researchers Trevor Waters and Toni Ivergard tested 12 men on four navigation tasks under red and white lights and found that the sailors disliked the red light more and had difficulty making out some of the red lines on the navigation charts under red lighting. When Luria and his colleagues tested blue, red and white lights, low-level white light was significantly more popular than either blue or red; it has also tested well on performance scales, Luria says.



Risky red: You're apt to bet more and take more chances in this casino atmosphere.

ALAIN KELER/SYGMA

Wener says. "If it could have been easily turned off, it probably would not have been broken."

Contrast is another key to creating pleasing lighting systems. Although conventional wisdom dictates that the difference in brightness (usually expressed as a ratio) between an object and its background should be less than 10 to 1, Bennett finds that "pleasant" lighting can have ratios as high as 640 to 1. He concludes that people prefer high contrast as long as it is not glaring.

One question designers face is whether to use fluorescent or incandescent bulbs. Bennett believes that the common complaints about fluorescent lights—that they are unpleasant, that they give off strangely colored light—are at least partially due to the lamps in which the bulbs work. When he and his colleagues designed lamp units that looked identical from the outside, 132 men and women rated the light from cool white fluorescent and incandescent bulbs as equally pleasant. This doesn't mean that performance would be the same under both kinds of light. Because of the way they are made, Bennett notes, fluorescent lights flicker very rapidly. This happens faster than the eye can see, but it may cause distress to some people, especially if they use computer terminals with screens.

Several fluorescent bulbs now on the market may solve some problems of artificial lighting by providing a full-range light spectrum similar to that of the sun. One is the Vita-Lite, manufactured by the Duro-Test company of North Bergen, New Jersey. "The bulb sells for two to three times what standard bulbs sell for," says Woody Bickford, director of environmental lighting at Duro-Test, "but is the only one that simulates natural light in both the ultraviolet and visible light parts of the spectrum." Studies by psychologist Philip Hughes, director of environmental photobiology at Duro-Test, suggest that such bulbs may improve visual acuity and make work less fatiguing.

Installing full-spectrum bulbs may also provide important health benefits to those who sit under them. In several medical centers around the country, therapists are using extremely bright full-spectrum bulbs to treat patients with a comparatively rare problem called "Seasonal Affective Disorder" (SAD), a form of depression that is particularly acute in the fall and winter months.

IT MAY SOON BE POSSIBLE TO TREAT PEOPLE SUFFERING FROM FORMS OF INSOMNIA AND JET LAG WITH LIGHT THERAPY.

Researchers believe that the brain's pineal gland plays an important role in helping the body adjust to its environment, including light. As the days grow shorter in the fall, the pineal gland secretes more and more of a hormone called melatonin. Melatonin levels can be used to measure a person's circadian cycle and sensitivity to light. Several researchers have found that having such patients sit under an extremely bright (up to 10 times brighter than office lighting) full-spectrum light for several hours each day can offer the real benefit of alleviating their depression. Psychiatrist Daniel Kripke believes that the SAD patients are a subgroup of the manic-depressives, who experience extreme mood swings. It is very common for winter depressives to experience periods of extreme elation in the springtime, he says. But Kripke warns that because of this, there can be side effects from light therapy. "It is possible for the light therapy patients to slip into mania," he says.

Other researchers, including psychiatrist Alfred Lewy of Oregon Health Sciences University, believe that certain wavelengths, such as blue-green light, are most effective in lifting the depression. Lewy classifies SAD patients as "phase delayed," meaning that their circadian body rhythms run behind schedule. They need morning light, especially, to put them back on track. Why the light works in treating "winter" depression is not yet known.

Another psychiatrist, Norman Rosenthal at the National Institute of Mental Health, has recently treated children with SAD with full-spectrum bright lights. In five of six cases, the treatment relieved symptoms such as fatigue, extreme difficulty in arising, sadness, irritability, anxiety, crying spells and headaches. Rosenthal believes it may soon be possible to treat people suffering from forms of insomnia and even jet lag with light therapy.

Other types of light are being used in health treatments. Hospitals bathe babies who are born with hyperbilirubinemia, a condition that can lead to neonatal jaundice, in blue light. By a mechanism that is not yet understood, the light causes toxic substances in the babies' bloodstreams to break down and wash out of their bodies.

Scientists in the Soviet Union are testing the use of ultraviolet light on children. Preliminary evidence suggests that they have clearer vision, increased resistance to fatigue and shorter reaction times to light and sounds than do untreated children. Past research has shown that ultraviolet light may help the body absorb calcium. But there are drawbacks: Excess exposure to ultraviolet rays has been linked to premature skin aging and, in the extreme, to skin cancer.

Psychologist Robert Gerard, a private practitioner in Los Angeles, believes that "using light in a series of symbolic visualizations can have a dramatic impact upon the health and well-being of patients." In one technique, he tells his patients to begin meditating and then asks them to imagine a color that they see as beneficial or healthy. If no colors come to mind, Gerard may suggest blue for relaxation or orange for activation. He then instructs patients to fill their bodies with the color or to imagine that they are taking a shower in the color. "It is much more reliable to use visualization than to use an actual color," he has found.

Even if the health benefits currently being claimed turn out to be less than expected, the potential benefits have spurred the research community into further study on the effects of light on the body. How people feel about the importance of light is shown by a Louis Harris poll of a few years ago, in which 85 percent of the office workers questioned named lighting as the number one factor in comfort on the job. ◻

Jeff Meer is an assistant editor at Psychology Today.

When the food has not been used for two months, it can usually be used once each four or five days without hazard. A return to daily usage will cause a prompt return of sensitivity, however.

APPENDIX

Food dye preparations as used by Dr. Stephan Lockey. Physicians can obtain small water soluble samples of ten food dyes from the Division of Specialty Chemicals, Allied Chemical Corporation, as described in his paper. These are the FD&C Blue 1, 2, Green 3, Red 2, 3, 4, 40, Violet 1, and Yellow 5 and 6. Method: dilute 2 grams of the food color with 98ml of triple distilled water. This solution will contain 20mgms of the particular dye per milliliter. This is dilution number 1. A further dilution should be prepared, using 1 ml of dilution number 1 and 9 ml of triple distilled water, so that 1 ml will contain 2 mgm of the FD&C certified food color. This is the dilution for testing the patient. Testing Method: 1 ml of dilution number 2 is placed sublingually and patient is observed for 20 minutes for possible bronchospasm, dermatitis, edema, headache, or other reaction. If no sensitivity occurs, the test can be repeated with dilution number 1.

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(FALL, '74)

Light, Radiation, and Academic Behavior

Initial Studies on the Effects of Full-Spectrum Lighting and Radiation Shielding on Behavior and Academic Performance of School Children

Lewis W. Mayron
John Ott
Rick Nations
Ellen L. Mayron

THERE IS A SCARCITY of knowledge with regard to the biological effects of artificial lighting and its instruments, especially as it applies to human beings. Much has been said about the value of outdoor daylight and sunlight; but, except for the well-known effect of rickets caused by vitamin D deficiency that resulted from lack of sunlight, there is little documentation of these values.[1] This study was initiated as a pilot attempt to establish and document the value of full-spectrum lighting as it affect's school-age children.

Methods and Materials

Four first-grade classrooms in the Gocio Elementary School, Sarasota, Florida, were utilized for the experiment. Two of these rooms were to be used as experimental rooms and two as control rooms. All four rooms had standard fluorescent light fixtures, and the fixtures were fitted into recesses in the ceiling. Rooms 1 and 3 were retained as control rooms, using cool white fluorescent bulbs (Westinghouse F40CW, 40 Watt) in unmodified fixtures (four bulbs per fixture). In rooms 2 and 4, three changes

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were made: Vita-Lite fluorescent bulbs (Duro-Test Corporation, Rapid Start/Preheat Power-Twist, TH12BTC, Code Number 3812, 40 Watt) were installed in the fixtures in place of the cool white bulbs; the cathode elements at the ends of the fluorescent bulbs were wrapped with lead foil to shield against soft x-rays; and the recesses containing the fixtures were covered with grounded aluminum mesh screen to shield against low frequency electromagnetic radiation. "Egg crates" (cubic plastic louvers) were used in the lighting fixtures of all rooms in place of the plastic diffusers. Just below the fixtures, there were 85 foot-candles of light; the range throughout the room was 65-85 foot-candles.

