applies. We can learn a lesson from our sense of smell. It
tires. If we smell a particularly
fragrant flower like a gardenia,
after a few moments, we must
pull away to recapture the
scent. Similarly, we must pull
away from one environment to
another in order to re-energize.
Light can provide the same
respite.

Playful light can energize the
community within it. Subdued
lighting calms, as harsh light
causes tension or discomfort.
The changes and conditions of
lighting create an atmosphere
which deeply affects people. As
a listener and reporter, Dr.
Belinda Collins brings about a
climate for change by reporting
the results of her research.
Evaluating people's responses
establishes a precedent for
designing lighting into the
environment. The evaluation
makes us aware of a need for
change that is based upon the
response of the human beings
who, if given the opportunity,
can define the positive and
negative aspects of light.

The title of the talk,
"Lighting Frontiers," intimates
futuristic images. The content
imagined could reach the
farthest possible regions of
technology, especially since Dr.
Gilbert Reiling is the engineer
who developed the metal halide
arc lamp. Reiling couples his
knowledge of technology with
his deep concern about human
beings. Not only did Reiling
discuss the progress of today's
technology, but as a manager
in Advanced Lighting Applica-
tions and Industry Standards
(the Lighting Technology
Division of General Electric),
he turned his attention to the
effects of lighting technology
upon people.

With a positive approach,
Reiling drew attention to
human needs by reviewing
technology's great discoveries.
He focused on the technology
of lamps as they affect people at
work. Noting the fact that
ninety percent of all the scien-
tists in the history of human-
kind are living in our own
time, Reiling foresees that
the potential for growth in
lighting technology is stagger-
ing.

Reiling offers the electric
light bulb as an example of
changing technology. Most of
us take light bulbs for granted.
If one burns out, we replace it
with little thought except to
choose the desired brightness
— 60, 100 watts, whatever. This
does not take any particular
skill or knowledge of physics.
Reiling refers to the incandes-
cent bulb as "convenient and
economical," but it is inefficient
according to energy standards.
In spite of the inefficiency,
Reiling disagrees with those
who believe the incandescent
bulb will disappear.

Reiling optimistically pre-
dicts improved efficiency for
the incandescent bulb. Cur-
cently, only seven percent of
the energy consumed by incan-
descent bulbs is released as
visible light. Fluorescent bulbs
utilize energy three times as
efficiently, releasing twenty-
three percent as visible light,
yet they have a history of
unnatural color rendition.
Today's technology has miti-
gated the dominant green and
yellow hues of old by introduc-
ing the warmth of red, thus
achieving a much more natural
light.

People love the natural light
of the sun, and in designing
environments they prefer to
emulate its full spectrum of
color and strength, which is
enlivening and reassuring. Yet
today's technology can only
produce a fraction of the sun's
6000° K light. Reiling's own
work has improved lamp tech-
nology by introducing halogen
gases into the bulb, which
enables the tungsten filament
to radiate twenty percent more
visible light than previously
possible.

We are only just beginning to
understand the connection
between light and well-being.
The accelerated pace of human life necessitates a careful look at circumstances that formerly were not a concern. Three lifetimes ago, almost everyone slept at night. In contrast, our society functions twenty-four hours a day. Light is a central factor in this revolution of working lifestyles. Reiling also points out that three lifetimes ago, most people worked out-of-doors; however, this is no longer true.

Now, the office supplants the out-of-doors to become what Reiling calls "the new neighborhood." He emphasizes that this physical shift needs attention and study. In a crucial statement, he says, "You're the most important thing in that office," and continues, "when people are comfortable, when their environment is pleasing, they will be happy and creative." Reiling urges that lighting in huge office buildings be a central concern. With today's technology, creating variety throughout the environment is not a problem.

"Dull is dead," claims Reiling. Furthermore, because "restricting light sources does lower productivity," he believes that increasing the variety and usability of lighting will result in greater worker productivity.

To summarize, he states that while aspects of culture change, human needs remain constant. With a vision of the technological frontier before us, Dr. Gilbert Reiling addresses our very human need for light.

At a wedding celebration that I attended recently, every person, article of clothing, every face and feature seemed luminous. Brilliant sunshine filtered through hundreds of square feet of canvas. The wedding participants sat eating their dinner and toasting from sparkling crystal under a huge tent, the sides open to the surrounding countryside. The billowing cloud of cloth, as in Dante's image, wrapped the community in radiance as the festivity turned to dancing and the bride swirled in cascades of white veil.

