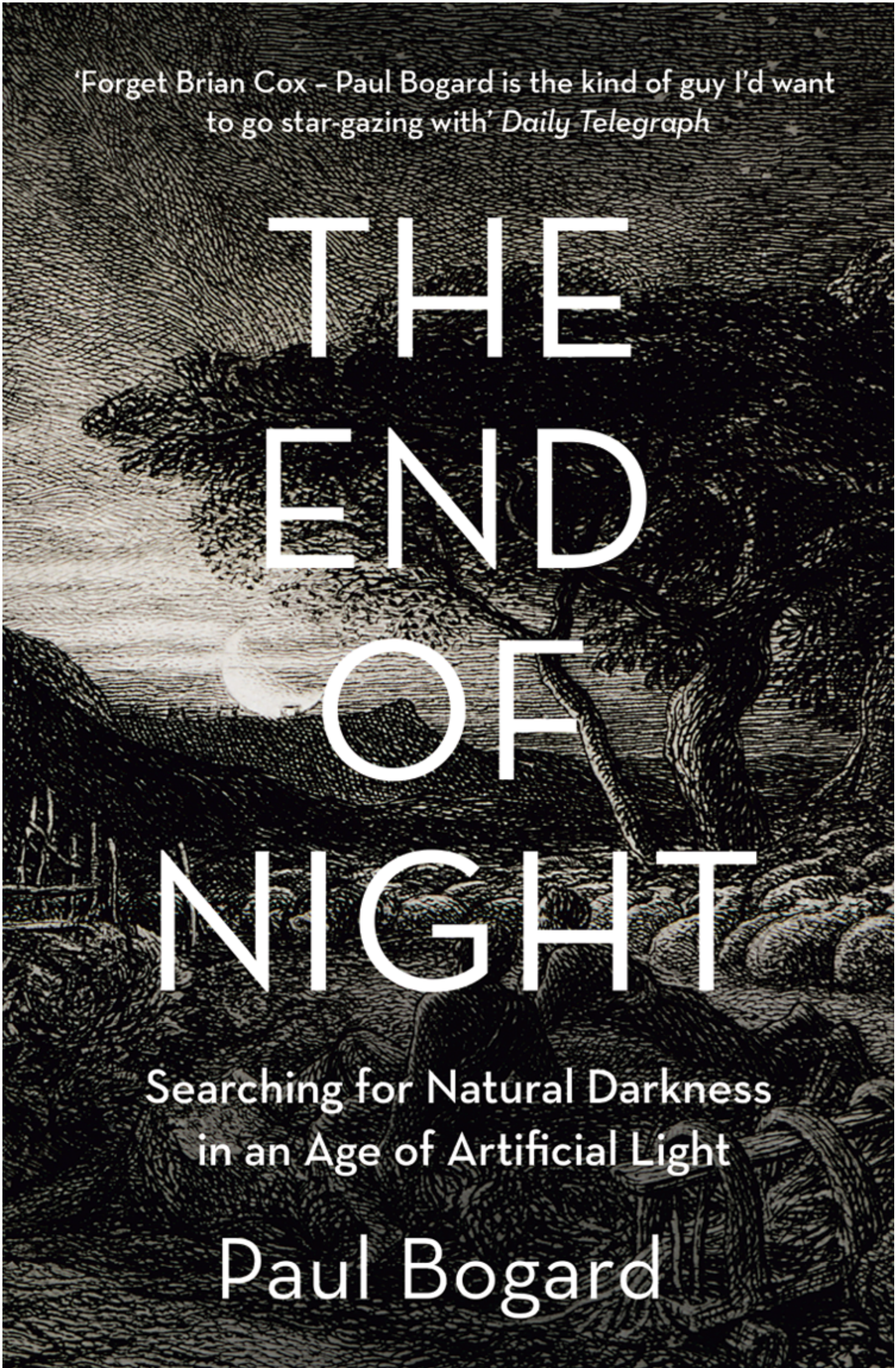
'Forget Brian Cox – Paul Bogard is the kind of guy I'd want to go star-gazing with' *Daily Telegraph*
THE END OF NIGHT
Searching for Natural Darkness in an Age of Artificial Light
Paul Bogard

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The End of Night: Searching for Natural Darkness in an Age of Artificial Light

«HarperCollins»

Bogard P.

