he show started at twilight. On a balmy evening last February outside Tasmania’s Museum of Old and New Art I sat spellbound, leaning back on a granite bench gazing up at a large white fiberglass canopy that floated several meters above my head. Light projected onto it began to gradually morph from one gorgeous hue to another. Lilac deepened to purple, then shifted to burnt orange, to chartreuse green, and on it went. Meanwhile, through a rectangular aperture cut in the middle of the canopy, the darkening sky seemed mysteriously to lose depth, becoming a flat plane of color that looked as if it had been painted on the ceiling. The interplay between artificial and natural light was hallucinatory: as the hue of the former changed, so apparently did that of the latter. In a silence punctured only by the raucous laughing of a pair of kookaburras the program shimmered on, ending after perhaps an hour, when the sky had become pitch black. A truly magical experience, one that I shall remember as long as I live (Figs. 1–3).

What I had witnessed was Amarna, one of the latest (2015) in a series of “skyscapes” created by the American light artist James Turrell. Skyscapes are Turrell’s signature pieces [1], [2]. Since 1974 he has built more than 80 of them, in 26 countries around the world [3]. During the 1980s and 1990s, however, Turrell was frustrated by the limitations imposed on his work by the primitive lighting technology he was obliged to employ. The concealed linear tungsten-filament tubes in his early installations were only capable of producing one color, a soft orange glow. He could vary their brightness, but that was it. The fixtures were no match for the dynamic full-spectrum illumination the artist imagined.

Back then color could be produced using plastic gels to filter white lights. Since the United States’ bicentenary in 1976 the upper floors of the Empire State Building had on special occasions been bathed in multicolored light produced in this way [4]. But the palette could only muster a few, washed-out-looking hues. It took maintenance workers up to six hours to fix the gels, by hand, onto the skyscraper’s 400-odd floodlights. Changeovers from one color to another could be automated using dichroic filters driven by stepper motors. But moving parts raised maintenance issues. Worse, control in such archaic mechanical systems was complicated: achieving even simple effects required a theatrical lighting professional [5], [6]. The only other option for colored light was “cold cathode” tubes, a relative of neon, a technology that originated in the late 1920s. In 1997, Turrell had used computer-controlled cold cathode tubes to bathe the exterior glass walls of a six-story gas utility building in Leipzig, Germany, with red, yellow, and blue light. Noble gas it might be, but neon was a nightmare to work with. The tubes were fragile and broke easily; the fixtures required high-voltage power supplies whose bulky transformers made them tricky and expensive to install and hard to conceal. Cold cathode was also notoriously difficult to dim below a certain point, preventing smooth transitions from light to dark and from one color to another [8].

In 1999, Turrell received two commissions. One was from the prestigious architectural firm Skidmore, Owings & Merrill to light a new library at
Greenwich Academy, a posh girls school in Connecticut; the other to illuminate the swimming pool in a play-barn owned by one of the school’s trustees. The architect at SOM on the latter project was Walt Smith. Around this time Smith was accosted in his office by an unusually pushy salesman brandishing a brand-new cove light, a type of fixture used in architectural applications to shine light upwards. A thin stick 6 in long, it contained red, green, and blue light emitting diodes that could be programmed, using pulse width modulation, to produce color changes, as well as effects like pulsing and strobing. The little fixture was capable of 256 intensity levels for each primary color, for a total of more than 16.7 million variations. It could shift seamlessly from deep, saturated hues to soft pastel tones. Smith was intrigued. He knew that Turrell’s stock-in-trade was large-scale washes: “instead of mixing light with a bucket, you can do it with a teaspoon” [10]. He has been using LEDs to illuminate his skylines ever since.