Box shelters were built into an upper corner of each room, into which a time-lapse camera (Bell & Howell 70 Series with a rebuilt shutter and a synchronous electric motor) was secreted. Four to five times throughout the semester of January to June, 1973, the 16 mm time-lapse camera was started automatically by a timer. Neither the teacher nor the students were aware of being photographed, and the films showed that no interest was being paid to the box with its hidden camera. Each photographic segment was taken over a period of 30 minutes at a rate of three frames per second. When processed and projected at a normal speed, each film segment lasted approximately three minutes. The motor activity of the students was thus recorded on film.

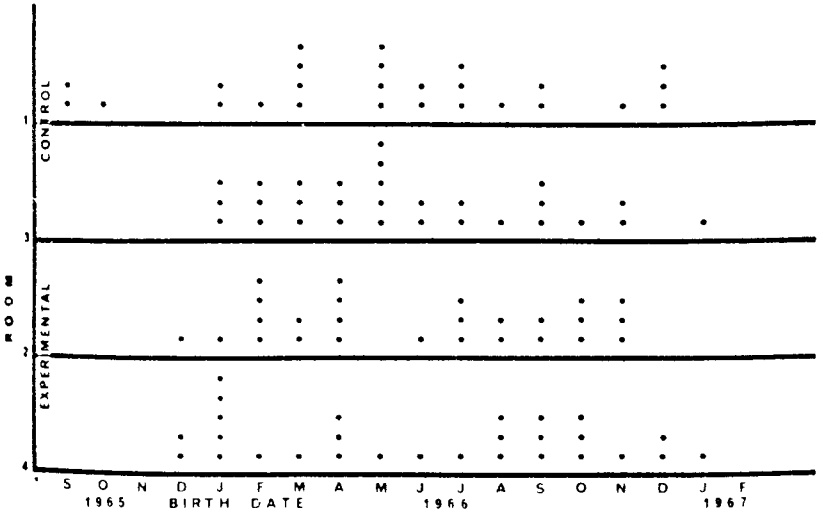
In order to convert the observed analog behavior into digital records, each film segment was timed to the second with a stopwatch. Then, each student was observed with stopwatch-in-hand, and the total time of hyperactive behavior was recorded. This was calculated as the percent of the total segment time, thus allowing a comparison between film segments and a common denominator with which to compare individual students. The percent activity values for the final film segment of the semester was subtracted from the percent activity values for the initial film segment to obtain a change-in-activity value, or delta. If a student exhibited less hyperactive behavior in the final segment, then the algebraic sign of the delta was positive, thus indicating improvement; if more hyperactive behavior was shown, the algebraic sign of the delta was negative, thus indicating deterioration of behavior.

Since there was a small amount of variation in percent activity values with students who exhibited fairly consistent behavior patterns, delta values of less than ±8 were not considered to be of any significance, and only values of ±8 or larger were seriously considered in the comparisons between rooms.

In order to consider the possibility that maturity factors might play a role, the birth dates of the students in each room were plotted by month to demonstrate the fairly even distribution, as shown in Figure 1. The age cutoff for school admission is January 1. Theoretically, the older half of the class consists of those whose birthdays are in the range of January through June and the younger half those whose birthdays are in the range of July through December. However, examination of the distribution of birth dates in Figure 1 reveals a more even division between May and June; thus, this division was used in the comparisons of data to evaluate maturation factors.

Figure 1

Student birth dates plotted by month and year for each room.



The data were also examined for differences due to sex, but no differences were observed; however, the numbers of subjects are small. Thus, slight differences may not be observable.

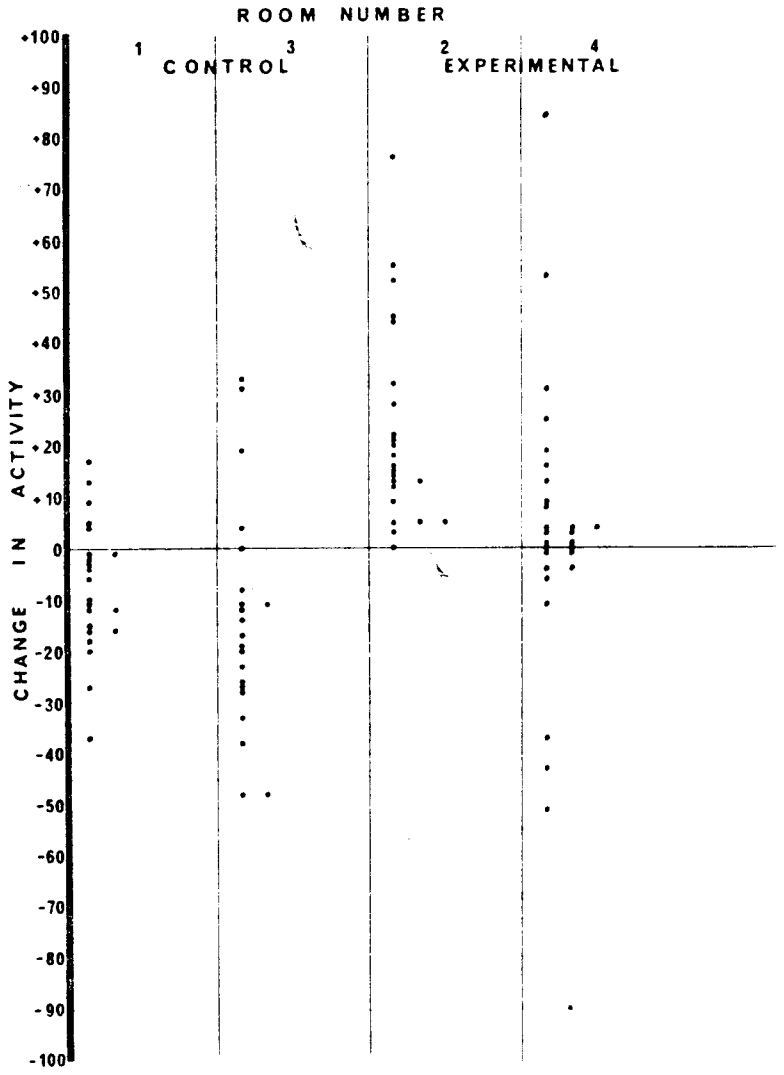
Academic achievement of the children was evaluated by testing them at three times in the semester; at the end of the second grading period (second quarter), at the end of the third quarter, and at the end of the semester. The test instrument used was the *SCORE* student performance objectives,* which are behavioral objectives at 18 achievement levels in reading and perceptual motor skills. Only five levels are allowed for the first

*Textbook Services, 2419 Hatton Street, Sarasota, Florida 33577.

school totaled 68 for room 1, 11 for room 3, 45 for room 2, and 24 for room 4; no age differential was seen. Behavior referrals were handled differently by each teacher, totaling 23 for room 1, zero for room 3, 23 for room 2, and 7 for room 4. Thus, no conclusions could be reached.

Figure 4

The change-in-activity data for rooms 3 and 4 are plotted against the number of SCORE levels achieved by each student.



Discussion

There are several known environmental causes of hyperactive behavior and/or learning disabilities, among them chronic arousal or stress,[2] allergy,[3] malnutrition,[4] toxicity,[5] and television radiation.[6] It would thus appear that improprotioned lighting (lighting with improper balancing of wavelengths) and/or radiation, can have similar effects. It may be that these factors are simply stress-inducing in particualr children and may have nothing to do with the particular susceptibility of these children to stress. At present, however, we have no means of ascertaining this.

The change-in-activity data shown here are highly significant and are clearly attributable to the experimental conditions.

The academic achievement data are also significantly different among the rooms, but the reasons for these differences are not clear. The 15 students who achieved two *SCORE* levels are much greater a number than would be expected, either as a percentage of the total, or with reference to the control rooms. The low number (one) of two-level achievers in room 2 is much lower than expected. Thus, it would appear that the results from these rooms are caused by teacher differences, with the teacher from room 2 doing a poor job of teaching, and the teacher from room 4 doing a great job of teaching. The *SCORE* level progressions for each room shown in Table 3 would appear to confirm this. When compared to rooms 1 and 3, however, (three and seven two- and three-level achievers, respectively), the results from room 4 are still much too good to be accounted for by simply saying "teacher difference." One factor has not yet been discussed: the effect of the experimental conditions on the teacher. If the teacher becomes "turned-on" by the conditions and in turn is able to stimulate the students to greater achievements, then this has to be considered one of the effects of the experimental conditions; and it cannot be explained away by the term "teacher difference."