Every surface was touched by light — ambient, balanced, and even. Although bright, the light was never offensive. Indirect illumination is in direct contrast to some of the systems evaluated by Dr. Belinda Collins. Some people might object that the workplace cannot be engineered under tent cloth, but much can be said for such a non-glaring, consistent light, a light which is playful. The diffusion of light through the tent cloth energized the wedding guests even through the driveness of the afternoon; it was quite different from the calm, serene light filtered through the leaves of the trees nearby. The whole festivity was a vivid display of color and movement, a vibrant invitation to animated dialogue and communication. Though the diffusion caused no shadows, here the effect was not adverse but enlivening. The quality of this playful light should be considered for the work environment.

The other powerful aspect of this specialized atmosphere was the refreshment provided by a change of scenery. The guests could look to a world outside the tent, to a pastoral scene dappled with direct light falling on grass, foliage, and the family's horses galloping in the fields. Collins points out that the levels of satisfaction in the most criticized lighting systems (IFFM) increase when the work areas are adjacent to windows. Daylight has a positive effect on lighting for the workplace, as does the view to the exterior environment: it refreshes the human spirit.

Similarly, the exteriors of many Italian houses do not reflect the beauty of their interior spaces. As in Asian cultures, the inner world is a miniature idealization. Windows and doors open to gracious vistas such as a fountain or sculpture, lush foliage, or a view of the sky. These scenes are refreshing. After hours at a task, a step into another environment or a view to other objects helps the system recuperate. If all that one sees are the tops of desks covered with papers, rows of terminal screens, or a labyrinth of cubicles, to step from the maze is to step into "recess," as we did in elementary school.

The notion of recess still
Conversely, satisfaction was always higher for work stations without task lighting. The IFFM task lighting systems were rated low in satisfaction for the following reasons: "perceived brightness was lower; ratings of amount of light for work were poorer; lighting quality was lower; glare from work surfaces was higher; and feelings of control were lower." These factors contribute to lower satisfaction even though the illumination levels directly at the primary work station were actually the highest of the systems in Collins’ database. Daylighting, according to these studies, does make a difference in the satisfaction rate. Even systems like the IFFM improve in their overall satisfaction rating when they are adjacent to windows. The Direct Recessed Fluorescent with Parabolic Louvers System (DRFLV) was much more successful in the evaluations in general, while the IFFM occupants found their work stations to be dim in comparison to the reactions of the occupants with the DRFLV systems. Collins also discovered that strong subjective factors add to the complexity of arriving at definitive standards. Other factors are not as nebulous; glare, particularly strong with the IFFM system, is extremely bothersome for workers.

The opportunity to take part in evaluations is a positive experience for workers because it gives them a vehicle for their suggestions and complaints. Collins’ research points to the efficacy of individually-controlled lighting systems at the work station; each worker can vary his or her work environment without affecting other stations. Collins also observed that consistent maintenance, cleaning, consistent lamping, and removal of flickering bulbs can also improve the workplace. Observations show that, in one fluorescent luminaire, three different lamps may be present: cool white, warm white, and daylight lamps. Flickering bulbs also betray the lack of simple care and contribute to conditions resulting in headaches, eye irritation, sleepiness, and stress — to say nothing of causing the environment to be "unsightly and depressing."

Post-occupancy evaluations pinpoint problems and often can indicate simple solutions. These evaluations are not cerebral exercises without practical application. The evaluations of Dr. Belinda Collins reflect a sincere interest in effecting change for the benefit of the occupants and giving voice to the community, raising awareness of lighting’s impact in the workplace.

Shakespeare’s few phrases crystallize a perfect description of the new light at dawn. The image is vivid and rich, presenting the gradual change from night’s dark pall to the day’s bright beginning. Unless a tryst be ended by day, people usually love sunlight! Dr. Gilbert Reiling appreciates this love of light. In his work he attempts to enhance the workplace by introducing light for production, exercise and repose.

The corporate world is also experimenting with light and space. In the Hong Kong Bank in Tokyo, a light scoop reaches out to every possible glimmer of sunlight, redirecting the brilliant rays into the building’s interior atrium. This contemporary gargoyle does not spout water as its medieval ancestors did; it spouts light. Without the light scoop, the inner environment would be deprived of direct access to the natural elements of sky and light. The scoop is an architectural attempt to satisfy people’s basic need for reassuring contact with nature and with the motion of the earth.

