Editorial Comment

Jack Runninger, O.D., F.A.A.O.

LIGHT AS A NUTRIENT

The country storekeeper delighted in quoting Bible verses to show how he practiced his religion.

"Do unto others as ye would have them do unto you," he would say as he treated a customer fairly. Or:

"Suffer the little children to come unto me," as he patiently helped a child decide how to spend his nickel.

One day an obviously rich man drove up to the store in his Cadillac with a fancy horse trailer behind it. "I'm taking my prize race horse to a big race and I forgot to bring his blanket," he told the storekeeper. "Do you have any horse blankets to sell?"

"Yep," replied the storekeeper as he reached under the counter and brought out a blanket.

"How much is this one?" the man asked.

"Ten dollars," the storekeeper replied.

"Do you expect me to put a ten dollar blanket on a $500,000 horse?" exploded the horse's owner. "Don't you have anything better?"

The storekeeper again reached under the counter and came out with an identical blanket, except in a different color. "Here's one for $75," he said.

"That's more like it," the man replied as he paid for the blanket and then drove off.

"Just what Scripture are you going to quote to justify how you just hornswoggled that man?" asked one of the bystanders in the store who had witnessed the proceedings.

"He was a stranger, and I took him in," answered the storekeeper.

When I first heard a little of the work of John Nash Ott, I must confess that I felt he was very possibly trying to "take us in". His "light as a nutrient" theories sounded a little crackpot to me on the basis of conventional knowledge. After all, we all know that ultra-violet light, for example, is bad for the eyes and should be screened out completely, don't we?

But, after talking to Dr. Ott, listening to his lecture at the recent Southern Congress, and reading reports from the National Institutes of Health which seem to confirm his ideas, I find myself agreeing with him that there is sufficient evidence to deserve further study.

We are devoting this issue of the Journal to his article, "The Dual Function Of The Eyes," a report from NIH, and a reprint of the New York Magazine article, "Caution: Artificial Lighting May Be Hazardous To Your Health."

I think you will find them to be very thought provoking, and fascinating reading.

THE DUAL FUNCTION OF THE EYES

by John Nash Ott, D. Sc. (Hon.)

IN ADDITION to the optic track and independent thereof, it is now well established that neurochemical channels connect a photoreceptor mechanism in the retina with both the pineal and pituitary glands and hypothalmic mid-brain region.[1] [2] [3] [4] The pineal and pituitary glands are the master glands that control the entire endocrine system, the production and release of hormones or, in other words, basic body chemistry. This would appear to be a carry-over into animal life of the basic principles of photosynthesis in plants which is sometimes described as a conversion of light energy into chemical energy, and which has not heretofore been recognized.

Life on this earth since the beginning has evolved under the full spectrum of natural sunlight. Recent studies have indicated that there are specific endocrine responses through the photoreceptor mechanisms in both the skin and the retina to narrow bands of wavelengths within the entire electromagnetic spectrum and not just to the difference between light and dark.[5] Some wavelengths of the general background radiation will penetrate ordinary building material as readily as visible light penetrates window glass and influence the biological rhythms in both plants and animals in "dark" rooms that were previously attributed to "biological clocks."[6]

If the specific wavelengths to which a photoreceptor mechanism responds are missing, this would be the equivalent of darkness to the photoreceptor mechanism and there would be no response even though there are other wavelengths present.

Various skin and suntan lotions block certain light rays from penetrating the skin, and ordinary glass in windows, windshields and eyeglasses stop most of the ultraviolet from entering the eyes. Tinted contact lenses, deeper colored sunglasses, and different artificial light sources, in addition to industrial smog, also grossly distort the natural spectrum of light that people are being subjected to. This is creating a condition now referred to as malillumination, which is similar to malnutrition, which results primarily from what is lacking in a proper diet.

MUSCLE STRENGTH

Recent findings now indicate that the electromagnetic environment significantly affects

rength of all muscles, including the heart scle. It is not as yet clear just how this effect s mediated to the muscle system, but the end result is very positive.

One obvious direct response of the eye to light is the muscle-mechanism that opens and closes the iris. Like other biological responses, it appears to react to certain wavelengths and not just to light, per se, as compared to darkness.

