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VOLUME 1 ISSUE 1
AUTUMN 2007 £4.95

LIGHT WITH SOUL

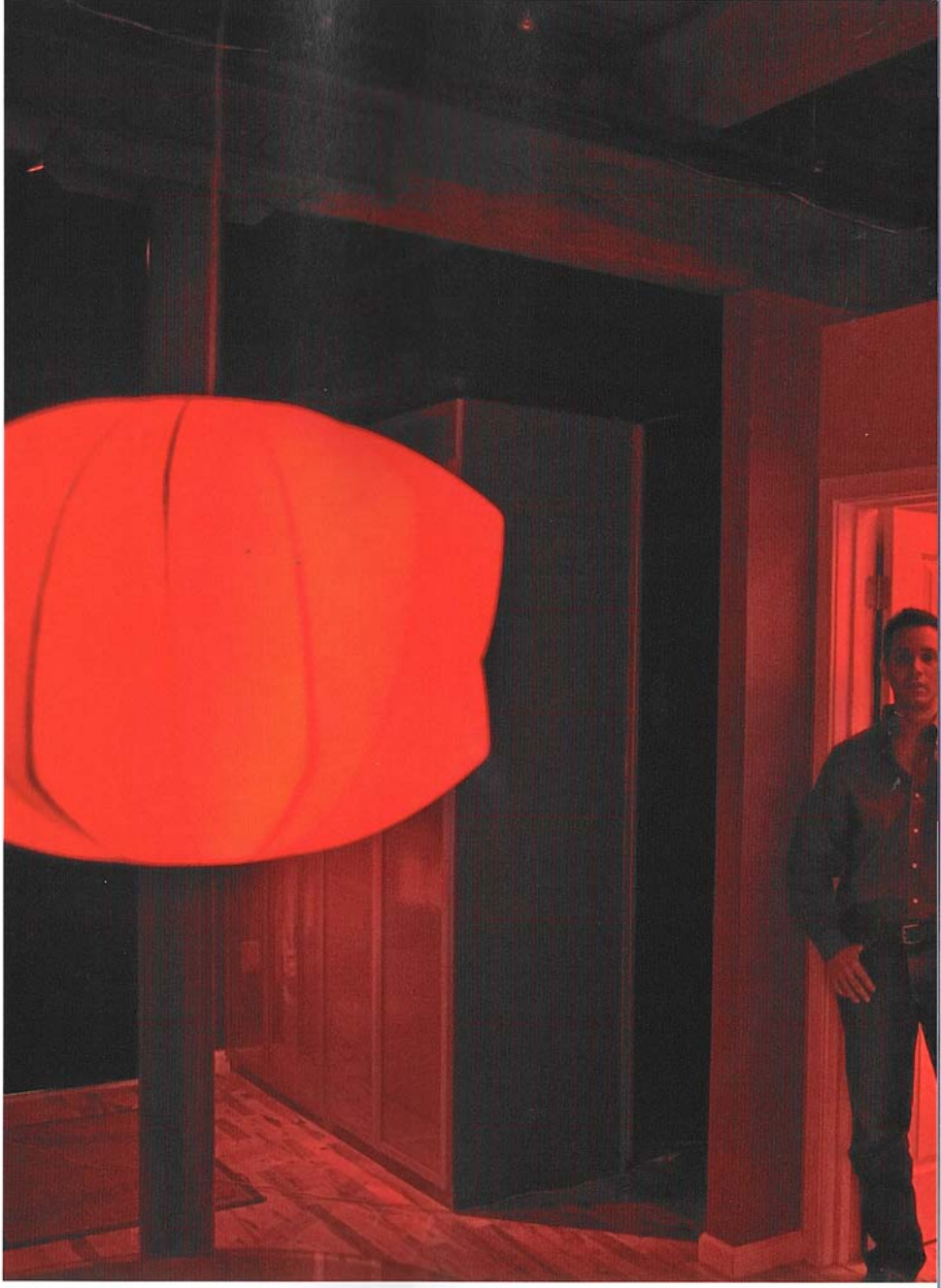
BULBS ARE INEFFICIENT. FLUORESCENTS ARE DIRTY. *ANNE SCHUKAT* EXPLAINS HOW LEDS WILL LIGHT UP YOUR LIFE—BEAUTIFULLY