The End of Night: Searching for Natural Darkness in an Age of Artificial Light / P. Bogard — «HarperCollins»,

Our use of light at night is negatively affecting the natural world in ways we're barely beginning to study. Meanwhile, our physical, psychological, and spiritual health are significantly influenced by darkness or a lack thereof; it's not a matter of using light at night or not, but rather when and where, how and how much.We live awash in artificial light. Since the 1930s its increase has been gradual enough that it would be easy to imagine our nights are as dark, or nearly so, as they ever were. But today some three-quarters of Europeans and Americans no longer experience real night and can't imagine real darkness—and nearly all of us live in areas considered polluted by light.In ways we've long understood, in others we're just beginning understand, night's natural darkness has always been invaluable for our spiritual health and the health of the natural world, and every living creature suffers from its loss.In Geography of Night, Paul Bogart investigates what we mean when we talk about the different shades of darkness, about what we've lost, what we still have, what we might regain. He travels from our brightest nights to our darkest, from the intensely-lit cities where public lighting as we know it began, to the sites where real darkness might still remain. Encountering scientists, physicians, activists and writers, Bogart discusses how our use of light at night is negatively affecting the natural world in ways we're barely beginning to study; how human physical, psychological, and spiritual health are significantly influenced by darkness or a lack thereof; and how it's not a matter of using light at night or not, but rather when and where, how and how much.A beautiful invocation of our constant companion, the night, which returns every day of our lives, this book reminds us of the power and mystery of the dark.

Содержание

THE END OF NIGHT SEARCHING FOR NATURAL DARKNESS IN AN AGE OF ARTIFICIAL LIGHT

PAUL BOGARD

FOURTH ESTATE • *London*

Introduction
To Know the Dark

Have you ever experienced Darkness, young man?
—ISAAC ASIMOV (1941)

At least when it comes to light pollution, what happens in Vegas does not stay in Vegas. What happens here seeps across the surrounding desert so that national parks in Nevada, California, Utah, and Arizona, tasked with conserving their features "unimpaired for the enjoyment of future generations," report their horizons aglow, their dark skies tainted. It's to one of those parks, Great Basin, that I am headed—two hundred fifty miles north on Nevada's US Route 93, two lanes rising from I-15 toward Ely—to see for myself what's left of the dark.

The story is the same all over the country—dark places disappearing from the map. Computer images based on NASA photos show—from the 1950s to the 1970s to the 1990s—a steady spread of light across the land, and the projected view of 2025 imagines the entire country east of the Mississippi as one great rash of yellows and reds, the most intensely populated areas blisters of white; even west of the great river only scraps of black remain, each surrounded by a civilization gnawing at its ragged edges. Still, the eastern Nevada desert is some of the darkest geography left in the United States, and Great Basin National Park lies at its heart. So here I am, charging out of Las Vegas toward maybe the darkest spot in the nation.

It's the early evening, and all around the racing car the earth is changing, temperatures falling, animals and insects beginning to stretch and move, night-blooming plants feeling life surge again. All day the desert rocks have been gathering heat, expanding in sunlight, sending thermals skyward to soar hawks and bump descending planes. But at night the direction of energy flow reverses, the temperature drops thirty or forty degrees, and the desert rocks glow with warmth like a winter's woodstove. In the natural rhythm of day and night, whole mountains swell and fall like the chest of a sleeper.