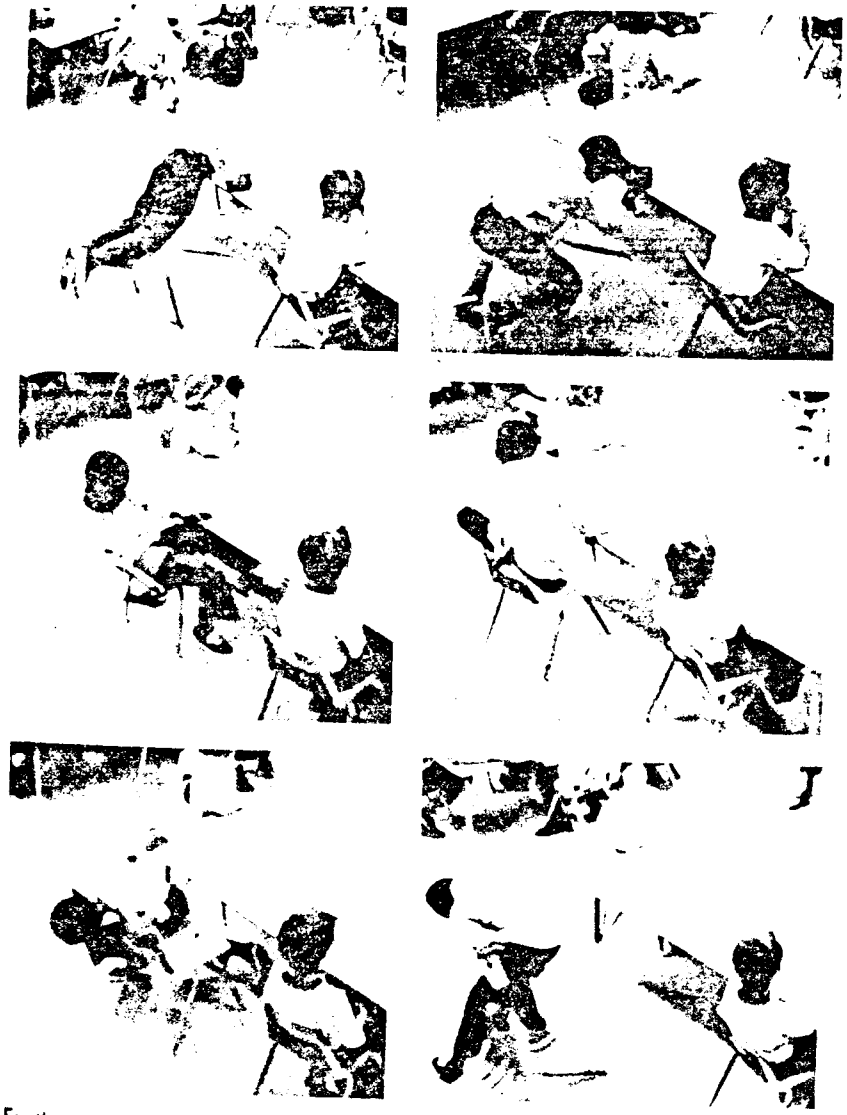
We examined the two rooms with the greatest numbers of two- and three-level achievers, rooms 3 and 4. With room 3, the movement of the change-in-activity figures is to the negative side; with room 4, the movement is to the positive side. Thus, the only way of comparing academic achievement with positive change-in-activity is to compare the ratios of + to — at the one- and two-*SCORE* levels achieved for each room. This was done; and the ratios appear to indicate (keeping in mind the small numbers used) that there is no correlation between academic achievement

and positive change-in-activity. This statement, however, must be softened by the realization that a student must pay attention in order to learn; and if he is not paying attention, then he does not stand a chance of learning.

Summary

It has been demonstrated that the use of full-spectrum fluorescent lighting and radiation shielding decreased the hyperactive behavior of students in two first-grade rooms as compared to the students in two control rooms with standard cool white fluorescent lighting ($p < 0.0005$). Academic achievement also was shown to be significantly different among the four classrooms ($p < 0.0005$), but in such a way that it was unclear whether the differences resulted from the experimental conditions or from teacher differences. There appeared to be no relationship between academic achievement and decrease in hyperactive behavior.

Classroom under experimental conditions. Initial film segment. Note position of boy in lower left corner with head under table (in square). Two boys (upper right) are climbing on the tables and one in the middle is playing with his chair.



Further antics of the boy shown in the square in photograph 1. This is also in the initial film segment.

The same boy 60 days later is shown partaking in class activities by paying attention, raising his hand for recognition, and working at the blackboard.

NOTES

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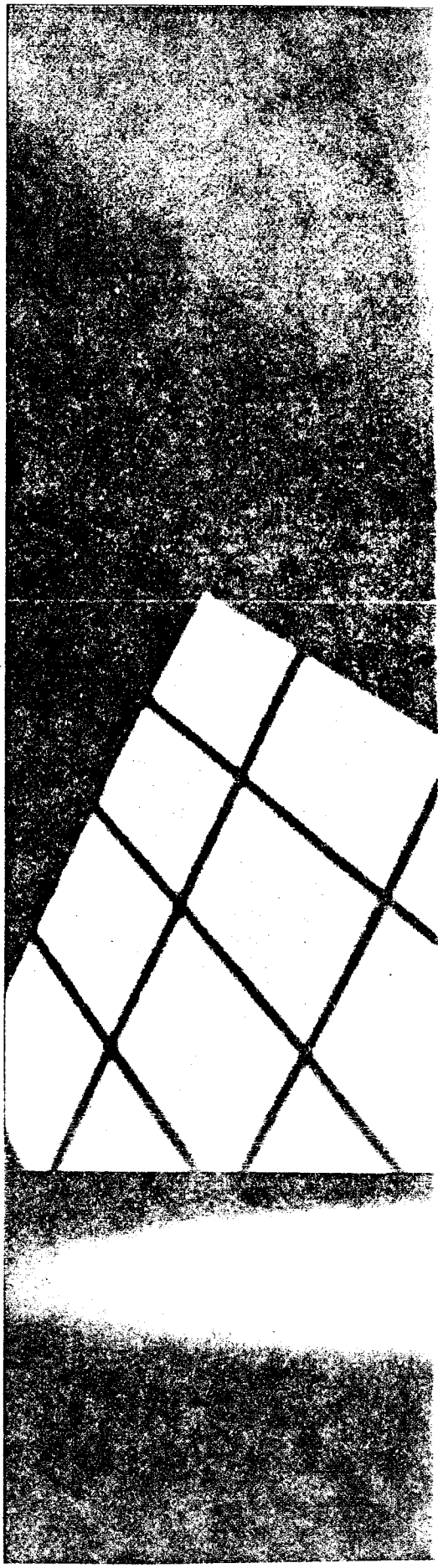
The Light Touch

LIGHTING AFFECTS YOUR WORK, THE WAY YOU DEAL WITH OTHERS, HOW COMFORTABLE YOU ARE AND EVEN YOUR MENTAL AND PHYSICAL HEALTH.

BY JEFF MEER



Most of the time we take light for granted. We walk into a dark room, flick the switch and banish the terrors of the dark. If the sunlight streaming through the window fades, we turn on a lamp and go on working.

But light is more than a convenience. Increasingly, researchers are finding that its components are necessary to our mental and physical well-being. The first international conference on the medical and biological effects of light was held just last year at the New York Academy of Sciences—a sign of the growing recognition of how much light affects us. Studies by researchers in fields as diverse as psychology, architecture and ergonomics have shown that light can also influence how we feel about our surroundings, how we relate to others and how well we do at work.

One of the earliest attempts to measure the productivity of workers under different lighting conditions was carried out at a Western Electric assembly plant in Hawthorne, Illinois, from 1924 until 1932. As part of a larger study on factors contributing to job performance, lighting levels were varied for groups of women who inspected parts, assembled relays or wound coils of wire.