Light-emitting diodes (LEDs) needed no filters or dimmers, had no moving parts, required next to no maintenance, generated relatively little heat, and promised to last more than a decade (a huge advantage for designers loath to put lights in hard-to-reach spots, only to have the bulbs burn out after a few months). LED fixtures were robust, vibration resistant, and ultracompact, meaning that they could be installed in previously inaccessible places, like on the cables of the San Francisco-Oakland Bay Bridge, where Leo Villareal choreographed strings of LEDs to dance from dusk to dawn in continuous, ever-changing patterns [11]. Artists such as Turrell and Villareal along with a cohort of lesser known lighting designers would deploy color-changing LED fixtures to enhance iconic monuments and enliven nocturnal cityscapes around the world.

This was more than mere eye-candy. Experience with colored solid-state light paved the way for a far larger and more important application: white light used for general illumination. White LEDs—actually blue light sources that “pumped” a yellow phosphor—were initially not bright enough to replace incandescent bulbs and fluorescent tubes. But LEDs are semiconductors, hence subject to the experience curve. As Moore’s law had been to computing, so Haitz’s law would be to lighting. Formulated in 1999, Haitz’s law predicted that LEDs would continue to get brighter, by a factor of 20 per decade, and cheaper, declining at a rate of ten times per decade [12]. Lighting accounts for around 10% of our electricity usage. LEDs use up to 90% less energy than incandescents. They would be crucial in reducing overall energy consumption [13]. By 2009, white LEDs had become bright enough for use in general illumination. But LEDs were not just a replacement technology; they were also a disruptive technology. The chips could be mounted on printed circuit boards and combined with other semiconductor devices such as sensors and microprocessors to form networks of tunable lights. Today LEDs are transforming what lighting can do, with enormous implications for healthcare, education, productivity, agriculture, personal well being, and other fields besides [14].

Among the first to recognize the significance of LEDs for lighting were two twenty-something electrical engineers, George Mueller and Ihor Lys. Their vision was of lights that would consist of individually addressable elements, whose color and intensity could be digitally controlled, and which could be networked with other lights. To realize this vision they founded Color Kinetics, the world’s first solid-state lighting startup and maker of the little stick light that had reduced James Turrell to tears. Mueller and Lys saw themselves as revolutionaries who would harness high-tech
brain power to execute what in their manifesto they called a “coup de color” on a hitherto low-tech industry (Fig. 4) [15]. Their intention, as Mueller put it, was to “kick the crap” out of traditional lighting companies at their own game [16]. During the ten years of the firm’s existence, from its founding in 1997 to its acquisition a decade later by Philips, Color Kinetics would revolutionize the lighting industry [17]. This was remarkable, since neither Mueller nor Lys had any prior experience in lighting.

Lighting was ripe for revolution. Throughout the 20th century the lighting industry had experienced little change. Indeed, lighting companies were notorious for being actively hostile to innovation. In 1911, GE introduced the tungsten-filament incandescent bulb. It produced five times more light than its carbon-based predecessor and lasted much longer. The problem for firms that had invested in building factories to manufacture it was that the new bulb lasted too long. The makers felt it would be better if the bulbs burned out sooner, obliging customers to purchase replacements. In 1924, the companies ganged up to form the Phoebus Cartel. Its goal was to develop an incandescent bulb whose filament would fizzle out after just 1000 h.

Though the cartel is long gone, the attitude of the lighting industry remained the same. Its aim, above all, was to control the market [18].

More recently there was the sorry story of the electronic ballast. In the late 1940s, GE’s Nela Park Laboratory in Cleveland, OH, USA, had shown that increasing the frequency of the current used to drive fluorescent lamps above 60-Hz mains would improve energy efficiency by as much as 30% [19]. But until the advent of affordable power transistors, frequency conversion was not practicable. In 1981, Universal Manufacturing of Paramus, NJ, USA, one of the two major U.S. makers of conventional (magnetic) ballasts, licensed electronic ballast technology from Luminoptics, the startup that pioneered the field. But Universal’s purpose in licensing the technology was to prevent electronic ballasts coming to market. In 1984, the founders of Luminoptics filed suit. They would ultimately win their case, but it took 13 frustrating years of court battles. In 1989, Motorola attempted to buy the license to electronic ballast technology. Though a clause in the contract stipulated that Universal would relinquish the rights if it did not intend to use them, the company refused to honor the agreement. It became clear that the real reason Universal had sat on the technology was simply to stymie competition [20].