To the east the mountain ranges still hold the rose color of the setting sun, while to the west already they are losing their definition, dissolving into silhouettes, the darkness sloping to the desert floor, long drapes hanging from mountainsides. We call this time "twilight," and officially, there are three stages—civil, nautical, and astronomical—that correspond to the gradual gathering of darkness and fading of the sun's light. In this twentieth-century classification, civil means the time when cars should use their headlights, nautical means dark enough that the stars needed for navigational purposes are visible, and astronomical means when the sky darkens nearly enough for the faintest stars. Unofficially, I love biologist Robin Wall Kimmerer's name for twilight: "that long blue moment."

We like to think that darkness "falls," as though it were like snow, but as the earth turns its back to the sun darkness actually rises from the east to wash and flood over land and sea. If you've ever stood at dusk and seen a gloaming on the eastern horizon, as though clouds were gathering, a thunderstorm brewing, that's what you're seeing—the earth's shadow as we rotate into it. What we call "night" is the time when we are caught in that shadow, a shadow that extends into space like the cone to earth's ice cream, a hundred times taller than it is wide, its vertex 860,000 miles above the earth. Dawn comes as we rotate out of that shadow into the edges of direct sunlight.

Driving northeast away from what's left of this light, I look to the darkening sky and wonder what will be revealed. Venus, the Evening Star, emerges in the driver's-side window just over a silhouetted range, and then the first few actual stars, those of the Big Dipper, maybe the most well-known pattern of stars in the history of the world. One of these stars, Mizar, the second from the end of the Dipper's handle, is actually a double star, a visual binary, confirmed by telescope in 1650

but known to stargazers for millennia. In fact, the ability to see Mizar's faint twin, Alcor, with the naked eye has long been a traditional test of vision, one I admit I'm failing as the first bright town appears down the road.

The name of the town doesn't matter, for at least when it comes to light pollution this town is the same as ten thousand others: while its lights contribute only a little to the pollution blanketing the nation, all the different threads of the problem are here. The lights are all unshielded, for one thing, and so glare shoots this way and that, cast into the dark with little reason. Wood and chain link fences mark the boundaries between neighbors, but each neighbor's lights here, as all across America, are allowed to roam far beyond their boundaries—a perfect example of what dark sky advocates call "light trespass." The lights from these unshielded fixtures not only trespass onto the yards of neighbors and into the eyes of drivers passing through but straight into the sky, their energy wasted. The solitary gas station is lit beyond daylight, that light too floating from under the gas pump canopy to wipe stars from over the town. Drop-lens "cobrahead" streetlights are strung down every street, glaring into bedrooms and living rooms, the surrounding desert, and up toward the stars. Toward the edge of town come a smattering of "security lights," those ubiquitous white lamps hovering over backyards, barnyards, and driveways across the country, and then one final billboard lit from below, the upward-pointing light skipping from the ad into space without pause.