Psychologists Elton Mayo and Fritz Roethlisberger were initially confused by their results: No matter how the lighting was varied, the women always seemed to produce more than they had before. Mayo and Roethlisberger finally concluded that the women were producing more simply because they knew they were being watched. This phenomenon came to be called the Hawthorne effect.

Although psychologists question the existence of any consistent Hawthorne effect, the Western Electric experiment points out one difficulty that continues to confound research on light: separating the behavioral effects of such a noticeable change as lighting from the effects created by other, less obvious factors.

Generally speaking, researchers have found that the brighter the room, the better the performance. Charlie Bates, an industrial psychologist at the Air Force Aerospace Medical Research Laboratory, says that cockpit lighting of Air Force jets can be adjusted to meet changing ambient light

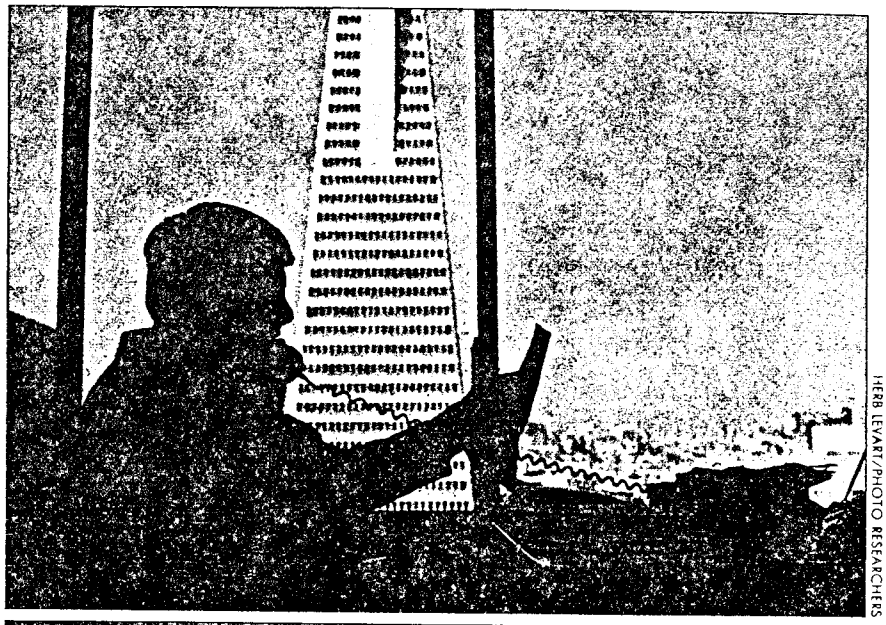
ROOM LIGHTING THAT IS APPROPRIATE FOR A 25-YEAR-OLD MAY BE TOO GLARING FOR THE SAME PERSON AT AGE 45.

levels. "We provide as bright a light as possible for pilots to do their job without washing out visibility altogether. We tell designers how bright things need to be."

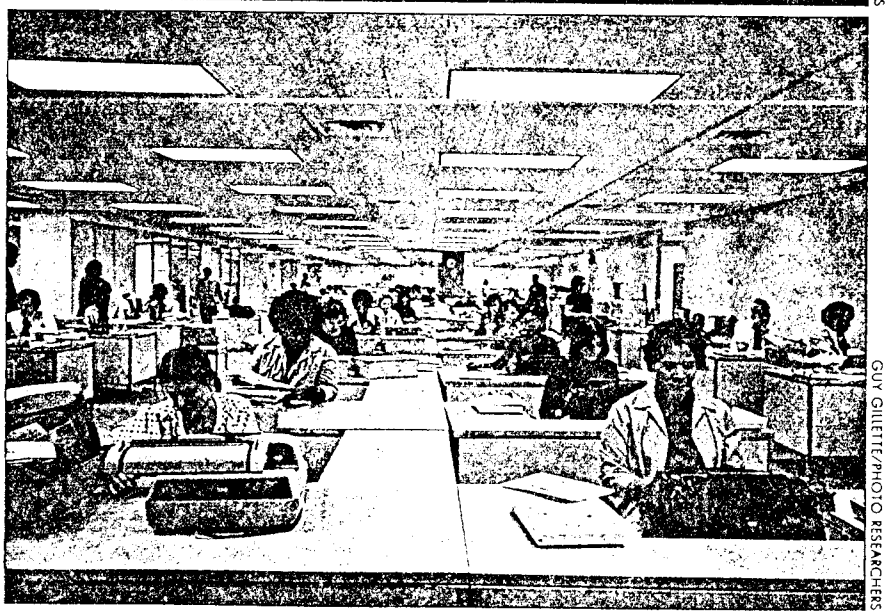
Most of us have come to associate bright lighting with work, and act accordingly. At business meetings, for instance, people who intend to make themselves heard sit under or near the lights whereas those who intend to be quiet lurk in the darker areas.

But bright lighting is not always the answer to top performance. Somewhat dimmer light can provide good visual acuity on the job and may be somewhat less fatiguing than brighter light. Psychologists Thomas Nelson and Margaret Johnson of the University of Alberta and Thomy Nilsson of the University of Prince Edward Island had 144 college students write stories about a set of picture cards. Although no significant differences emerged, those who worked under bright lighting were somewhat more tired and wrote somewhat fewer stories than those who worked under dim lighting. The Alberta students who worked under the bright lights reported more boredom.

Jean Wineman, professor of architecture at Georgia Institute of Technology in Atlanta, notes another, more serious problem: The same room lighting that is appropriate for a person at the age of 25 may have too much glare for the same person at age 45. "There seem to be increases in activity and productivity right up until you reach the level of glare," she says. Varying the angle at which light hits the work surface, cutting down on the brightness of the light and changing the work surface to a less reflective material can all help solve this problem.



HERB LEVART/PHOTO RESEARCHERS



GUY GILLETTE/PHOTO RESEARCHERS

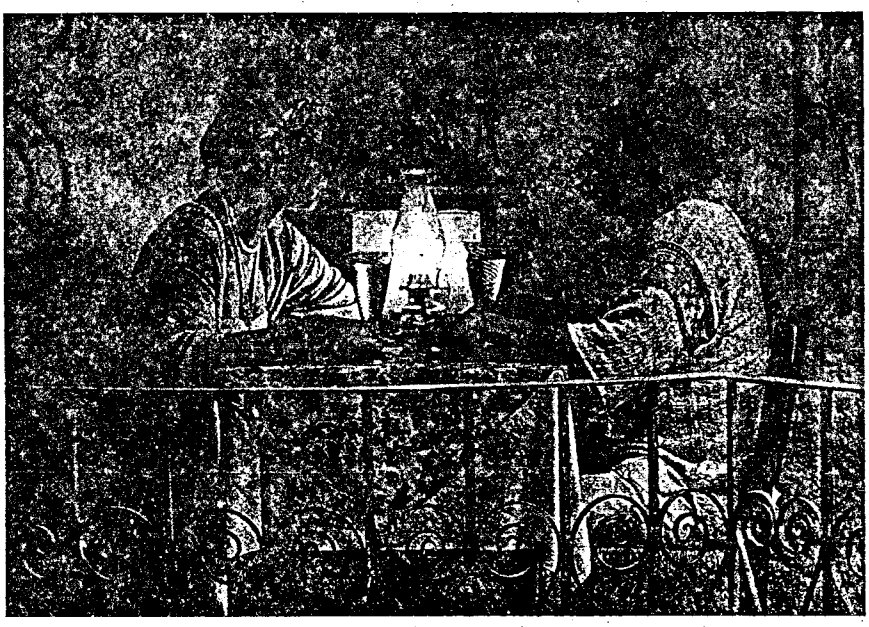
Even though people tend to prefer natural light at work, most offices have direct overhead lighting, which many workers find unpleasant.

Wineman has found "a great preference for natural lighting, far beyond the contribution made by that light." The preference is so marked, she says, that workers often radically overestimate the percentage of light they receive that is sunlight.