The enclosure of great numbers of people in artificial environments is a reality. The office has indeed become the “new neighborhood.” Fields, sky, and sun are distant from these centers for productivity. Thus a challenge looms ahead for talented professionals to create dramatic and dynamic environments where the best of comfort and productivity are possible.

Human beings need the earth’s softness and the sun’s brilliance. If you are skeptical on this point, take a tour of a prison with its glossy painted walls, the hard surfaces of floor and ceiling from which every sound ricochets and reverberates through your brain. In some of these facilities bare bulbs hang overhead. The visual and aural environment is thunderous as the bars close.

The stark environmental lessons here show that surfaces, light and sound can be repellent. Conversely, a concern for human comfort, such as Reiling expresses, can render light as a welcome.

A welcoming light is surely not beyond our technology. In fact, hearth fires and candlelight provide a primitive and still-treasured antecedent to “warm light” lamps. In the workplace, the atmosphere, the appointments, and the lighting constitute the “warmth” or “coldness” of a welcome and signal the possibility for human interaction or creativity. A warm light suggests an environment for accomplishment, cooperation and production. Reiling seeks to humanize the work area through his application of light.

Thus, “Lighting Frontiers” is a glorious and perhaps misleading title which beckons to us with technology’s potential. However, before we literally
reach for distant stars, the area upon which we are standing, the desk upon which we are writing, the keyboard on which we are typing, the space we call our work area must be familiar, encouraging, and supportive. Just as we create an atmosphere in our homes, we must create light in our “new neighborhoods” that will invite human growth. We do not dread the dawn of day as did Juliet, but embrace the prospects of work in a “jocund light.”

Architects work diligently on their designs, guiding them through the construction phase so that the built space will fit the needs and desires of their clients. Unfortunately some design problems or oversights do not become obvious until the owners occupy the space. We commonly hear people say, “We wish we had put a closet near the front door,” or “We wish we had screened in the back porch.” For an office building, we might hear, “The storage room is not large enough,” or “the lighting for this area is not flexible enough.”

The old expression, “Hindsight is twenty-twenty,” has a familiar ring in design situations. Dr. Belinda Collins, the leader of the Lighting Group of the Building Environment Division in the Center for Building Technology — National Institute of Standards and Technology, develops the tools for evaluating “hindsight.”

Her work centers upon evaluation techniques for post-occupancy (as well as the effectiveness of retro-reflective safety colors). Post-occupancy studies provide information for correcting existing problems or avoiding similar mistakes in the future.

Collins’ talk centered on her evaluations of “thirteen office buildings typical of current design practice” as well as the working environment at selected U.S. Army Field Stations. The results of these evaluations are just one part of the publications generated by the maze of bureaucratic government agencies. The reports of these agencies are mountainous in proportions, but they cannot all be brushed off as ineffectual mental exercises which have no substantive value. Post-occupancy evaluations point out the problems which arise in the workplace, and move toward solutions. In the magnitude of the government system, with myriad offices and people, individual concerns can get lost. Workers can feel that no one really listens to their complaints or suggestions. In the government/military complex, evaluations designed by skilled professionals like Collins provide the circumstance where the individual will be heard.

Collins works for change in the leviathan world of the government and the military; she encourages designers to rethink the use of task lighting as an integral part of furniture design because her research indicates the ineffectiveness of designs like the Indirect Fluorescent Furniture Mounted system (IFFM). Collins reports that this system “has the highest mean illuminance as well as the greatest variation in illuminance,” but “lighting satisfaction at work stations with furniture-integrated task lighting was consistently lower.”
moods and ignored the visually poetic passage of time, the lengthening shadows. Creative treatment and well-designed lighting can reintroduce shadows. Light can invite textures for a serene environment. It can also open our minds to festivity — the clamor of dancing, the chatter of crowds. Light suggests, enlivens, evokes, and even controls.

The earth’s light rises and subsides with a pulse, a rhythm. The engineering of our visual environment should reflect the naturalness of the earth’s surfaces and the rhythm of its light, variety and differentiation, the textures and the sensory possibilities. The lessons of Boyce, Yeats, and Tanizaki, like different but similar voices, can lead us to comfort and creativity. Sharing the artist’s palette and the poet’s intuition, the lighting specialist has all the available hues, textures, and shades of light. Peter Boyce, a human factors scientist, introduces us to a broader, richer, more colorful and textured world of possibilities for lighting, a world where designers can enhance human existence.