BOSTON isn't supposed to be this cold in mid-May. It's 7°C and raining so hard that any hints of spring have turned to grey mush. And then you enter a loft apartment, a few miles north of the city, that is a symphony of light. Spotlights illuminate the entrance, in an old brownstone building that was once part of the Charleston Chew candy-bar factory. A shifting radiance draws your gaze to the oval dining table where a George Nelson bubble-lamp glows soft green, then fades to yellow. On the right, a shelf-like structure covers part of a wall. Each of its 20 chequerboard panels slowly morphs from blue to purple, in a lightshow that, with the panels' ability to take on any colour, could be as varied as the music from the piano beside it. Around the corner in the kitchen, a large cabinet is fronted by four doors of translucent glass. Tucked inside, hidden backlights bathe bowls, plates, cups and glasses in a luminous, fuschia-pink wash.

THIS IS THE work of Joey Nicotera, lover of light. Since he was a child, Nicotera, now 33 years old and working as an IT manager, has collected and dabbled with toys that light up. But it was when he started to use fixtures based on light-emitting diodes (LEDs) that his vision came to life. He first read about colour-changing LED lamps several years ago, and knew right away that he wanted them. In 2005 he bought the Boston loft, his first home; since then he has installed more than 50 computer-controlled LED fixtures.

Light-emitting diodes, made of semiconductor chips that convert electricity into light, have come a long way since Nick Holonyak junior invented the first one for General Electric in 1962. At first they were not very bright, so they were used mainly in such gadgets as calculators and watches. As they improved, LEDs made their way into traffic signals, signs and displays. During recent years, they have expanded their reach into retailing, entertainment and architectural lighting, including landmarks and façades. Now, with the help of a few visionary pioneers like Nicotera, they are crossing the final frontier—into the home.

JOEY NICOTERA IN HIS APARTMENT
BOSTON 2007
PHOTOGRAPHS BY
MICHAEL CHRISTOPHER BROWN



Whereas LEDs are rapidly improving, the common light bulb, a glass-encased filament heated to incandescence, has advanced little in design or efficiency in the past 100 years. Only about 5% of the energy it uses is emitted as visible light; the rest is wasted as heat (which is why some in the industry mock it as an oven in disguise). Fluorescent lights, which were developed in the 1930s and consist of tubes that contain mercury, are roughly five times as efficient. The appeal of LEDs is that they contain none of the mercury and already rival fluorescents in efficiency, making them better for the environment.

LEDs have other advantages besides. They can endure up to a decade of non-stop use and, instead of failing, just grow dimmer with time. That spares you the cost and inconvenience of replacing burnt-out light bulbs. An LED is also shock-resistant and takes up hardly any space. Each LED is typically about the size of the rubber at the end of a pencil.

On top of all this, LEDs promise to give you more control over your lighting than any other technology. Unlike incandescent or fluorescent lamps, which spew light in all directions, LEDs generate directional light, which makes them ideal for illuminating the spaces you want. Because LEDs produce light in a narrow range of wavelengths, you can avoid any potentially harmful or unwanted radiation, such as ultraviolet or infra-red light—a feature that has made them popular with art collectors. Moreover, mixing the light of red, green and blue LEDs can generate millions of colours, which lets you tune the light output of a fixture according to your mood, the occasion, or the time of day. And because LEDs are small, they allow for a far greater choice in fixture design and position.

Some in the industry believe LEDs could lead to a revolution in lighting design and even in architecture. New types of fixture, such as walls, floors or ceilings that light up, could become commonplace. "A new style of lighting will evolve," says Jim Benya, whose firm Benya Lighting Design is based near Portland, Oregon. "Lighting as we know it today will become history."