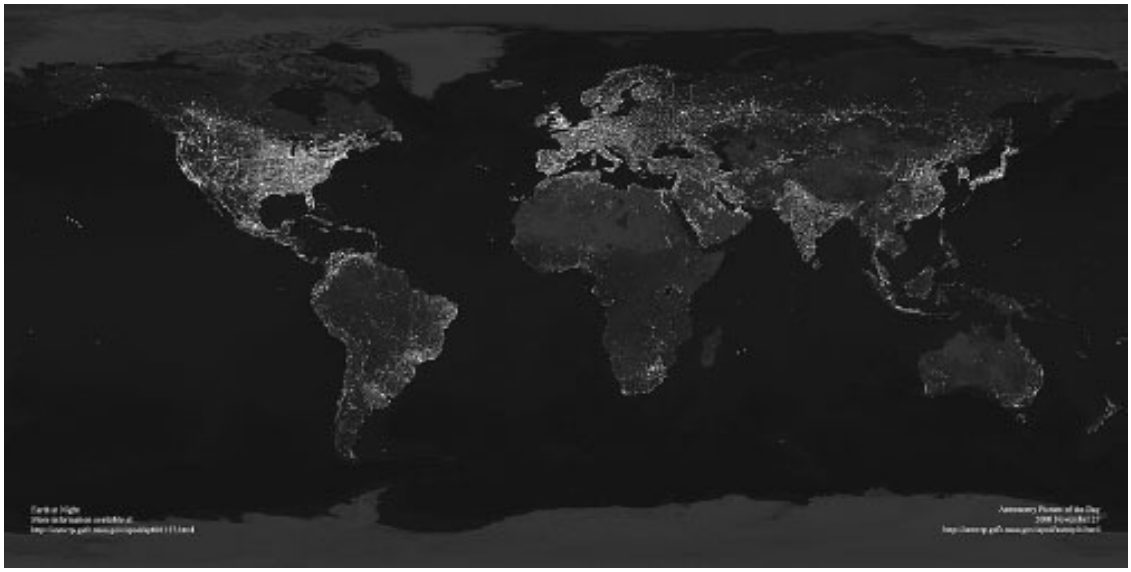
When the town ends, the darkness at its edge envelops the car, and my headlights cut the lit world down to just what lies ahead. The land on either side falls away, as though the highway is a bridge with thousand-foot drops to the left and to the right. The windshield soon resembles a Van Gogh night sky with its starry smattering of bugs. A jackrabbit sits eating at the side of the road, lifting its long ears absently as the car rushes past. Not long after, a coyote steps from the highway's other side, eyes aglow, a less fortunate jack hanging from its jaws. A barn owl lifts from a highway marker on the shoulder and flaps ahead for a few beats as though leading the way, then veers off into darkness and disappears.

In the Minneapolis suburb where I grew up lies a golf course with a road cutting through its center, white picket fence on either side. As a teenager I drove an old Volvo box that allowed me to turn off its headlights and sail a sloping, curving road lit only by parking lights, 35 miles an hour. The red wagon I own now is too smart and safe for that—the headlights remain on whether I want them or not—and I assume the same is true of my brand-new rental. But I'm wrong. The temptation is immediate and irresistible, and despite the fact that I'm not going 35 mph on this straight highway but nearly three times thirty-five, I rotate the dial.

In an instant the road disappears, my stomach drops, and I feel as though flung from the edge of the earth. The sensation is exhilarating fear, as my every fiber demands to know what I'm doing. I turn the headlights back on and feel my heart return to beating. The highway before and behind me holds no other cars, and no artificial lights shine in the black sea on the other side. I turn the lights off again and again—longer each time, long enough for my eyes to focus on what little of the highway my parking lights reveal, long enough to look ahead at the starry night flowing toward and over and past, and think of *Star Trek*'s starship *Enterprise* accelerating into space. Long enough to feel the car begin to float from the road's surface and fall into the sky.

The temptation is to leave off the lights, to drive in the dark for more than these few moments. But while I'm happy to know the thrill of boldly going 100 mph through the desert at night, to feel catapulted from earth into space, I am also happy to be alive, and so I slow to 20 mph. It's what seems now a trolling speed, and so I turn even the parking lights off and lean my head from the driver's window. The warm dry air flows over, the asphalt rolls underneath, and I realize I am headed directly toward a meeting at the horizon with the Milky Way as it bends from one end to the other. As though on its own, the car slows to a stop in the middle of Route 93 in the middle of the Great Basin desert. Any car or truck coming from either direction will show long before I'd need to move. Unless, of course, they are driving with their lights off, too, staring up at this altogether other highway.

"To know the dark, go dark," advises Wendell Berry. But seen from satellites at night, our planet's continents burn as though on fire. Across the globe the collected glow from streetlights, parking lots, gas stations, shopping centers, sports stadiums, office buildings, and individual houses clearly details borders between land and water, sometimes spreading even into the sea on squid fishing boats, their spotlights built to mimic noonday sun. It would be one thing if all this light were beneficial. But while some does good work—guiding our way, offering a sense of security, adding beauty to our nightscape—most is waste. The light we see in photos from space, from an airplane window, from our fourteenth-floor hotel room, is light allowed to shine into the sky, into our eyes, illuminating little of what it was meant to, and costing us dearly. In ways we have long understood, in others we are just beginning to understand, night's natural darkness has always been invaluable for our health and the health of the natural world, and every living creature suffers from its loss.