An experiment of placing an ultraviolet transmitting contact lens in one eye of a patient and an ultraviolet absorbing contact lens in the other eye showed the pupils were both the same size indoors without any ultraviolet light. However, outdoors, in sunlight, the pupil receiving the ultraviolet was significantly smaller than the pupil in the eye that received no ultraviolet.[7]

This indicates that the muscle-mechanism controlling the iris reponds to both the visible wavelengths, plus the continuing part of the spectrum into the near ultraviolet. Accordingly, this may explain why people wearing ordinary clear eyeglasses or looking through an automobile windshield that block out the ultraviolet have to squint and suffer eye strain from too much light entering the eye. They then feel the need for dark glasses. Their pupils remain larger than they normally would under the same intensity of natural daylight containing the normal amount of the near ultraviolet.

In addition to the indicated effect of light on muscle action of the eye, recent studies have shown that light entering the eye has an immediate effect on muscle strength elsewhere in the human body.

Gross loss of strength of the deltoid muscle as a result of a distorted light spectrum entering the eye can easily be demonstrated. While outdoors under natural daylight, or under the new type radiation shielded full spectrum fluorescent fixtures*, and without wearing any eyeglasses or contact lenses, hold one arm straight forward at a right angle to the body. Then resist hard while a second person presses downward on the top of the wrist to establish the normal deltoid muscle strength. Repeat this procedure wearing different eyeglasses or contact lenses.

Clear glass or ultraviolet absorbing plastic will noticeably weaken the muscle strength, U.V.A. plastic more so than glass because the U.V. inhibitor stops all the U.V. more efficiently. Sunglasses designed to ban both the ultraviolet and infrared plus distorting the natural balance

Dr. John N. Ott

of visible wavelengths cause the greatest loss of muscle strength. Lenses that eliminate glare and reflections or turn darker outdoors also cause gross loss of muscle strength.

Delicate instruments are now available to accurately measure the exact amount of muscle strength loss, but the results are generally so apparent that such an instrument is not necessary for an overall observation. Generally speaking, the average loss of muscle strength is approximately plus or minus fifty percent. Pink or orange cause greater loss of strength and blue the least. However, in a carefully timed 10,000 meter amateur race with over 3,000 entries, one runner improved his best previous time of just over forty-eight minutes by a little more than six and a half minutes when he did not wear his blue tinted contact lenses. It was further noted that most all the people wearing sunglasses came in huffing and puffing at the tail-end of the race.

No noticeable loss of muscle strength occurs when wearing full-spectrum ultraviolet transmitting neutral gray lenses** that cut down the entire spectrum evenly. If the eyes are closed while testing the other types of conventional sunglass lenses, the muscle strength will return

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in a second or two, indicating that it is the distorted wavelength spectrum and not less intensity that causes the problem of muscle strength loss.

After making a number of tests with different types of lenses, the experiment may be repeated again under natural or shielded full spectrum light without any lenses and the muscle will regain full strength, indicating the weakened condition was not caused by fatigue.

Such tests come within the relatively new science of kinesiology which also shows similar results from low level radiation of wavelengths beyond the visible, ultraviolet and infrared, and also include sound, nutritional factors and other stimulae to the human system.[8 9 10]

Preliminary tests using the new type blood pressure dynomometer also show a similar loss of strength in the heart muscle which has many far-reaching implications requiring further study.

EFFECT OF LIGHT ON PLANTS AND ANIMALS

A number of interesting observations[11] on plant and animal growth responses to variations in the wavelength distribution of light energy have resulted from a hobby of taking time-lapse pictures of flowers blooming and plant growth over the past 52 years. The effects of artificial lights[12] used for photographic purposes, and also supplemental growing lights necessitated because of restricted natural daylight conditions, gave evidence of influencing physiological growth responses in both plants and animals. Such growth responses included development of all staminate or all pistillate buds on a pumpkin vine and influence on sex ratio of guppies and mice born of parents kept under different types of light.

The most significant abnormal conditions were found in the animals under pink fluorescent, which represents a concentration of the wavelength energy in a narrow part of the spectrum towards the red end of the visible spectrum. The animals used in this particular experiment were mice and rats, which are both nocturnal in nature and do not see into the far red end of the spectrum. This is why red lights are used in the so-called night rooms of many zoos, so that these nocturnal animals are more active and not asleep in a corner of their cage while the zoo is open to the public during the daytime.

The abnormal responses in the animals under the pink fluorescent consisted of excessive calcium deposits in the heart tissue, smaller numbers of young in the litters and lower survival rate, significantly greater tumor development or cancer,[13] plus a strong tendency toward their becoming irritable, aggressive, constantly fighting with one another, and cannibalistic.[14]

Former Warden Regan of Statesville Penitentiary in Illinois was a great believer in horticultural therapy. He was a guest on my TV gardening program on several occasions to tell of the work done by the inmates at the penitentiary. I also visited him several times and was amazed by the beautiful gardens within the prison walls and also the very extensive prison farms. Warden Regan stated on many occasions that it was only through horticultural therapy that he was able to rehabilitate some of the most extreme psychological cases, making them actually eligible for parole. He said that the other forms of manual therapy, including painting and sculpture done indoors, did not have the same beneficial effects. Maybe the results of the horticultural therapy was purely psychological, as the men got closer to nature and worked with flowers. And maybe getting them outdoors into the natural sunlight was a very important factor, especially when consideration is given to how poorly the average jail cell is lighted.