Availability of power transistors enabled electronic ballasts. The biggest improvement in conventional lighting technology was also brought about by a new semiconductor device. During the first 80-odd years of its existence, the incandescent bulb could be either on or off. Little thought was given to control, except in the theater, where for dramatic purposes it was useful to be able to fade lights up and down. To achieve these effects, stage lighting used rheostats, bulky devices that took up space, gave off lots of heat, and had to be operated manually. In 1958, a physicist named Joel Spira came up with the now-familiar rotary-dial dimmer. In 1961, he established a firm called Lutron to manufacture his invention. Today Lutron is the world’s leading maker of lighting controls [21].

Lutron was the exception that proved the rule. In the lighting industry the paradox was that outside the big three—Philips, GE, and Osram—most “lighting” companies did not make light sources themselves. Traditionally these firms had been in the business of shaping reflective steel or aluminum housings into which light sockets could be bolted or screwed. They referred to themselves as “metal benders.” Few had electrical engineers on their payrolls. Nor were they accustomed to spending much on R&D. In 2002, an Irish engineer named Mark Hand left the ailing telecom firm Nortel to join Acuity Brands, the leading U.S. fixture maker. “In terms of technology it was like stepping back fifty years in time,” Hand told me. The features on semiconductor chips were measured in micrometers, but lighting folks still reckoned the tolerances on their metal castings in plus or minus an eighth of an inch. “That’s not a tolerance,” Hand joshed his colleagues, “that’s a dimension!” [22].

In this well-entrenched good old boys’ club where nothing much changed from one year to the next, the unseen-for advent of LEDs caused consternation, especially once it became clear that henceforth, fixtures and sources would be integrated. It was onto this stagnant industry that Color Kinetics descended, as one lighting designer described it, “like aliens from an advanced civilization” [23]. Where were these aliens from? The answer was Planet Pittsburgh, home of Carnegie Mellon University (CMU) and in particular the school’s Field Robotics Center, where George Mueller, Ihor Lys, and the core engineering team at Color Kinetics all cut their teeth.

The Field Robotics Center was an offshoot of CMU’s Robotics Institute,
Scanning Our Past

founded in 1979, the first such department at a U.S. university [24]. As an undergraduate Kevin Dowling, who 20 years later would join Color Kinetics as head of engineering, became the institute’s first employee. He read an announcement in the student newspaper. “It said they were going to be investigating robotics to solve problems in industry” recalled Dowling [25]. From the outset the Robotics Institute was, of necessity, multidisciplinary. It recruited from electrical, mechanical, biomedical, and civil engineering, from computer science, but also from unexpected areas such as art and sculpture, because sculptors knew how to build things. “The thing about CMU that really stood well for us in later years was how interdisciplinary it was there, much more than in other universities,” said Mike Blackwell, who joined the institute around the same time as Dowling, and who would later become principal hardware engineer at Color Kinetics. “It gave all of us who grew up in the Robotics Institute a much broader perspective on how things work,” Blackwell added [26].

Robots consisted of sensors, actuators, motors, and computers, components which had to be integrated into a system so that they could communicate with each other. A decision in one area inevitably impacted other areas. The approach of researchers at the institute was thus systems based. The institute’s roots were in artificial intelligence. It mustered plenty of theorists who spent their time writing esoteric code. At the Field Robotics Center by contrast, the emphasis was on rolling up your sleeves. The starting point for any investigation in robotics today would be performing high-speed simulations in a virtual world. But back in the 1980s, there was not enough storage available to contain such a world. To determine how a robot would behave in a given environment, you had to build one and test it. “There were no plans, no drawings—we just had to sort of decide how it was going to work and put it together,” Ihor Lys said. “Our big concept was that if you create a machine and you put it in front of ten guys with keyboards, they’ll figure something out” [27].