The earth at night, circa 2000. *(C. Mayhew & R. Simmon (NASA/GSFC), NOAA/ NGDC, DMSP Digital Archive)*

Our light-saturated age makes it difficult to imagine a time when night was actually dark, but not all that long ago it was. Until well into the twentieth century, what passed for outdoor lighting was simply one form or another of fire—torches, candles, or dim, stinking, unreliable lamps. And while these forms of lighting were an improvement on the earliest (skewering and burning oily fish or birds, gluing fireflies to your toes), how feeble this light was: A single 75-watt incandescent bulb burns one hundred times brighter than a candle. Historian E. Roger Ekirch reports that "pre-modern observers spoke sarcastically of candles that made 'darkness visible,'" and a French proverb advised, "By candle-light a goat is lady-like." Travelers considered moonlight to be the safest option for nighttime navigation, and lunar phases were watched far more closely than they are today. By the end of the seventeenth century, many European cities had some rudimentary form of public lighting, but not until the end of the nineteenth century did any system of electric lights—now so easily taken for granted—come into use. The darkness of our nights has been fading steadily ever since.

No continents burn brighter than North America and Europe. Already, some two-thirds of Americans and Europeans no longer experience real night—that is, real darkness—and nearly all of us live in areas considered polluted by light. In the United States, Henry Beston's warning of "lights and ever more lights" from Cape Cod in 1928 may have seemed extreme for many of the 120 million Americans alive at the time, most of whom lived in rural areas without electricity, but fewer than ten years later he was well on his way to being proven right. With FDR's signing into existence the Rural Electrification Administration in 1935, the old geography of night in the United States was certain to change. By the mid-1950s, whether in the city, the suburb, or the country, most Americans lived

with electric light. In the half-century since, as the American population has risen past 300 million, those lights have continued their steady spread unabated and, for the most part, unnoticed. Could we jump from the dark of the 1930s (or 1950s, or even 1970s) to that of tonight, few of us would fail to be impressed by the dramatic increase in artificial light. But that increase has been gradual enough that it would be easy to imagine our nights are still as dark, or nearly so, as they ever were.

With this in mind, and knowing, as he says, "the extent to which ever-growing light pollution has sullied the heavens," amateur astronomer John Bortle created in 2001 a scale on which he described various levels of dark skies, ranking them 9 to 1, brightest to darkest. He hoped his scale would "prove both enlightening and useful to observers," though he knew it might stun or even horrify some. While Bortle's distinctions can seem overly subtle, or inconsistent, they offer a language to help define what we mean when we talk about different shades of darkness, about what we have lost, what we still have, what we might regain.

Most of us are all too familiar with the brighter end of Bortle's scale—his Class 9: Inner-city Sky, or Class 7: Suburban/Urban transition, or Class 5: Suburban Sky—for these are the levels most of us call normal, what we call "dark." But Bortle's scale shows us what we are missing. Indeed, most Americans and Europeans, especially the youngest among us, have rarely or never experienced—and perhaps can't even imagine—a night dark enough to register 3 ("a rural sky" where only "some indication of light pollution is evident along the horizon") or 2 (a "truly dark site"). As for Bortle's Class 1, which he describes as a sky so dark that "the Milky Way casts obvious diffuse shadows on the ground," many question if such darkness still exists in the Lower 48. While rumors arrive from the deserts of eastern Oregon and southern Utah, the Nebraska prairie and the Texas-Mexico border, there's no denying that Bortle has described a level of darkness that for most of human history was common but for the modern Western world has become unreal.

From the moment I first encountered Bortle's scale, I wondered about the places I had visited and lived and loved, like the lake in northern Minnesota where as a child I first experienced real darkness and began to learn about night. I wondered as well if there were any Bortle Class 1 places left in my country. Another way to phrase that question is this: In the Lower 48 states, are there any places left with natural darkness? Or, yet another way, Is every place in my country now tarnished by light?