Usually when we hear the word “prophet,” we think of a person who foretells the future. This is actually the role of a soothsayer, while the role of a prophet is to comment on contemporary events. He or she is an indicator of the conditions of the time. In the talk, “The Education of the Illuminating Engineer: The Basis for a Profession,” Dr. Alan Lewis was the prophetic voice. Even more interesting is the fact that we might not expect this content in the straightforward world of engineering. It is reassuring because technology can preclude conscience when it is science for science’s sake. Technology can allow for conscience when ethically informed, and it can be a powerful voice in an inevitable future.

As an introduction, Lewis recalled the Arab oil embargo of the seventies, a time indelibly imprinted on the minds of any of us who were drivers at that time. Long lines to the gas station and alternate days for gas purchase depending upon the odd or even numbers of your license plate were the norm. Lewis pointed out that the effects are still with us today. This is manifested in “power budgets, lower levels of illuminance, and more efficient light delivery systems.”

Lewis made his listeners aware of the new energy crisis: “...driven not by energy availability, but by the need to reduce the polluting effects of power generation.” The message is chilling from the lips of a scientist; somehow we can accept “reality therapy” from movie stars-turned-ecologists and treat it rather casually because of their credentials (though we may recognize the truth in what they say). Scientists deliver the facts dispassionately and without the emotionally charged rhetoric of the actor. Their direct manner coupled with factual coolness devastates our naiveté: “The challenge is not how to reduce lighting — we will be required by law to do so; the challenge is to provide good lighting while staying within the energy constraints which will be placed upon us.”

During his talk, this prophetic presenter dispelled another stereotypical presumption about engineers by challenging for reform with positive suggestions for the future illuminating engineer: the need for a lighting professional who will provide environments which are “aesthetically pleasing, performance-enhancing, and energy-conserving.” These individuals must also be “technically qualified and specifically certified.” Here we see the vision for the development of a profession and not just an avocation or side interest. Lighting specialists will have developed an expertise.

Lewis is a good resource for this future professional spe-
cialty because of his own varied expertise. He is a professor of physiological optics at the SUNY College of Optometry. The primary focus of his work in visual performance and color vision is improving human performance. Serving on the executive committee of the U.S. National Committee of the International Commission on Illumination, Lewis is also a member of the Illuminating Engineering Society of North America, and is the president of the Ophthalmic Research Institute.

Lewis does not suggest that a lighting specialist acquire a Ph.D. He points out that a doctorate is a research degree, whereas the lighting specialist should have an interdisciplinary professional master's degree. This would enable the individual to have practical and pragmatic training for his or her role. However, lighting specialists will not be people who only dabble in the field—resorting to “simplistic cook-

book solutions to what is a complex problem.” According to Lewis, they should have formal education and competency-based certification in order to provide lighting which is “innovative, attractive, effective, and environmentally responsible.”

Lewis believes that although the program should be at a school with a “strong academic base as well as a measure of prestige and stability,” the program should not be established in a particular department. Diversity should attract “a proper mix of people” who will be instructed by a diverse faculty. The curriculum could be an exciting mix as well—physics, electricity, optics, design, perception, architecture, and vision. All of these elements combined would certainly help the lighting specialist in the diverse demands of an ever-growing field which so deeply affects human life.

As Peter Boyce points to a broader view of the visual environment than measurement or illumination schedules, poetic imagery may lead us along other avenues of inspiration. The Yeats excerpt not only presents a romantic sense of the celestial panorama, but also poses possible criteria for evaluating light conditions. Variety creates interest. Whereas Yeats succinctly presents the dynamism of light changing between night and day, much of contemporary lighting lacks variation, contrast, and subtlety. The poet crafts verbal images to recreate the stellar canopy, glowing with subdued and brilliant contrasts, shimmering with mysterious attraction.

Yeats’ poetic lesson is one of light textures. These textures fascinate and intrigue us with the drama of the lightscape. Similarly, James J. Gibson, a theorist in visual perception, speaks of “gradients” in light conditions. Like Yeats, he treats the subtle changes of shade and light, the chiaroscuro, which form the visual envelope of each object. These objects are the “affordances,” the surface areas where light can play; they offer opportunities for infinite change and delight.

These same surfaces, gradients, and textures are also the palette for the artist/technician of the lighting field. As on the painter’s palette, there are daubs of all sorts of hues, combinations, and possibilities; lighting specialists have a wide spectrum of possibilities within their grasp. In many ways, the availability of luminaires and lighting techniques has greatly increased the potential for innovation. Pin point spots, floods, rheostating, various lamps, and color variation, used strategically, can harmonize with materials and surfaces to achieve aesthetic and productive results.