As its name implied, the Field Robotics Center sprang from a need to tackle real-world problems in the field, such as investigating the wrecked reactor building at Three Mile Island. There, following the core meltdown, high levels of radiation prevented humans entering. The remote reconnaissance vehicle that the center’s graduate students made for Three Mile Island in 1983 was the first in a long line of machines that were built to solve specific problems. One was the Tessellator, a robot that Kevin Dowling worked on that could check the ceramic heat-resistant tiles on the underside of NASA’s space shuttles (Fig. 5) [28]. Another was Neptune, a treaded robot for which George Mueller designed camera lights, that could crawl into large fuel storage tanks to check for corrosion [29]. But the area that would become the center’s forte was autonomous vehicles. The first of these was the Terregator, a six-wheeled robot intended to operate inside mines. Then, in 1986, came NavLab I, a panel van that could trundle along at a quarter of a mile an hour. Dowling led the team that constructed it. There would ultimately be 11 generations of this family of mobile robots, the direct antecedents of today’s self-driving cars. In 1991, while working on the second of these, NavLab II, a converted military ambulance, 21-year-old George Mueller and 22-year-old Ihor Lys met and became friends.

It was hard to avoid comparing Mueller and Lys to another dynamic high-tech duo, the cofounders of Apple. Like Steve Wozniak, Lys was a technical whiz. Like Steve Jobs, Mueller was charismatic, capable of generating a reality-distortion field that inspired people to take on the impossible. “George is an amazing salesman,” Walt Smith said admiringly, “he can make you believe anything is true.” But in addition to similarities there were also significant differences. Jobs would bully employees into getting his own way, whereas Mueller was respectful of the talents of others. As Kathy Pattison, who had worked at Apple before joining Color Kinetics as head of marketing, could attest. “Steve had a belligerent intensity to him,” Pattison recalled, “but that is not George at all.” A keen snowboarder and kite-surfing Mueller exuded a sense of fun. He had both vision and determination. “George knew where we were going and he never lost focus on the path,” Pattison said. She would always remember their initial meeting. “He had a ponytail, he oozed enthusiasm, panache, and charisma. The day I met George I thought, Oh my God — this is going to happen!” [30].

Born in 1970 in West Bloomfield, an outer suburb of Detroit, MI, USA, Mueller as a youngster was a natural athlete who played soccer and hockey and also excelled in art, his passions being sculpture and photography. Expecting him to apply to a design school like Parsons his art teachers were surprised when Mueller opted instead to do a dual major in electrical and computer engineering at CMU. In fact, he had been a computer buff since getting his first PC, a TRS-80, at the age of ten. He taught himself how to hack computers and to “phreak” phone networks. His initial encounter with LEDs dated back to high school.

Fig. 5. Tessellator Team at CMU’s Field Robotics Center, c 1994. Kevin Dowling, front, second from left; Fritz Morgan, fourth from left; Mike Blackwell, back, second from left. Permission: Kevin Dowling.
I would make pendants by taking a little LR-44 watch battery, hooking it up to an LED, then gluing them on top of a translucent crystal and attaching a leather cord to form a glowing necklace,” Mueller recalled [31]. Despite his degree, Mueller never practiced as an engineer. When it came to, say, designing a circuit, he would defer to others. “George is the guy that I’ll find the three other smartest people he knows,” said Lys, “and ask them how it should be done.”

The smartest guy that Mueller knew was Ihor Lys. “Ihor is just this absolute tech genius, gifted beyond anyone I’ve seen,” Mueller said appreciatively. “Ihor can do anything—he’s hyper-skilled on the digital side, and he’s also an analog expert. He can do chip layout with the best of them. He can program at a high level, in C or any of the languages that you might want, and at a low level, in assembler or machine language. Then you add onto that he was a roboticist for years, and robotics people are systems engineers.” Lys had a stubborn streak: the best way to motivate him was to tell him that something was impossible. “Ihor would get all huffy and go off,” Mike Blackwell recalled, “then he’d come back a couple of weeks later and say, No, no — this is how I solved it.”