Sometime later, visiting the Miami Seaquarium, I noticed one area where black light ultraviolet fluorescent tubes had been placed over some of the aquariums. I asked the Director about this, and he explained that in view of the increasing interest in psychedelic lighting, it was done just to create an eerie effect. He went on to state that he had noticed within ten days after installing the black light ultraviolet fluorescent tubes that a severe condition of popeye or exophthalmus in some of the fish completely disappeared. He and his co-workers also noted that this added small amount of ultraviolet eliminated another very common problem, that of fin-nipping. He also mentioned that he was now able to keep many rare species of fish thriving that never could be kept in captivity before.

We have experimented in breeding rats under standard cool-white fluorescent and the new full spectrum type of fluorescent tube. Under ordinary types of fluorescent light, it has been common practice to remove the male

rom the cage before the litter arrives because of the tendency toward cannibalism. However, under the new type of fluorescent tubes and radiation shielded fixtures, it is no longer necessary to remove the male, as he invariably will show a more normal parental instinct in helping to take care of the young.

At the State of Florida Marine Research Laboratory, where I have been fortunate in having the opportunity to serve as a consultant, a new laboratory building has been constructed, using ultraviolet transmitting plastic in all skylights and windows, as well as a new type of full spectrum fluorescent tubes with radiation shields that more closely duplicate natural outdoor sunlight. Dr. Frank Hoff and his assistant were both working on a project to find a way to raise shrimp on a commercial farming basis, as has been done in the past with catfish. In the old laboratory under standard cool-white fluorescent lights, the chief problem encountered was that of cannibalism. In the new laboratory under the ultraviolet transmitting plastic and the full spectrum fluorescent tubes and radiation shielded fixtures, this problem of cannibalism has completely disappeared.

In another experiment conducted at a small college, a professor of psychology submitted a questionnaire to all students asking, among other things, whether or not they wore tinted contact lenses or sunglasses, and if so, what color. The answers, though not statistically significant because only three cases were involved, did indicate that three students constantly wore "Hot-Pink" sunglasses, and a check with the faculty ratings indicated that these same students were also considered to be the most psychologically disturbed students in the college.

Microscopic time-lapse pictures of the streaming of the chloroplasts,[15] within the cells of Elodea grass, showed that all the chloroplasts streamed actively to the full extremities of the cells under direct sunlight unfiltered through ordinary window glass. When the sunlight was filtered through ordinary window glass, that blocks much of the ultraviolet that normally penetrates the earth's atmosphere, most of the chloroplasts would continue streaming, but some would move to the center of each cell and remain motionless. Removal of the glass, or addition of the equivalent wavelengths and intensity of ultraviolet from artificial light sources, would cause all the chloroplasts to resume their normal streaming pattern. When different colored filters, permitting only specific narrow bands of wavelengths to pass, were placed in the light source, certain chloroplasts would continue streaming in each instance to the full extremities of the cells. Some would move to the center, some to one end of the cells and remain practically motionless, and others would establish different patterns of motion, forming short circles from one end of the cell to the center instead of the normal continuous flow to the full extremities of the cells.

Time lapse photography like this by Dr. Ott using artificial lights showed their effect on physiological life of plants and simpler animal life forms.

Variations in the distribution of the wavelengths from that of natural sunlight brought variations in the pattern of streaming of the chloroplasts within the cells of Elodea grass.

Towards the end of each 12-hour period the activity of the chloroplasts would noticeably slow down. After dark the chloroplasts would virtually become totally inactive and would require a dark period before again resuming their normal response to light energy.

Streaming of the chloroplasts goes on in connection with the process of photosynthesis, which is a conversion of light energy into chemical energy which the cell uses in various ways. It therefore seems reasonable to assume that if the characteristics of the source of energy responsible for this conversion to chemical energy are altered, the end result will likewise be altered. In other words, in addition to nutrition and other important variable factors, the chemistry of the cells and the plants they are a part of will be influenced, through the process

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of photosynthesis, by the wavelengths of the light energy under which they are growing.