Well-planned visual environments can alleviate boredom. Lighting specialists should consider the need for variation, light, and even shadow. The Japanese writer Jun’ichiro Tanizaki observes that Westerners are not comfortable with shadows: “From candle to oil lamp, oil lamp to gaslight, gaslight to electric light—his/her quest for a brighter light never ceases, he/she spares no pains to eradicate even the minutest shadow.”

There is a pleasing aesthetic in subdued light; even conversation becomes decibels lower. Shadows offer differentiation, interest, and dimension. Tanizaki introduces his readers to their exquisite beauty: “I marvel at our comprehension of the secrets of shadows, our sensitive use of shadow and light.”

Our Western culture has forgotten light’s variety and
as many as ninety percent of office workers who were surveyed judged the illumination of their workspace as uncomfortable. Yet, other studies reveal a much higher comfort rate. Thus, even though many offices have “sufficient” light, significant problems persist. Boyce insists that other factors must be considered: distribution, color, glare, and flicker.

Some lighting designs have problems, but these cannot be solved by energy standards alone. According to Boyce, lighting codes miss a variety of discomfort factors as well as an even larger number of positive contributions if illuminance is the only consideration. As an example, Boyce discussed a hockey rink that was amply illuminated so that the players could see the puck, but which offered the audience no visual differentiation in its interior design. Every surface was of equal brightness and of monotonous hue — ice surface, walls, and roof. To introduce hue and value contrast, the girders were painted red, which alleviated the spectators’ discomfort. Surfaces, textures, and materials are an important concern for the visual environment. Strictly speaking, the solution did not involve illumination; it altered the visual environment.

The red girders alleviated the visual monotony. This is an obvious example of energy standards failing to pinpoint and solve a problem of light.

Boyce claims that the idea that lighting codes and illuminance measurements alone can achieve effective and comfortable results is “the illuminance illusion.” Design must address the entirety of the visual environment and all its nuances — factors which can be gleaned from sources other than energy tables. Lighting can only play an essential role in the creation of a positive experience when it is seen as part of a total environment.

Technology does not necessarily treat the need for the aesthetically beautiful, a very real need that cannot be quantified or calibrated. Both efficiency and aesthetics are essential to dispel the illusion and address the real needs and possibilities of illumination and the visual environment.

Many of us have heard some version of the opening phrase of Edna St. Vincent Millay’s short poem since our childhood. It was more applicable, however, when we reached the more mobile age of our teens, and the driver’s license and the key to the car gave more ready access to parties which lasted well into the night. Warnings came with worried expressions that our health would suffer or that we might be—oh, a dreaded word—grounded because we were “burning our candle …” At that age, it was hard to imagine that the brick wall of reality might be right around the corner. Meanwhile, carefree youth was “on override,” and we would doubtless make it through this temporary crisis with our adult supervisors — our wings unclipped!

Dr. Alan Lewis is one of the people who makes us aware that the state of our planet is hardly a passing problem. Articles, editorials, and newscasts are all evaluating the global heating trend, the greenhouse effect, loss of the rain forests, acid rain, smog, air and water pollution, drought, and disaster. The care-and attitude is not just limited to the United States, where we have escalated our needs to the point that we require over a third of the world’s energy resources. Millay’s poetic expression, “it will not last the night,” echoes the cavalier approach of that age-old global folly, “here today and gone tomorrow.”

During the summer and fall of 1988, crops were dying in the fields, medical wastes washed up on our beaches, and heat waves killed hundreds in Athens. There were floods in Bangladesh, hurricanes in the Caribbean, and earthquakes in Armenia. Scientists and commentators alike wondered whether our abuse of the planet had caught up to us in our own lifetimes (rather than remaining a grim legacy for the concern of future generations).

The power generation demanded by our voracious lifestyles was hitting with an immediacy that made everyone take notice. Rolling blackouts and brownouts turned off air conditioners, fans, lights, stoves, refrigerators, and stereos. The previous abundance of energy had somehow curtailed our process of maturation. Even after the Arab oil embargo, we tried to return to the status quo. Human nature resists change and tenaciously holds on to old habits, but the voices of the concerned keep us aware of the mounting problems and the need for new directions in conserving the resources of the planet.