Mueller quickly learned how to push his friend’s buttons, betting him a few beers that he couldn’t do something; then, when he came up with a solution, urging him to do better.

At Color Kinetics, Lys set a blistering pace, ideas pouring from his fertile mind. He was impatient with those who could not keep up. Pattison remembered him asking her during a job interview how quickly she could move, because he was intending to pump out a new product every month. Lys was prone to hyperbole. Kevin Dowling recalled him explaining to bewildered potential customers at a trade show that, since LED fixtures generated so little heat, their casings could be made of cheese. But Lys was also game for anything. On one occasion, to promote Color Kinetics’ products at Lightfair, the industry’s annual showcase, Pattison asked him if he could craft a basket of color-changing Easter eggs. Overnight, Lys obliged. Then it was decided that the best way to draw attention to the basket was for someone to dress up as the Easter bunny and carry it around the show floor. Lys volunteered. “Ihor walked around Lightfair in a large pink bunny suit with a basket of color-changing eggs!” Pattison laughed. On a dare from Mueller, he continued to wear the suit on the plane home to Boston.

Lys was born in 1969, just outside Washington, DC, USA, to Ukrainian parents. At CMU he majored in electrical engineering, where his specialty was low-power CMOS chips. As a member of the university’s Analog Group, Lys dabbled in the dark arts of analog circuitry. Membership of the group gave the youngster the chance to have chips he had designed fabricated under a DARPA program, experience that would later come in handy. On the Analog Group’s website, Lys d dryly described himself as “a seventeenth-year PhD student who has been at CMU for as long as he can remember.” (In fact, he spent just over a decade at the school.) He listed his hobbies as “roller-blading, bar hopping, and spending massive quantities of DSSC [data storage systems center] funds” [32].

At the Field Robotics Center, there were always piles of components lying around, an invitation to tinker for creative young engineers with too much free time. “We started playing with LEDs,” Lys recalled. “We did many of the things people aren’t supposed to do with LEDs—we ran them really hard, pulsed them at crazy frequencies, tried to get them to do all sorts of strange things.” Mueller would egg on Lys, telling him to drive the LEDs harder, try this, try that, try something else. All great fun but, as Lys confessed, “very little of it did much of anything useful.”

Mueller remembered having seen an electronic novelty sign at the Detroit Science Center. A single vertical row of flashing LEDs, it exploited the scadalic motion of the eye to produce a lingering image, an effect known as persistence of vision. For an assignment in a digital electronics course in his sophomore year, Mueller had built a little ten-bar PoV sign that displayed the word “LOVE.” He gave it to his mother for Christmas. (For his roommates, he made another sign that read “BEER.”) Later, when Mueller took classes at business school he wrote a business plan based on PoV signs. “George is a big proponent of when you’ve got something, try and sell it,” Lys observed. In 1992, the pair formed a company they dubbed Stone Age Technologies (“because there weren’t supposed to be any technologies in the stone age, right?”). Lys built a multicolor, multicolumn persistence of vision display that was 4 ft high and incorporated thousands of LEDs. The target market was advertising. There were, however, two issues. Potential buyers kept asking them if they could make the image sit there and hang. This was fundamentally incompatible with a perpetually scrolling device. The other issue, which took the pair years to realize, was that they couldn’t compete on price with the existing display technology, namely television. By the end of 1996, Stone Age Technologies was more or less defunct. But their foray into displays had given them invaluable experience working with LEDs.