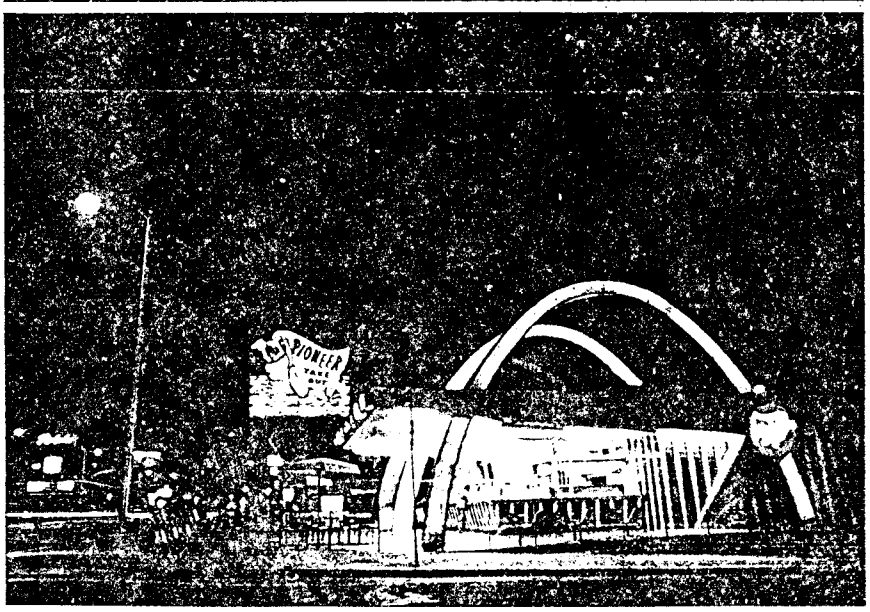
Having sunlight may make people feel good, but psychologist Stephen Margulis of the Buffalo Organization for Social and Technological Innovation found that it doesn't necessarily make them like their workplace any better. After surveying a national sample of office workers, he and colleagues Michael Brill and Ellen Konar concluded that there was no consistent relationship between having daylight in the workplace and worker satisfaction with that workplace.

Human-factors psychologist Corwin Bennett and statistician Juan Santamaria found a similar lack of correlation between sunlight and work performance. When they tested students at needle-threading, proofreading and graph reading, those working under cool white fluorescent lighting and under sunlight did equally well, as long as the rest of the environment was the same.

Wineman believes that one reason natural light in the workplace makes people feel better is the presence of a



LARRY DALE GORDON/THE IMAGE BANK



VAN BUCHER/PHOTO RESEARCHERS

The glow cast by intimate candlelight draws people together; stark, bright floodlights can cause them to hurry on by.

window. "When people are near a window, they can see variety, change over time and nature's rhythms," she says. These may all add to better feelings.

Acceptance of people's need for sunlight, at least in homes, may be gaining in this country. "At last count there were 56 cities in this country investigating laws that would guarantee a person's right to sunlight in places of residence," says Ralph Knowles, professor of architecture at the University of Southern California at Los Angeles. Especially for people who spend a lot of time at home, retirees, invalids and those in institutions, "a 'solar envelope' is important in maintaining both the comfort and joy that derive from seeing the rhythmic variability of nature," he says.

Lighting can be crucial in establishing a mood or determining people's expectations, behavior and relations with others. For example, Jeff Hayward, an environmental psychologist, observed 140 blood donors in the recovery room of a Massachusetts clinic in a six-week period. Half of them sat in a room lit with direct overhead lighting, while the rest were seated in a room lit only with table lamps. The latter donors sat closer together, talked to each other more and chose to sit in chairs along a wall looking into the room. Donors under the brighter, direct lighting sat farther apart, tended to read a book or magazine and sat with their backs toward the middle of the room. Hayward believes that the more intimate table-lamp lighting encouraged people's interaction.

Party hosts put this dim light-intimacy connection to good use when they turn up the lights to show guests that an intimate evening is over. The same connection helps explain why nightclubs and bars are normally dark places. Darkening a room reduces the number of stimuli and makes it easier for people to feel close to others around them.

In intimate surroundings it seems that most people speak more softly and make less noise than those in bright lighting. To test this idea, psychologist Mark Sanders of California State University at Northridge and two of his students measured the noise level in a brightly lit college corridor where students congregated between classes. When they turned off two-thirds of the overhead fluorescent lights, they lowered the average noise level from 61 to 50 decibels.

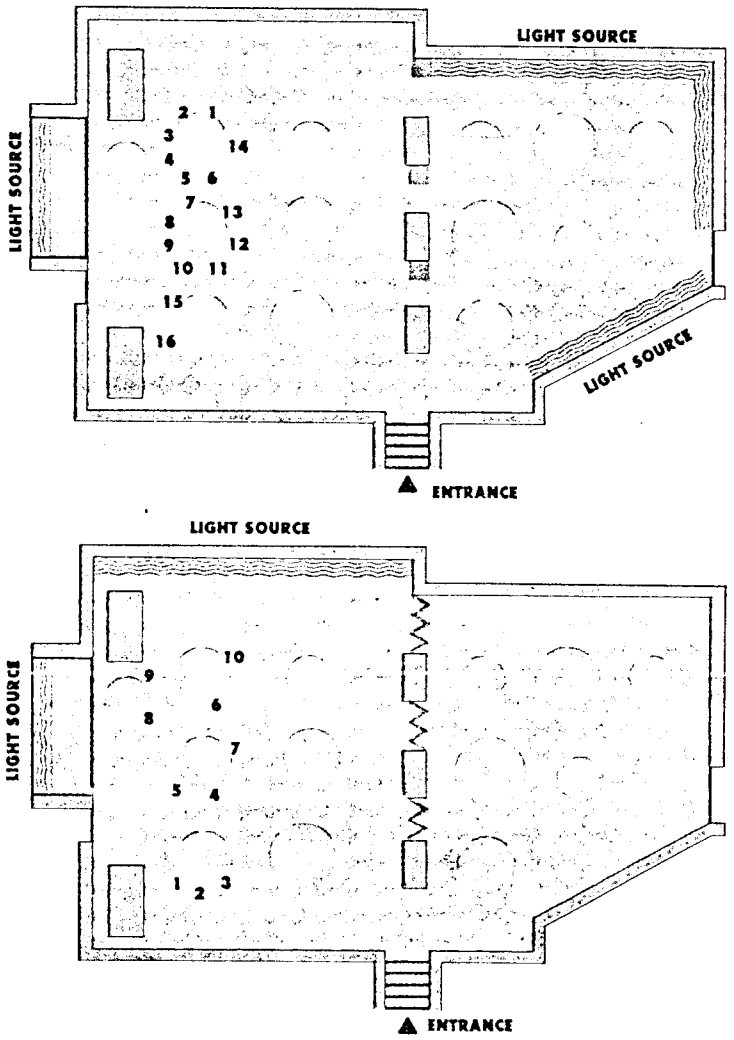
Lighting can even affect which direction we face when we sit down. In one of a series of experiments at General Electric's NELA Park lighting institute, the late architect John Flynn (considered the father of modern lighting research), psychologists Clyde Hendrick and Terry Spencer and architect Osyp Martyniuk observed diners in the company cafeteria. By varying where the lighting came from, the researchers were able to show (see diagram on next page) what Spencer calls "the moth effect." Regardless of the direction from which they entered, people generally sat facing the light.

Flynn, Hendrick, Spencer and Martyniuk also gauged the reactions of more than 100 volunteers to six lighting schemes. Using a sophisticated computer technique, they analyzed how the direction, brightness and evenness of light affected the subjects' feelings about the clarity, spaciousness and general feeling of a room.

"We were able to determine that clarity was almost all due to whether the room was bright or dim," Spencer reports. The other relationships were less clear-cut, but "whether the room was pleasant or not was mostly determined by whether the lighting came

Like a Moth to a Flame

Researchers are able to influence where people sit and what direction they face by varying where room lighting originates. When the light came from the far end of the room (top), cafeteria diners sat in the dark areas and as many as possible faced toward the light. The numbers indicate the order and position in which the seats were filled. When Flynn, Spencer, Martyniuk and Hendrick made the light emanate from a side wall (bottom), diners continued to sit in dark areas. Despite the fact that they still entered by the same door, they chose different seats in a different order and faced in a different direction.



NINA WALLACE

from directly overhead or from the side walls." When lighting came from the side walls, the room seemed friendlier, more relaxing and more satisfying.

"How spacious the room was," Spencer says, "was determined . . . to a large degree by whether the light was uniform or nonuniform." When the lighting seemed equal in all parts of the room, the room seemed bigger, a finding with obvious implications for office and home design.