The first residence fitted entirely with LEDs was in London's Chelsea. In 2003 Marcel Jean Vos, then a property developer, teamed up with two companies to embed colour-changing LED fixtures in the floors and walls of his own apartment. Everyone thought he was mad, recalls the tall, exuberant Dutchman, but the result was stunning. He sold the property a year later for a premium of nearly 20% over the going market rate. Earlier this year Vos Solutions, his London-based design consultancy, completed a project for a wealthy British businessman who had his villa in Portugal fitted with more than 1,000 LEDs.

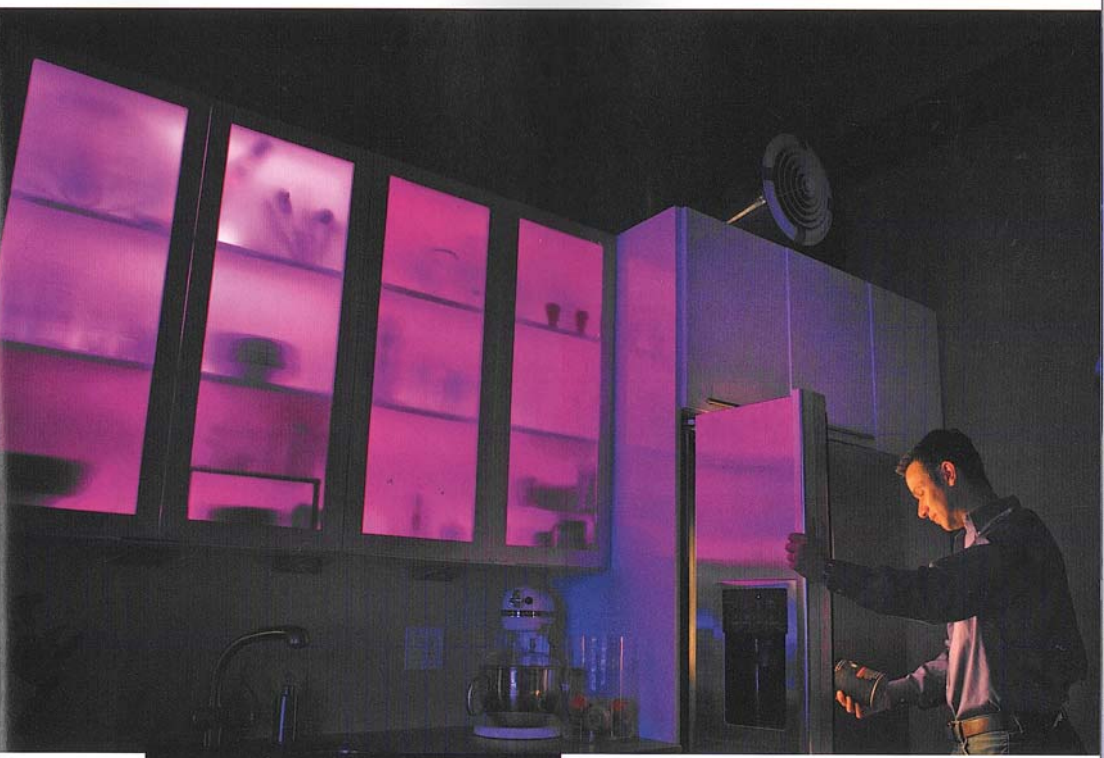
Although few homes are lit entirely with LEDs, an increasing number of designers are using them for special tasks—to light a home theatre, for example, or a rotunda or a hallway. Focus Lighting, a New York-based design firm, recently used LEDs to light a staircase made of glass in a Greenwich Village penthouse owned by a young couple—she a creative director at an advertising agency and he a chef. "The LEDs are capped into the back of the glass, so they just glow magically," says Paul Gregory, the owner and principal designer of the firm. "That's hard to do with any other light source."