One of the most effective statements on conservation that I have seen is a short film from the Episcopal Media Services. This film is a five-minute animation. The visuals begin with a baby playing with toys. The baby cries out as the
orchestrated sound imitates what appears in the caption over the baby’s head — “MORE!” Toys are heaped up as the cries persist until the baby disappears under a pile of playthings. The scene changes to a man eating fried eggs. His voice sounds rather indelicately imitative of food ingestion. His cries of “MORE” are met with an accelerated response of the conveyor belt whose source is a hen laying eggs to a flashing light, now blinking at strobe frequency.

The images continue as houses clone and multiply over the whole countryside, filling the screen. In the voice of the chorus the doorways mouth the now familiar four-letter word. The cigar-smoking foreman of the power plant calls out for “MORE” on his phone. The smoke of the cigar enshrouds him as the plant’s smokestacks belch out their own blackening clouds, finally inundating the whole picture, as a tuba sounds “MORE, MORE, MORE. . . .” Soon the moaning planet is seen from afar. It rumbles and implodes.

The point is well made: the crisis is not one of energy availability, but is a need to reduce the polluting effects of power generation. We need specialists who can resist “the lovely light” syndrome that makes people ignore the long-term consequences for the planet. Is there a person, or persons, who is competent to provide “an environment which will be aesthetically pleasing, performance-enhancing, and energy-conserving?” This person will have to be a wizard! Lewis plays with the title “luminologist,” but this conjures up the figure of a person with a floppy pointed hat and robe sprinkled with stars, voluminous sleeves, and a magic wand in hand. The luminologist cannot be a conjurer, but must be a professional who engenders competency and trust in order to gain confidence of the community. With confidence will come openness to the need to change lifestyles and meet the prudent energy needs of the planet. Education will lead to education. The lighting specialist’s competence will nurture a process of understanding and wisdom in the community.

This search can only lead to an investment in the future. The question is not so much what these lighting specialists are to be called, but what the necessary credentials are, what they will do, and how they should be prepared. Lighting specialists must be familiar with how people see or perceive things. They must know the established and speculative sciences and what industry is producing. These specialists must understand vision and psychology. This may very well be a new interdisciplinary application of science with its own particular focus, direction, and means for evaluating the requisite credentials.

These Merlin-like women and men must have breadth as well as direction in their preparation for the field and finally in the expression of their work. What is most obvious is the need for this field to be inter-disciplinary and certainly not myopic in any sense. Overlying the entirety of the lighting field is the need for these people to be ecologically sensitive. This is a tall order, but with the mandate comes the excitement of a new field with discoveries and possibilities. The “lovely light” will be provided by mutual education which will provide a future, a conservation, and a hope for generations to come.

Dr. Peter Boyce
December 8, 1988

Dr. Peter Boyce is a scientist concerned about people. A research officer at the Electricity Council Reserve Centre in Great Britain, he has spent over twenty years researching people’s reactions to light and lighting. He received his Bachelor of Science degree in Physics at Reading University, and, for his Ph.D., he studied eye movements. Along with his book, Human Factors in Lighting, Boyce has researched a variety of related topics, including the effects of lighting on visual fatigue, the influence of age on visual performance, the visual problems associated with visual display units, and the ability of people to exit a building safely under emergency lighting conditions.

Boyce has conducted a series of studies to examine human reactions to simulated emergency situations when electric power fails. Emergency lighting codes, varying from country to country, dictate the amount of illumination, measured in lux, along a path of egress. Research has shown that people can exit with ease, safety, and speed at a lux of 1.0, with the bottom line for safety set at 0.2 lux. Anything less than 0.2 lux may result in hesitancy or collision with furniture. These studies are important because many workplaces are windowless and therefore virtually lightless environments. If power fails, people are left with no orientation to exits and obstacles in their paths. Video studies filmed under infrared lighting conditions (invisible to the naked eye) have helped to determine requisite levels and standards for emergency lighting in the United Kingdom, but these standards, according to Boyce, cannot fully guarantee a safe environment. Nor can any illuminating standards alone guarantee a comfortable, productive, and aesthetic setting.

Boyce’s broader premise, “there is more to good lighting than illuminance,” raises questions about our standards for illumination. Boyce reported that some studies reveal that
Howard Brandston’s lecture, “Lighting Design: The Process,” raises a fundamental issue for the lighting industry: we must learn to see. Learning implies a sense of quest, wonder, and discovery. Seeing implies a physiological response to visual stimuli, but it also represents a philosophical point of view, the idea of understanding. The combination of these faculties is much more the philosophical issue of perception. Perception is the process by which a person sees physically and then interprets what is experienced.