Several studies have confirmed that people prefer other types of lighting to the kind of overhead direct lighting found in most offices. Virginia Bottorff, a researcher in environmental psychology and lighting at Eastern Michigan University, studied two areas in the same office building, one where direct overhead lighting was used and one where both indirect lighting (from a fixture that bounces light off the ceiling) and task lighting (a spotlight or high-intensity desk lamp) were used. She found "more reported eye fatigue and headaches among workers in the direct [lighting] area."

But the indirect lighting areas have their own problems. People who work under light reflected from the ceiling seem more bothered by noise. "It is possible that an unconscious reaction to areas with even illumination and low light level is to lower the voice level and to expect a relatively quiet environment," Bottorff suggests. When this atmosphere was shattered by a jangling telephone or the pager system, it was more of a distraction than it was in less subdued areas.

Psychologist William Kallman, who is in private practice in Oxford, Mississippi, echoes this idea. Since human beings rely so heavily on vision, he says, "light and visual stimuli [may] override all other stimuli in the environment." If the level of lighting is lower in an indirect lighting environment, that may allow other stimuli to take on greater importance.

How much control people have over lighting systems affects how they feel about them. "What a lighting designer needs to do," architect and environmental psychologist José Bernardo says, "is to allow the individual to custom design and control his own installation."

Environmental psychologist Richard Wener of the Polytechnic Institute in New York notes that individual on-off switches are especially important in institutional settings, such as prisons. In one Chicago prison, he reports, the light in the television lounge was almost always broken. "This bulb produced glare on the television screen,"

Seeing Red, Tickled Pink— How Color Affects Us

By Marilyn Murray Willison

If you believe that drug injections or physical punishment are the best ways to subdue a belligerent individual, you may be wrong. According to experts at the American Institute for Biosocial Research in Tacoma, Wash., the best treatment for some kinds of violent behavior is "the pink cell."

The pink cell is simply a small concrete room painted a bright, almost shocking, shade of pink. When individuals displaying destructive behavior patterns (such as youngsters who have taken PCP, or "angel dust") are placed in these rooms, they are docile and cooperative within 15 minutes. If left in the room for an hour, they almost always fall asleep.

Dr. Paul Boccumini, director of clinical services at the San Bernardino County Probation Department in California — which uses this treatment for some offenders — also believes that pink has the power to rapidly halt aggressive behavior. Exposure to the color pink apparently diminishes the muscle strength of most people and causes glands to decrease the secretion of adrenalin. The heartbeat then slows and the person gradually begins to calm down, usually without ever realizing why.

Researchers claim that what people "see" is not the color pink, but rather a band of electromagnetic energy. All colors have such "bands," but pink is the most effective for use as a muscle relaxant.

While all shades of pink are considered calming, the effects are increased by using progressively stronger, brighter shades. In Des Moines, Iowa, the Prescribed Activity Center, a nonmedical treatment center for brain-injured individuals, has discovered that donors are more inclined to be receptive — and generous — if volunteer fund raisers wear pink.

Can pink really lull people into this kind of calm and suggestibility? The evidence says yes. Dr. Humphrey Osmond, a Scottish psychiatrist specializing in schizophrenia, gives his patients small squares of pink cloth because he has found that looking at the cloth for a few minutes each day helps patients calm themselves without the use of chemical tranquilizers. One school for hyperactive children in New York City has a pink "quiet room" for children who misbehave, and it reports good results in getting the children to calm down once they're in the room.

While pink seems to be the current focus of color therapy, psychologists and psychiatrists have been aware for years of the effects color can have. Perhaps the best-known pioneer in the field was the late Dr. Max Luscher, who first presented his controversial "Luscher Color Test" to an international medical conference in 1947. His test, still used today, involves making selections from 73 color patches, with 25 different hues and shades, but it takes only 10 minutes to administer.

Luscher's theory was that certain colors represent common values to all people: gray = noninvolvement; blue = calm; green = resistance to change; red = desire. Luscher believed that patients would express unconsciously through their color selections what they might refrain from expressing verbally.

Through his research Luscher discovered the effect of color on the body. He learned, for example, that yellow increases blood pressure, pulse and respiration rates but does so with a more relaxing effect than red. His conclusion was that preferences for certain colors, and rejection of others, reflected a state of mind and/or a physical (usually glandular) state of health.

By 1960, Dr. L. Steinke of Switzerland proved that even "color-blind" subjects were able to be tested accurately using Dr. Luscher's methods. Those in need of peace automatically chose the darker colors, while those longing for activity or creative expression chose bright hues.

The practice of using color to *alter* a person's behavior rather than merely reflect it is relatively new, but it is continuing to grow. Volkswagen plants in West Germany are color-hued to make the environment both pleasant and conducive to efficiency. Margaret Hutchison, cofounder of Color Consultants, a firm that advises people on how to use color in their environment, reminds clients that "time passes more quickly in a red room and more slowly in a blue room."

And Albert Mehrabian, an environmental psychologist at the [illegible] of California, Los Angeles believes that anger and fear can be produced through prolonged exposure to certain shades of yellow and red, while contentment can result from exposure to blues and greens.

Advertisers know that color can subliminally affect buying patterns. Best-selling author Vance Packard warned us 23 years ago in *The Hidden Persuaders*, that sugar manufacturers don't use green packaging because they know of its subliminal "astringent" message.

Using color to influence purchase patterns and behavior will undoubtedly increase during the next decade, and the findings of color experts will be utilized in industry and business.

And why not experiment with color in your own life. The next time you wake to a gray, rainy day, put on that bright yellow sweater. It could be just the boost you need. FW

Ms. Willison is the author of Diary of a Divorced Mother *(Bantam).*

HOW COLOR AFFECTS US

The athletic director of the University of New Mexico wasn't trying to be funny when he decorated his football team's dressing room in bright red and their opponent's quarters in pale blue pastels. Alonzo Stagg, while head coach at Chicago, employed somiliar strategy when he had two dressing rooms for his players—one painted blue for rest periods, and the other painted red for fight talks. Both men were simply using smart color psychology.

Scientists, busy unlocking the secrets of the rainbow, have unearthed some amazing facts about color. They have proved that the colors on the red side of the spectrum are warm and stimulating while their blue-green opposites are cool and relaxing.

Blue can be a real emotional sedative. Some hospitals have found that patients recover more quickly if they are placed in blue rooms following major surgery. Blue rooms are sometimes used to quiet violent inmates of mental hospitals.

The right shade of yellow can produce a sensation of sunlight and warmth, but just a slight change in shading can cause a feeling of nausea. Commercial airlines many years ago abandoned interior decorations in yellow because certain shades encouraged air-sickness. For the same reason yellow foods should also be avoided during air or ocean voyages. Yellow is an excellent color, however, where "food for thought" is concerned. Research has shown that the grades of school children rose noticeably when their study rooms were redecorated in yellow.

One student of color, Howard Ketchum, declares: "Whether we realize it or not, color can lower our sales resistance, make us feel hot or cold, gloomy or gay. It can affect a man's personality and mental outlook quite as definitely as a sleepless night, a cold in the head or a good square meal.

Ketchum tells the story of a New York manufacturer who redecorated the cafeteria of his factory in light blue. The women employees soon began to complain that the cafeteria was chilly. Some of them even started wearing their coats to lunch. The plant engineer protested that the temperature was thermostatically controlled and that the cafeteria was just as warm as the rest of the factory. The complaints continued, however, and a color engineer was called in. He ordered the baseboards repainted orange, had orange slip covers placed on the chairs—and the complaints ceased!

Workers in another factory complained they were straining their backs lifting black metal boxes. Over the week-end, the ingenious foreman had the boxes repainted pale green. The following Monday several of the workmen were heard to remark about the ease of lifting "these new lightweight boxes."

Studies had shown that dark-colored objects will almost invariably be adjudged heavier than light-colored objects. The average person is inclined to underestimate the temperature of a blue-room and overestimate the temperature of a red room.

Green and red seem to have physiological effects. Dr. Gilbert Brighouse of Occidental College in Los Angeles recorded the muscular responses of everal hundred students under the influence of red and green lights. He found that ther reactions were faster than usual under a red light, while green light actually retarded their reactions.