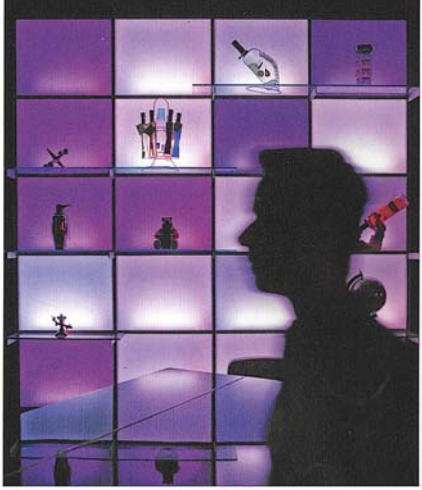
James Turrell is a light artist who has used LEDs in several works in people's houses. Born in 1943, Turrell, a Quaker with white hair and a beard, lives on a ranch near Flagstaff in Arizona. His work has a meditative quality and often plays with the perception of light. He is best known for his "skyspaces", which typically consist of a small, enclosed chamber with an opening in the roof so you can see the sky. The colour of the light inside the chamber, coming from hidden fixtures around the opening, is programmed to change slowly as the colour of the sky changes with the time of day. His largest installation, at the Roden Crater in Arizona, is a long-time work-in-progress that consists of tunnels, chambers and a viewing area inside the crater's vast space.

Most recently Turrell completed an installation at the Napa Valley estate of Norah and Norman Stone, two art collectors. The work consists of a skyspace surrounded by an outdoor pool and an unenclosed skyplane above an outdoor dining area. The designers thought about using other light sources for the project, but none had the colour range or was as easy to control as LEDs, says Dan Dodt, a lighting consultant who helped with the project. Turrell also designed the lighting of an indoor swimming pool and adjacent rooms for Richard Baker, a property developer based in Greenwich, Connecticut.

"A NEW STYLE OF LIGHTING WILL EVOLVE...LIGHTING AS WE KNOW IT TODAY WILL BECOME HISTORY"

For his part, Nicotera did his own designing. He had all the walls in the loft outside Boston painted in shades of medium grey and ensured that his furniture was also in neutral colours so as to maximise his choice of light. In addition, all the fixtures are either functional or decorative, so that they do not look strange or out of place when the lights are off.