Meanwhile, serendipitous developments were occurring in the technology of light emitters. Following their invention in 1962, the tiny devices had for more than 30 years been used mostly as indicator lights. During the 1980s, new families of compound semiconductor materials were investigated. These led to the production of the first bright LEDs. Red and subsequently amber devices found niche applications in car brake lights and traffic signals. But, lacking bright blue and green, solid-state lighting was unable to realize the ubiquity its inventors had foreseen. Then, in December 1993 came a bombshell: Shuji Nakamura, a previously unknown engineer working
at Nichia, an obscure Japanese company, announced the world’s first bright blue LED. This was quickly followed by the first bright green LED [33]. In late 1996, Mueller and Lys obtained samples of the new devices. They cost $6 each, but for those with eyes to see it, the writing was on the wall. Around this time, in a final attempt to hawk PoV displays, Mueller and Lys attended Lighting Dimensions International. This was a trade show catering to “lighting jocks,” theatrical professionals who did the lights for plays and musicals, and roadies who ran the equipment at rock concerts. The pair noted a gap at the low end of the market. To squeeze controllable colored lighting into smaller performance spaces, the only option was to use halogen “cans” fitted with filters and dimmers. It was obvious to them that LEDs were a better way to meet this need. They had piles of LEDs sitting around doing nothing. That was how Color Kinetics originated.

Mueller headed off to Boston to hone his entrepreneurial chops on an Internet securities company with his older brother Gary, leaving Lys to finish up his PhD in Pittsburgh. At night, beavering away with a soldering iron on the coffee table at his cramped apartment, Lys built, tested, rebuilt, and retested a set of 30 programmable LED canisters in three sizes (Fig. 6). In November 1997, the pair stuffed the lights into a jumbo-sized backpack and headed off to LDI, held that year, appropriately enough, in Las Vegas, NV, USA. Their booth consisted of a white vinyl tent pitched far from the show’s central aisles. Inside it, they demonstrated the lights, changing their color and causing them to pulse and strobe. Attendees flocked in. To their surprise, the pair ended up winning the show’s best new product award (Fig. 7) [34]. It confirmed they were onto something.

Lys moved to Boston to join Mueller. The fledgling firm began operations out of a third-floor walkup apartment above an Italian restaurant in the city’s historic North End. Initially they funded everything on Mueller’s credit cards. But to manufacture and market their lights, they needed serious cash. Venture capitalists in the grip of dot-com mania turned up their noses. Lighting companies were likewise indifferent. “The traditional lighting industry told us that this would never work,” Mueller recalled. “There was so much resistance from people saying, Naw—LEDs will always be these blinky little toys.” Ultimately, the pair were obliged to rely on angel investors, none of whom knew anything about lighting. But a little due diligence by the cannier among them revealed that the lighting market was large, complacent, hence vulnerable to the kind of radical innovation that Mueller and Lys were proposing (Fig. 8) [35]. Thus far, it had been just the two of them. Now, to scale up their activities they needed staff. They turned to the obvious source—roboticists from CMU. One of the first people Mueller contacted was Kevin Dowling, who had recently moved up to Boston to work for a robotics firm. “George invited me to his apartment to look at this new color-changing LED fixture that Ihor had created,” Dowling recalled. “He led me into the bathroom—the only room that could be made dark, because there were no curtains on any of the windows elsewhere in the apartment—and said, Look at this.” Dowling was beguiled. The tiny lights were still not nearly bright enough, but Mueller made a persuasive case that LEDs, being semiconductors, would improve rapidly. Dowling had always wanted to work for a startup. “And the idea of changing the lighting industry was very appealing to me,” he said. Dowling himself would not join Color Kinetics until 1999, but in the meantime he recommended two of his old friends from CMU: Fritz Morgan, who would later become the firm’s CTO, and Mike Blackwell. Ultimately the core engineering team would muster seven former roboticists. (The other two, Brian Chemel and Colin Piepgras, would go on, following the acquisition of Color Kinetics, to form Digital Lumens, a second-generation solid-state lighting startup, which in its turn would be acquired, a decade later, by Osram [36].) At Color Kinetics they
would replicate the culture of innovation that had worked so well at the Field Robotics Center.