Most people tend to overestimate the passage of time under the influence of red and underestimate it under the influence of green or blue. This was shown in experiments with two groups of salesmen. The first group, diverted of watches, was ushered into a red room for a conference. At its close, they were asked to guess how long it lasted. The average estimate was six hours. Actually the meeting had lasted just half that time! A similar poll was conducted among a group of salesmen conferring in a light blue room. All thought they had spent less time than they actually had.

Color is an integral part of our daily life—from the green of the grass to the blue of the sky. Even our language is liberally sprinkled with colorful phrases we use to express our emotions—such as seeing red or green with envy. Certain qualities have been associated with specific colors. Black for instance is the traditional color of tragedy and death. In the Middle Ages, suicides from Blackfriar's Bridge, gloomy black structure in the heart of London, declined by one third when it was painted bright green.

The effect of color on digestion as the result of such thought-association was dramatically demonstrated by Samuel G. Hibbon, an illumination engineer. He invited several guests to a table set with tempting foods. Each guest had a good appetite—until the group was seated and Hibbon pushed a button. The dining room was flooded with specially designed lights. As a result, the juicy brown steaks looked gray; the crisp celery turned pink; the coffee was transformed into a sickly yellow fluid. Most of the guests couldn't eat a thing. Some of those who forced down the food were actually nauseated.

The importance of color in business and industry was shown when a Chicago packing house tripled its sales after changing the yellow walls of its display rooms. Aware that each color has its specific after-image color engineers discovered that the yellow created a gray after-image which robbed the meat of its natural redness. Sales leaped after they advised painting the walls green because the contrasting after-image made the meat look redder than ever.

Exhausting tests have demonstrated that color is one of the prime factors in the sale of virtually every commmodity on the market today. When frozen foods first appeared they were packaged in ice-green or snow-blue containers with pictures of Eskimos or igloos or other Arctic designs. They didn't attract the eye of the average housewife, however, until they were re-packaged in warmer colors that suggested the appetizing appearance of the re-heated food.

Selecting the proper colors to suit your changing personal moods is a more difficult matter. Suppose you feel depressed and in need of a bright environment for an emotional lift? Then suppose by tomorrow you're brimming over with exciting plans that require the sedative effect of pale blue? Well, the Color Research Institute of America has a partial solution to this problem. — keep changing colors with your moods.

That's easy enough in clothing, and it can be done also in your surroundings. Keep the walls gray or some other neutral shade and use spots of color—in pictures, slip covers or hangings—that can easily be changed.

As for the right colors to go with the outfit that suits your mood, the institute suggests: Take a sheet of black paper or cardboard, cut out a two to four inch square, look at the color of your outfit through this "window" for about 30 seconds and then look at a blank sheet of white paper. The color that appears on the paper will be the after-image a complement of the original color.

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THINK PINK

One way to calm people who "see red" with anger is to get them to see pink.

Experiments indicate that certain shades of pink seem to act as a sedative and can even relax muscles. According to reports in *Brain/Mind Bulletin*, a chain reaction of hormonal secretions, set off by different colors, apparently affects the adrenal glands. Pink causes the hypothalamus to signal the adrenals to slow their secretions, which slows down the heart muscle. So a person determined to express his anger can't if he's in a pink room—his heart muscle won't go fast enough.

But don't paint your rooms all pink. Prolonged exposure to the color, even a little as 15 minutes, can lead to a condition called malillumination, which results in an imbalance in the endocrine system.

BLUE LIGHT AND ELECTRICITY AS ANÆSTHETICS.

A few months ago attention was called in these columns to a method of producing anæsthesia by means of blue light. It was not claimed for the method that it would answer for any but minor surgical operations; still it seemed sufficiently promising for the painless extraction of teeth. The patient was submerged, as it were, in a bath of blue light. The rays, it was thought, influenced the brain through the optic nerve. Perhaps there was also something of hypnosis in this supposed effect.

Dr. J. C. Watkins, a southern dentist, has conducted some experiments which have certainly added much to a true conception of the cause and effect of blue-light anæsthesia. He used the blue light, not for the extraction of teeth, but for "the reduction of swelling and the alleviation of pain." The system that he advocates is simple. It consists merely in applying the blue rays directly to the part affected.

The apparatus which he employs comprises a sixteen-candle-power blue electric-light globe arranged in a funnel-shaped tin shield which at its mouth is about four inches in diameter. This is extended about four inches, and has at its end a ground blue glass and convex lens. The ground blue glass is used to disseminate the blue rays so that the patient may not know the simplicity of the apparatus; no especial virtue is to be attributed to the lens.

A clinical history of cases which he has treated and which he has enumerated and discussed in the Dental Cosmos more than bear out the doctor's claims for the anæsthetic effect of blue rays.

Still another method of producing anæsthesia is that of Prof. Leduc, whose studies with electric currents of low tension have attracted not a little attention. Dr. Louise G. Robinovitch, of New York, one of his assistants, has continued his work and has recently published the results of her investigations. Thus far chiefly animals have been used for experimentation. With 110 interruptions per second, the animal receiving about 1.3 milliamperes, at 5½ volts, complete anæsthesia results. The preliminary contractions seem to be painless. General and special sensibility and consciousness are soon abolished. When fully under the influence of the current, the animal may be picked up by a fold of its skin, turned from side to side, pinched or pricked without provoking any reaction on its part. Hearing and sight are lost. The animal remains limp and senseless so long as the current is kept up, sleep being immediately interrupted by the opening of the circuit. Once awake, the animal shows no untoward symptoms. A large number of these experiments made in Prof. Leduc's laboratory were accompanied by no objectionable manifestations. In some instances the same animal has been subjected to the experiment several times during the same day, without causing the animal any apparent discomfort or fatigue. Prof. Leduc, Prof. Rouxeau, and Dr. Robinovitch subjected one animal to electric sleep during a period of three hours and ten minutes, without having caused it any discomfort. Prof. Leduc has himself performed the experiment on dogs over one hundred times and on rabbits a good many times, obtaining good results in all the cases. He has studied the current in its various phases, and cautions against its application for the purpose in question with a lower frequency of interruptions. A higher frequency is also useless.

Prof. Leduc submitted himself to experiment, and the description he gives of his sensations during this sleep is interesting:

"Although disagreeable, one can readily stand the sensation produced by the excitation of the superficial nerves, as this sensation gradually dies away in the same manner as does the sensation produced by a continuous current; after reaching its maximum, the disagreeable sensation commences to wane, although the potential is still increasing. The face is red, and slight contractions are visible upon it, as well as on the neck and even the forearms; there are also some fibrillary twitchings, and tingling sensations extend to the hands and tips of the fingers as well as to the feet and toes. As regards cerebral inhibition, the center of speech is first to be affected, then the motor centers become completely inhibited. There is impossibility of reaction even to the most painful excitations. At this stage it becomes impossible to communicate with the experimenter. Without being in a condition of complete resolution the limbs present no rigidity. Some groans are emitted, but not on account of any pain; excitation of the laryngeal muscles seem to cause the sound. The pulse remains unaltered, but respiration is somewhat disturbed. The current was gradually increased to 35 volts, and its intensity in the interrupted circuit was 4 milliamperes. When the maximum of the current was turned on I could still hear, as if in a dream, what was being said by those near me. I was conscious of my powerlessness to communicate with my colleagues. I still retained consciousness of contact, pinching and pricking in the forearm, but the sensations were stunted, like those in a limb that is 'asleep.' The most painful impression was that of following the gradual dissociation and successive disappearance of the faculties. This impression was similar to that experienced in a nightmare, in which one feels powerless to cry out for help or to run away when facing great danger."

Prof. Leduc regrets very much that his colleagues did not increase the current sufficiently for complete suppression of sensibility and inhibition of consciousness. The experiment was performed twice, lasting twenty minutes each time. In both instances awakening was spontaneous, with a feeling of well-being.

As the experiment on Prof. Leduc was not complete, it may be of interest to remark that anæsthesia is absolute when a current of sufficient potential is used. Dr. Robinovitch experienced herself complete anæsthesia of the forearm, hand and fingers from a local application on the forearm of this current, 25 volts being used. Anæsthesia was perfect.

Yellow and Red Rays Also Vital to Body Growth

ALL the colored rays of sunlight and not merely the invisible ultra-violet, or "health" rays, are needed to make your body grow.