The intensities of ultraviolet referred to in this report are within the range of intensities only capable of influencing the pattern of the streaming of the chloroplasts within the cells that would influence the process of photosynthesis or growth response over a period of extended time and not of sufficient intensity to cause noticeable physical injury to the leaf structure.

Time-lapse cinemicrographic studies utilizing the tissue culture method of growing pigment epithelial cells of the retina of a rabbit's eye in vitro[16 17] revealed variations in the responses of the pigment granules when subjected to variations in the intensity, periodicity and wavelengths of light. These cells are located right behind the rods and cones and are thought to have no visibility function. When the slides were freshly prepared, all of the pigment granules appeared to move actively throughout the entire cell. After a 12-hour daily exposure for one week to ordinary incandescent light, an estimated 90% of the pigment granules became sluggish in their action and remained virtually motionless at one end of the cell. By adding a low intensity of black light or near ultraviolet to the ordinary incandescent light source, all of the pigment granules would become active again and move in their normal pattern within the cell. No method of measuring the intensity of the ultraviolet was available, but was arrived at by trial and error in connection with the experiment previously mentioned which showed similar results with the chloroplasts in the cells of the Elodea grass. By substantially increasing the intensity of the near black light ultraviolet or using an artificial ultraviolet light source without proper filters equivalent to the atmospheric cut-off at approximately 290 mu, the result was abnormal action of the pigment granules and death of the pigment epithelial cells within a period of two hours. Toward the end of the normal daytime period the activity of the pigment granules would noticeably slow down. Similar to the action of the chloroplasts, the pigment granules also required a dark period uninterrupted by light before resuming their normal responses to light energy.

It is suggested that the responses of the chloroplasts and pigment granules may be

Fig. A. Under normal sunlight chloroplasts move around the inside of a plant cell in an orderly fashion.

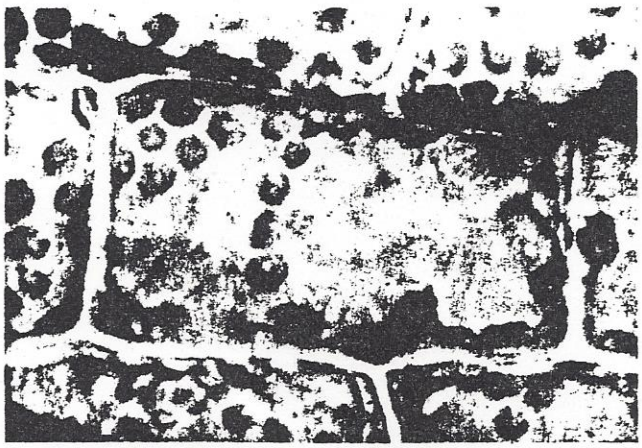

Fig. B. Under red light chloroplasts cluster in corners or cut across the middle of the cell.

"tuned" to the natural sunlight spectrum. It is further suggested that the chemistry of the plants may be affected by the various responses of the chloroplasts to both the periodicity of light and darkness and the intensity and distribution of wavelengths influencing the process of photosynthesis. It is further suggested that the similar responses of the pigment granules in the pigment epithelial cells may be the photoreceptor mechanism that stimulates the retinal hypothalmic endocrine system in animals and thus influences the hormonal balance or body chemistry.[18 19]

CONCLUSIONS

There is increasing evidence of the harmful biological effects of filtered or distorted light sources received through the eyes. The question of to what extent these effects constitute a major contributing factor to human health and

havior, including the more serious problems of alcoholism, drug addiction, crime and violence facing today's modern society and civilization, should be further investigated.

Editor's Note: A native of Chicago, John Nash Ott, spent 20 years as a banker before retiring to make a full-time career of time-lapse photography. Out of this grew his interest in light research and his writings on the subject. He holds an honorary doctor of science degree from Loyola University of Chicago.

FOOTNOTES

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TATTLE TALES

Your January editorial brings to mind the very large black 67 year old lady who was about 5′ tall and weighed 300 lbs. at least. Never having had her eyes examined, I wanted to make sure that her health was in the best condition especially after looking at the arterio-vascular tree. I told her I was going to check her blood pressure. I placed my stethoscope around my neck and went to get the sphygmanomometer in another room.

When I came back the lady had her blouse off! Trying not to look shocked I simply told her I was not going to listen to her heart, just check her blood pressure. She put back on her blouse and bra, and I continued the examination and found her hypertensive and in need of a visual correction.

After explaining her case I asked if there were any questions. She said, "Yes, if I was slender, 18, and white what would you have done—check my heart?" She smiled, and asked me that whenever I told this story to please not use her name. I agreed.

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