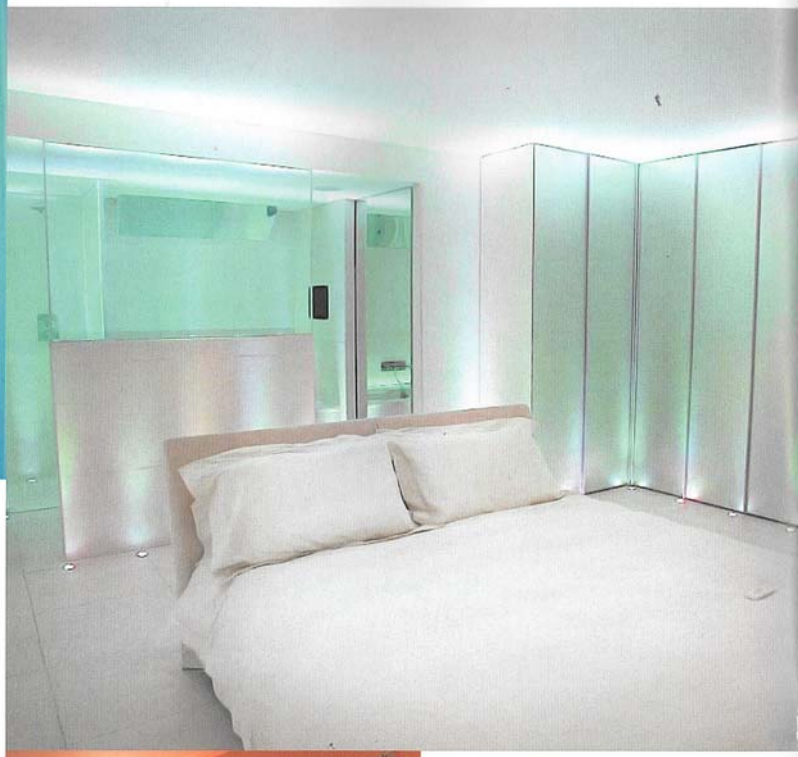




HOW LEDS WORK

An LED chip, housed inside a dome-shaped lens, is based on two types of semiconductor materials that are sandwiched together. The two layers are referred to as "n-type" and "p-type". The n-type contains an excess of negatively charged electrons, whereas the p-type is characterised by an abundance of positively charged "holes" that can accept electrons. At the junction, where the two materials meet, electrons pair up with holes. This forms an area that is depleted of charge, thus preventing current from flowing. But if you apply a large enough voltage across the junction, electrons and holes flow in from opposite sides. As electrons and holes recombine, each electron gives up energy, which is emitted in the form of light. Whereas most semiconductor chips in electronic devices are made from silicon, LEDs are made of complex alloys of exotic materials like indium and gallium. In fact, it is the composition of the semiconductor materials that determines the wavelength of the photons produced by each electron, and thus the colour of the light.

JOEY NICOTERA IN HIS BOSTON APARTMENT



VOS PAD
CHELSEA LONDON 2005
PHOTOGRAPHS BY
VOS SOLUTIONS

With his good looks and easy laugh, Nicotera tells of his fascination with light when he was a child. As well as insisting on having his own Christmas tree each year, he also experimented with building different types of lighting devices. When he was 13, he put together a colour organ, an electronic box that converts sounds into lighting effects (and, with his pottering, nearly set his father's desk on fire).

Nicotera thought of becoming a lighting designer, but studied psychology instead. He never shook off the light bug, however, and ended up writing his master's thesis about the effect of light on appetite. Restaurants typically use low light levels and warm colours, such as gold, orange and brown, he explains, to show the food at its best.

Nicotera used his technology-tinkering talents to go into IT. It was designing his loft with LEDs that brought him back to his original love of lighting design. During the past year, he has even begun consulting on the side for a number of private clients. Two from the Boston area are interested in using LEDs in their homes to light art and one in Maine is using LEDs in a restaurant.

For the average homeowner, LED lighting is still an expensive proposition. Because LEDs operate on low power, you need a transformer to change the electricity from high-voltage alternating current to low-voltage direct current. At the moment, few lights arrive ready to wire in and turn on. That is partly why completely new installations can be complex and pricey—and why they are found mostly in upmarket residences or homes of technophile, do-it-yourself enthusiasts. Another reason for this exclusivity is that LEDs cost much more than incandescent lamps. The installation of the lighting system in the "Vos Pad" for example, cost about £30,000 (or €44,500) including about £10,000 for the fixtures.

In the long run the energy savings add up, says Nicotera. At full intensity, all his 55 LED fixtures together use no more than two 100-watt conventional light bulbs. His entire LED installation costs only $2 a month to run.

AT FULL INTENSITY, ALL OF NICOTERA'S 55 LED FIXTURES TOGETHER USE NO MORE THAN TWO 100-WATT LIGHT BULBS. HIS ENTIRE LED INSTALLATION COSTS ONLY $2 A MONTH TO RUN

Other aspects of LEDs still need improvement. Because an LED's exact composition is hard to control during manufacturing, devices from the same batch often show noticeable variations in colour. And although LEDs don't emit the sort of heat that incandescent bulbs do, they still generate some heat internally that—if not drawn away from the fixture—can cut their useful life and cause colour shifts. Because the industry is so new, it lacks standards. As a result, manufacturers can make theoretical claims about efficiencies that may not be borne out in practice. Such snags make some architects, lighting designers and homeowners wary of choosing LEDs.

Yet the last lighting revolution did not happen overnight either. When Thomas Edison demonstrated the first practical light bulb in 1879, most people could not imagine that gas lighting, the standard in most European and American cities at the time, would be cast aside. Because electric lighting required an entirely new infrastructure, its success, at least at first, appeared uncertain. For several decades fixtures were often designed to work with both gas and electricity.