That is the conclusion of Dr. Charles Sheard, of the Mayo Clinic, Rochester, Minn., who tried raising two broods of chickens, one in light from which colored window panes removed the red and yellow rays only, and the other in light with the green and blue rays removed. In both broods the overworked parathyroid glands, which have an important part in converting food into tissue and energy, became abnormally enlarged in an effort to make up the deficiency. Cod liver oil in small doses remedied the trouble.

Pop Sci Jan '29

How Orange Light Cuts Fog

IN A darkened room, look at a newspaper through soapy water illuminated by a flash light. Place an orange-colored film over the lens and the printing will be easier to read. Blue and green waves are broken up and reflected; red and yellow waves pass through.

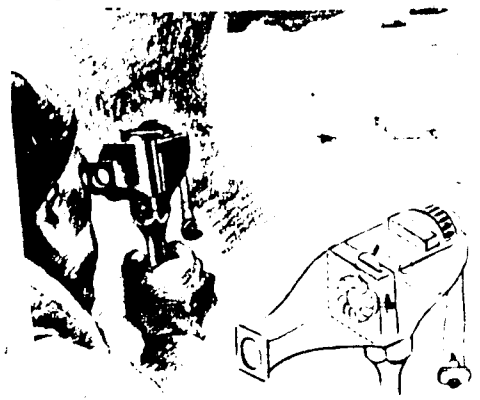
Propose Use of Yellow Danger Signals

TO REPLACE red warning signals, which often are confused with the common neon signs, it is proposed to use the new sodium-vapor lamps. Because they produce a peculiar yellow light, unlike anything in common use, the new lamps are said to be effective warning signals.

POPULAR SCIENCE MONTHLY
Sep 37

Go blue, no bugs

For someone who has traveled so much, Georgia Hesse should know what the peoples of Europe, Asia and Africa have known for more than 3,000 years: that flies fear and hate the color blue (ants, too). That is why in Siberia they use blue on houses and streets, especially kitchens and butcher shops. Try it and see. You will never have to poison a place with insecticide again.



SEEING AT NIGHT or in the dark is aided by the device at the left, invented by David Gordon of Bridgeport, Conn. Looking into the instrument with one eye, the observer sees a spot of light that is controlled as to size and intensity. This gives the appearance to the other eye that the light is projected or flashed on the scene observed. As shown in the drawing, the sky becomes lighter while the objects, which are originally darker in color, remain black. The instrument is regulated by a rheostat controlled by batteries, and contains a bulb that gives off light to a ground glass and a hole in a film.

LIGHTING HAZARD

Fluorescent lighting has long been associated with headaches and eye strain because it produces a rapid flicker. But little scientific evidence supported the notion. Until now, the flicker rate was considered far too fast to affect the eye or brain, which can't sense more than 30 flashes per second.

By measuring signals in nerves leading from a cat's eye to its brain, researchers at the University of Essen in West Germany say they've detected a response to fluorescent light flickering at 100 cycles per second. Their findings are reported in the *Archives of Pharmacology*. ■

Red Men Prefer Red Color

THE red man's fondness for color is well known, but it has remained for Dr. T. R. Garth, of the University of Denver, to ascertain scientifically the color preferences of Indians in the Southwest.

Full-blood Indians prefer red to all other colors, then blue, violet, yellow, and white in the order named. White men, living in the same social and educational environment, preferred blue, then green, and then red.

Products preventing malillumination: Full Spectrum Lighting Fixtures, Plastic and Optical Lenses

The problem of weakened muscular activity due to malillumination can be overcome through the use of two products that are manufactured in the United States. Full spectrum lighting fixtures that are grounded, lead-shielded according to the specifications of **Dr. John Nash Ott**, are available from **Acme Dunbar Industries, Incorporated**, 1130 West Cornelia, Chicago, Illinois, 60657, United States of America. The company has a toll-free number, (800) 621-5804. At present, several federal government health and penitentiary facilities in the United States use these fixtures in order to decrease hyperactivity, and enhance general efficiency and positive behavior. Another manufacturer, **Eyecraft Optical, Incorporated**, Industrial Park, St. Cloud, Minnesota, 56301, United States of America, produces full spectrum lenses for opticians. The vice-president, Mr. Wilson, may be reached by a toll-free number, (800) 328-7070 and will locate an optician who sells full-spectrum lenses or will make sure that your local optician can order them directly. The manufacturer distributes **"Sun-Lite"** full-spectrum lenses purchased from **Armorlite Incorporated** of San Marcos, California. Ultraviolet transmitting plastic for windows and skylights are specifications: **UVT Acrylite** manufactured by **American Cynnamid Company** and **UVT Plexiglas** manufactured by **Rohm and Haas Company.**

1427. Action of Light on Thin Metallic Sheets. Q. Majorana. *Accad. Lincei, Atti,* 28. *pp.* 132–136, *Sept.*, 1938.—This subject has been dealt with in various preceding papers and further experiments are now described. Thin sheets of gold were intermittently illuminated by light from a Hg or incandescent lamp placed behind a rotating disc with gaps around the periphery. A pulsating electric current was produced in the gold sheet which was compensated by means of a photo-cell arrangement. The value of $\Delta v/r$ (maximum variation of the electric resistance of the sheet) was measured, and also the alteration of phase, ϕ, between the pulsation of the light and that of the electric resistance. When the thickness of the sheet is above that for which a trace of optical transparency appears the action of sources of radiation of different nature is sensibly identical. [See following Abstract.] J. J. S.

1428. Action of Periodic Light on Thin Sheets of Gold. Q. Majorana. *Accad. Lincei, Atti,* 28. *pp.* 137–142, *Sept.*, 1938.—Further experiments are described [see preceding Abstract]. Various results obtained are not capable of explanation by the pure thermal theory, but indicate the existence of a photoelectric phenomenon of a new nature. J. J. S.

PHOTOELECTRICITY.

3876. Effect of H.F. Oscillations on Photoelectric Currents. T. Terada. *Kyoto Coll. Sci., Mem.* 31. *pp.* 39–46, *May*, 1938. *In English.*—The electric current from a photo-cell increases when a very high frequency oscillation of a few volts is superposed upon a continuous voltage. This peculiar effect depends upon the intensity of illumination and the frequency of the oscillatory voltage, but is nearly independent of the temperature. The effect may be explained at least partly by the disturbances of the negative charge accumulated in front of the kathode of the cell. From this point of view, it is suggested that a critical frequency of the electrons in the cell is about 2140 kc./sec. Author.

POP. SCI. JAN. '29

The inventor puts the finishing touches on a scene painted in colors chosen by the chart

Using the color chart to transpose a sheet of music into its corresponding color tones

Chart Transposes Musical Notes into Colors

WHAT is the color of your favorite piece of music? After several years of research into the relationship of music to color, Dr. Carl Omeron and Archie Vasquez, of Los Angeles, Calif., support the theory that all musical tones have their corresponding colors of the spectrum. To translate a note into its appropriate hue, they use a novel instrument of their own devising called a "color-tono-graph." This is a chart having a movable indicator for rapid transposing of any written note into its individual color. By this means, the experimenters claim, musical selections can be painted as well as played. Soon, they believe, homes may be painted in colors that harmonize with the musical tastes of occupants.

Fluorescent danger

RALEIGH, N.C. — Fluorescent lights may be hazardous to health. An extensive study at Research Triangle Park shows that cool white fluorescent light can reduce fertility rates and hasten the growth of tumors in mice.

Colin Chignell of the National Institute of Environmental Health Sciences studied a breed of mice in which females develop spontaneous breast tumors when they are about a year old. He found that females raised under fluorescent lights developed tumors a month sooner than females raised in daylight. He also found that the female mice under fluorescent lights reached sexual maturity at a later age and delivered significantly smaller litters—about 5.5 pups on the average, compared to six pups for mice in daylight.

The results, which confirm previous researchers' suspicions, have immediate implications for the many scientists who experiment with animals in laboratories with fluorescent lights. Animals in the top rows of cages, says Chignell, may differ from animals raised in the shadow in terms of organ growth, fertility, and degree of stress—all of which can confound experimental results. Might the lights also affect the health of the scientists themselves—and the millions of other office workers who sit beneath fluorescent fixtures? Several human studies underway may bring answers to light.