Building an LED fixture was not simply a case of soldering the tiny lights onto a printed circuit board, sticking a lens on top, then bolting the resultant ensemble onto a reflective housing. To take advantage of the unique properties of LEDs, notably their energy efficiency and small size, it was necessary to rethink what a lighting fixture should be. A systems-based approach was required. “We spent an incredible amount of time and effort to simplify our systems,” Lys said (Fig. 9). One particularly pressing need was to be able to put power supplies inside the lights. Clunky off-the-shelf “bricks” like the ones used to power personal computers were much too big to fit into the kind of hard-to-access nooks and crannies that were ideal for super-compact LED fixtures. The combination of power supplies, low-voltage wiring, and LED controllers also suffered from unacceptably high energy losses—typically around 40%—which meant lots of heat that had to be dissipated somehow. In confined spaces it was not possible to incorporate a fan. The goal was thus to design an energy-efficient power supply that could be integrated within the fixture itself. Eliminating unneeded protection and isolation was not enough: the system had to be completely redesigned, totally removing whole sections. Lys dispensed with one power conversion step entirely. He reduced the parts count by almost two thirds, from 278 to just 99, and improved the wall-plug energy efficiency to around 90%. In addition to being substantially smaller, the resultant power supply was also controllable, dimmable, and able to communicate over a network, enabling fixtures to be daisy chained with standard wiring. For this work, Lys would be named National Inventor of the Year in 2008 by the Intellectual Property Owners Education Foundation [37].

Another problem was also size related. It seemed there might be a market for strands of small Christmas-tree-like lights, all of which could be individually addressed. Using an embedded microcontroller for each node would have been too large and prohibitively expensive. A compact application-specific integrated circuit was required, but a startup like Color Kinetics did not have the resources to develop such a chip. Lys took the challenge upon himself, working on his own in his spare time after hours and at weekends. Ultimately the chip he designed would be mounted on one side of a circuit board just 8 mm in diameter with the LED on the other side. One of its most impressive applications would be in the strings of lights that illuminate the Bay Bridge. Today, 16 years after its introduction, the chip and its numerous clones are still in widespread use.

At trade shows in the late 1990s and 2000s, Color Kinetics won many awards for its innovative products (Fig. 10). But so long as the firm stuck to colored fixtures aimed at niche markets, the lighting industry could afford to ignore it. Then, in December 2004, Color Kinetics announced a new range of digitally controllable white light products. For leading fixture makers such as Acuity Brands, there could be no mistaking the upstart firm’s intent: the geeks were out to eat their lunch. In response, Acuity launched a crash LED catch-up program that the firm’s chief technology officer Rick Earlywine told me was explicitly focused on what Color Kinetics was doing [38].

In June 2004, Color Kinetics went public [39]. “Many people in the industry were shocked,” Kathy Pattison recalled. “They had no idea we’d come so far in such a short span of time.” There was also another reason to take note of the upstarts. Around its products the company had built up a barrage of patents, many of them including hundreds of claims. By 2007, the company had revenues of $80 million and its portfolio had grown to 79 U.S. and foreign patents granted, with a further 180 applications pending [37]. Checking whether a product infringed on any of these represented a huge effort and expense for its rivals. Companies like Philips had done a commendable job of developing LEDs bright enough to be used for illumination. But they had overlooked the electronics around the controls for solid-state lighting, and the novel applications that they enabled [40]. There was nothing the Dutch firm could do: the upstarts had them over a barrel. In June 2007, Philips bit the bullet, paying $781 million to acquire Color Kinetics. Acquisition was vindication. “Every lighting expert told us we were wrong, it was foolish, LEDs would never amount to anything,” Mueller said. “But we had the vision—and the blind
optimism—to be able to say, No—we’re right.” At LDI, in 1997, Color Kinetics had been the only company offering LED fixtures. Two decades later, as Lys walked around Lightfair in San Diego, CA, USA, where he now lives, he did not see a single non-LED fixture. “From desk lights to stadium lights,” he said, “they were all LED.” Though many of these were simple replacements, there could be no doubt about the outcome. The aliens had won.

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ABOUT THE AUTHOR