In his text on visual perception, E. H. Gombrich quotes the critic John Ruskin: “There is no ‘innocent eye.’” Interpretation comes from the dynamics of our own experience and life events; each individual has a unique fabric and makeup. How we learn and see must be a concern for the lighting designer. The process is as much philosophical as it is physiological.

Brandston addresses the philosophical issues in a down-to-earth manner. Categorizing the “homogenized solutions” of money-oriented lighting designers, he appeals for “real problem-solving design analysis.” Design requires real thought and real work. Brandston boldly states, “Discipline, not genius, equals success.” This phrase echoes another of Gombrich’s exemplars, the 19th-century landscape painter John Constable, who equated seeing and training the eyes: “The art of seeing nature is a thing almost as much to be acquired as the art of reading the Egyptian hieroglyphs.” Training the “eyes” is not capricious, mechanical, or automatic, but is the result of diligent effort.

Brandston, a past president of the Illuminating Engineering Society of North America (Fellow and recipient of the Distinguished Service Award from that Society), denigrates the ephemeral approach of some contemporary lighting designers. Brandston refers to their lighting solutions as the “snake oil” from an Old Wild West Show complete with doses of “handbook tables, homogenized statistical analysis, light quality metrics, and computer simulations.” There are no sure-fire potions or mystical lighting cookbooks for lighting design except the hard work of analysis.

Brandston began his career in lighting in the New York theater and takes his inspiration from a 1930 text, Theater Lighting, by Louis Hartman, who asks that we apply theater lighting concepts to the architectural world. Lighting is much more than illumination; lighting is both mechanical and imaginative; lighting must present a series of contrasts; and experience is the best teacher, though it requires a great deal of energy.
In the theater, lighting apprentices still learn at the sides of the masters. Daily living provides a recipe for visual education: "First you learn to see, then you learn how to create what it is you wish to see and feel, and communicate that experience to the audience." Brandston points out that recalling the experience of a variety of lighted environments enables the specialist to re-create, enhance, and occasionally transcend previous experiences of light. We build "a data bank of memories of lighted environments, from real life experiences," so ideas should be written down before they are forgotten. Ideas are the building blocks for the future.

Today is no different from the 1930's, because lighting professionals still focus on equipment as magic cure-alls. Yet Brandston avoids new products as the answer to everything, saying, "I never think about equipment or data. I only try to learn to see better so I can serve better through design." Brandston makes a commitment to each new commission: "Start fresh each time."

Brandston, the lighting designer, and Constable, the landscape painter, challenge us to accept the work of seeing. Through this process we discover the joy and the wonder of being in service to learning, the excitement of learning's freedom and its growth. The humility implied here is that of an apprentice ready and willing to serve and, because of that service, ready to succeed.

Hartford, Connecticut certainly does not have the cavernous feeling of New York City, but it does have some similar places. My brother and I grew up in an apartment building with twenty-three other families who provided our playmates. Our own apartment had three rooms — two bedrooms, a kitchen, and a bath. Two of these rooms faced north into an inner court; our parents' room caught the last glimpses of sunset. The light would stream from their room across our floor. I would often sit in that puddle of light in front of an old console radio: it was the only direct sunlight that I remember in the apartment. During the rest of the day we lived on "borrowed light," light which reflected from the windows of the upper apartments across the court.

Borrowed light began my obsession and fascination with houses and buildings whose windows captured the sun. These spaces glowed with their vantage points and light availabilities. I remember longing for light — playing in the vacant lot opposite our building, and when I got older, in the forbidden lots across the avenue where old abandoned cars were stored. There was also a creek under a canopy of leaves in the woods at the base of the train tracks where, on a summer's day, the heat made their destination a mysterious, wavy vision.

Even later in high school, my French book promised a visitor to Paris a vision of light radiating through rose windows at Notre Dame. When, as a graduate student, I found myself basking in their brilliance, I never imagined that my doctoral work would be about this obsession, this light which haunted my youth and has continued to thrill me into my forties. I found it in sculpture, music, architecture, poetry, and on gray days in Paris, I found it in the Impressionist paintings of the Jeu de Paume. Now I find it in my own writing.

Light images abound in our daily lives. In some ways, I could not help but integrate into these proceedings the all-pervasive light imagery which has captivated me from my earliest days. Perhaps it all began as it did for many of you, where suddenly in a darkened room, the arrival of the twinkling flames on a birthday cake announced a special day. Light heralded festivity and still gives joy to the passing of years.