People also had trouble adapting to the glare of the new light. Whereas gas was known for creating a soft, flickering glow, incandescent bulbs cast a steady and much brighter radiance. "When electric light came in, the light was so bright and so harsh that people complained about it," says Roger Moss, an architectural historian and executive director of the Athenaeum in Philadelphia. Moreover, early electric fixtures were usually bare or differed little from the ones used for gas illumination.

Eventually, new designs appeared that were better suited for light bulbs. The famous

Tiffany lampshades, for example, which consist of intricate combinations of stained glass, only became possible when there was no open flame and the brighter light source could shine through an otherwise opaque surface, says Moss. In addition, using wires instead of gas lines made it possible to install lighting where it couldn't have been before.

So, moving beyond the limits of a technology that has reigned for a century is likely to take some time. Already, a number of companies are offering LED fixtures that mimic the design of traditional incandescent lamps, though some are sceptical that this approach will work. "I think that taking today's technology and putting a product of the future in it will be difficult," says Pamela Hull Wilson, a Texas-based lighting designer who has used blue LEDs to up-light columns inside a guest house.

A project at the Lighting Research Centre, part of the Rensselaer Polytechnic Institute in Troy, New York, demonstrates what an LED system may one day look like. A few years ago, the centre worked with the lighting industry to build an entire room with walls and ceilings made up of interchangeable, electronically controlled tiles—each featuring a type of LED lamp, ranging from spotlights, to hanging fixtures, recessed "cove" lights, or simple translucent tiles that can light up. To show the flexibility of this scheme, Russell Leslie, an architect and the associate director of the centre, walks to one side of the room and quickly pops a tile out of the wall. He then replaces it with one that has a different light fitting. What excites him about LEDs, he says, are the opportunities for rethinking the infrastructure of lighting in residential and commercial buildings.

Another area of research at the centre is the effect of light on health and the circadian system or "body clock", factors that may eventually play a role in lighting design. As it turns out, blue light in particular is the main stimulus that keeps our circadian rhythms synchronised with the solar day. "We are blue-sky detectors," says Mariana Figueiro, an assistant professor at the centre and an expert on the body clock. Because the energy emitted by a blue LED is very close to the peak sensitivity of our circadian system, it can help regulate our internal clock. In general, we need exposure to bright white light or blue light in the morning and lower-level warm light sources at night, says Figueiro.

With the help of LEDs, some designers and architects have already begun to devise schemes for the home that reflect the way light changes during the day. Walter Smith, an architect at Skidmore, Owings & Merrill in New York, who has worked on several projects that involve LED lighting and collaborated with James Turrell, says: "Now we're able to create these walls that can be anything we want them to be. They can be a beautiful blue hue, they could become a sky, they could become a sunrise."

LEDs made of organic materials, which first appeared in electronic devices several years ago, promise even more revolutionary designs. Based on flexible, thin-film polymers, they emit a softer, more distributed light than conventional LEDs and may eventually create softly glowing wallpaper or curtains. "That's probably the scary part," says Patricia Rizzo, who manages the residential programme at the Lighting Research Centre. "Almost everything is going to be possible now; everything is lightable. So we have to be a little discreet in how we use LEDs." Other lighting designers are even more cautious, saying that colour-changing LEDs do not suit the home and people are likely to continue to prefer the kind of white light they are used to from incandescent bulbs.

But not everyone believes you have to make that choice. "With LEDs, the fortunate thing is you can have both," says Kevin Dowling, vice-president of innovation at Color Kinetics. The company, which was just acquired by Philips, a Dutch electronics company, has been at the forefront of designing colour-changing LEDs for a decade and also makes a variety of white-light LED fixtures.

Nicotera would agree. He recently decided to sell his loft and buy a plot of land in Saugus, a small town about ten miles north of Boston. There he plans to build his dream home, almost entirely lit with LEDs. As well as using colour-changing fixtures, this time he also wants to use tunable white-light LEDs, allowing for more subtle variations that range from a cool to a warm white. By the end of this year, he wants his new home to be completed, just in time to entertain his family and friends with a spectacular show of Christmas lights. ■