Gary Gelfenbien, Ph.D.
Rensselaer’s Lighting Research Center opened in March 1988 with core funding from New York State Energy Research and Development Authority. The LRC, housed in the School of Architecture, is one of Rensselaer’s multidisciplinary centers of excellence. The location of the LRC in the School of Architecture and in a world-class technological university is ideal, because our mission is to change architecture by improving lighting quality and energy efficiency. To accomplish this mission we work closely with industry, government, practitioners, educators, professionals, and researchers.

The speakers in our lecture series represent one or more of these divergent backgrounds. Each speaker is an internationally recognized leader in his or her own field and came to Rensselaer to publicly share thoughts about lighting. More important to the people at the LRC, however, these leaders are also close friends and colleagues. All were kind enough to visit with us for one or more days, working with us to help point the LRC in the right direction during our critical first year of operation. For their leadership and encouragement, we are deeply grateful.

This publication is unusual. It avoids the typical journalistic approach of precisely documenting what was said by whom. It also avoids the editorial approach of trying to persuade the reader to accept a particular point of view. It represents reflections on the very human aspects of the lectures and the lecturers. It is a unique approach by a unique individual, Gary Cellenhen, Ph.D. After reading a few pages of this publication you will certainly gain a better understanding of Gary. Perhaps too, after reading the whole document you will gain a different perspective on lighting. Certainly it represents a very different perspective than the ones I gained in my formal training in science and engineering!

This publication is unusual, too, in that it has been published by a research center at a leading technical university. To accomplish our mission to improve architecture, however, we must be able to appreciate and encourage creative individuals who can take bold technology and create something of beauty. We hope that some of the beautiful, human aspects of lighting come through as you read Gary’s reflections on the LRC Lecture Series for 1988-1989.

Mark S. Rea, Ph.D.
Director
Lighting Research Center

When the space shuttle Challenger was blown out of the sky, our own view of technology as infallible was shaken to the core. The continuous media replay of the fiery catalysis magnified our horror and certainly undermined our confidence in the space program, and in technology in general. The old philosophy of getting back on the bike or behind the wheel of the car after an accident did not apply. Every facet of the space vehicle had to be retrieved and dissected. The design of the shuttle had to be thoroughly investigated and analyzed. Extreme care and skill in this investigation lessened the risks and allowed the program to resume.

Howard Brandston’s commitment to discipline reflects the same kind of careful dedication found in the person of George M. Low. When Low was placed in charge of the Apollo program, he met the mandate of landing a man on the moon within the decade. Years later as the president of Rensselaer Polytechnic Institute, Low pointed to the school motto, “Knowledge and Thoroughness,” as the essence of accomplishing a goal, the discipline requisite for the task.

Discipline requires vision, not in the physical sense, but in the philosophical. First, vision implies imagination and realization; we have to be able to dream about and imagine future possibilities, to actually see the goal toward which we are aiming. Second, vision gives reason for the energy and work which will realize the project; this is the commitment to the project. Vision is the beacon toward which our efforts strive.

As an artistic person, I am somewhat at odds with Brandston’s statement, “Discipline, not genius, equals success.” I do agree that artists and performers must be as disciplined as scientists. Dancers must practice hours each day beginning with a series of simple moves called plie. Musicians must develop a technique by rudimentary scale work which enables them to play the most demanding pieces. Although artistic vision needs discipline, it also needs something more. That something is genius. An element of genius is essential to both the artist and scientist. Genius is the extra gift which may be described as an uncanny intuition. These artists or scientists can “see” more; perhaps it is their sense of imagination. Their minds and spirits are daring where the rest of us are cautious. Add genius to discipline and we have the extraordiary person. Disciplined technique plus genius have given us Bach and Baryshnikov.

Howard Brandston may care to disagree with me, but he has genius, the genius of artistic
interpretation or exploration which comes long after the technical aspects are accomplished. Genius is the final ingredient which gives flair and adds the “extra” to “ordinary.” For the pianist, the discipline of long hours playing scales combines with the innate gift for finding the nuances of the phrase which will lift it into true music; for the dancer, long hours moving and stretching at the barre translate into glorious movement and perfect line. For the lighting designer, the discipline of hours and years of observing light and lighting aligns with the unique “eye.” Genius shows at the time of application to the final product. Eventually the seeing, listening and willingness to serve people culminate in results as breathtaking as Brandston’s illumination of the Statue of Liberty and of Rockefeller Plaza.

REFLECTIONS ON THE 1988/1989 LECTURE SERIES