I decided to find out. I would travel from our brightest nights to our darkest, from the intensely lit cities where public lighting as we know it began to the sites where darkness ranking a 1 might still remain. Along the way, I would chronicle how night has changed, what that means, what we might do about it, and whether we should do anything at all. I wanted to understand especially how artificial light can be both undeniably wonderful, beautiful even, and still pose a long list of costs and concerns. I would start in cities such as Las Vegas—in NASA photographs the brightest pixel in the world—and in Paris, the City of Light. I would travel to Spain to explore "the dark night of the soul" and to Walden Pond to check in with Thoreau. I would meet with scientists, physicians, activists, and writers working to raise awareness of the value of darkness and the threats from light pollution: the epidemiologist who first connected artificial light at night with increased rates of cancer, and the retired astronomer who founded the world's first "dark sky" organization; the minister who preaches the necessity of the unknown, and the man whose work has saved countless nocturnal migrating songbirds in several major cities—it's through people like these that I would tell this story.

My first move was to contact Chad Moore, a founder of the National Park Service's Night Sky Team. For over a decade, Moore has been chronicling levels of darkness in the U.S. national parks, and I wanted to know what he thought I would find.

"Well," he explained, "as you slide down this ramp from nine to one into darkness it's not a smooth slide. It's … bumpy." Moore explained that with the Bortle scale, while the difference between 9 and 5, or between 5 and 2 would be obvious to anyone, the difference between 9 and 8 or between 2 and 1 can be difficult to discern. "There's so much fuzziness that it's prone to misinterpretation,

and so if you're grumpy you'll give yourself a five, and if you're optimistic you'll give yourself a three … and it's really a four," he laughed.

That made sense, but are there still any Class 1 places left in the United States?

"There are rare places and rare moments where places in the U.S. compare with the rest of the world," he said. "I would like to think that I've seen that, that I've glimpsed Class One. But it takes some diligence. It's easier to get a plane ticket to Australia and drive out past Alice Springs … It could take a while before you find that combination here in the United States."

Satellite photographs of the earth at night tell of two worlds—the illuminated civilization of developed (and developing) countries and the darkness of poor or uninhabited areas—and in some ways Moore is right; it would be easier to fly somewhere exotic and remote. But I wanted to know night closer to home. I wanted to know the darkness we experience in our daily life.

I decided to focus my journey on North America and western Europe. First, this is where the artificial lighting now sprawling over the world began and where it continues to evolve: It is Western thinking about darkness and light—and Western technology—that shapes the developed world's night. Second, few of us will ever fly to Australia and drive out past Alice Springs, but we all experience night where we live and work and love.

And most of us, if we wanted, could get ourselves out to real darkness closer to home, like the darkness of a rural highway in eastern Nevada.

"Our sun is one star in a disk-shaped swarm of several hundred billion stars," writes astronomer Chet Raymo. That disk-shaped swarm is our Milky Way Galaxy, and what arcs in three dimensions above this dark Nevada desert is the outer arm of that spiral, toward which we look from our inner-galaxy location. Raymo continues:

I have often constructed a model of the Milky Way Galaxy on a classroom floor by pouring a box of salt into a pinwheel pattern. The demonstration is impressive, but the scale is wrong. If a grain of salt were to accurately represent a typical star, then the separate grains should be thousands of feet apart; a numerically and dimensionally precise model of the Galaxy would require 10,000 boxes of salt scattered in a flat circle larger than the cross-section of the Earth.

This means that every star in our night sky, every individual star any human has ever seen with his or her naked eye, is part of our galaxy and its "several hundred billion stars." Outside our galaxy exist innumerable other galaxies—one recent estimate put the number at 500 billion. At some quick point the size of the universe becomes overwhelming, its distances and numbers bending our brains as we try to comprehend the incomprehensible—that our night sky is but one tiny plot in a glowing garden too big to imagine.

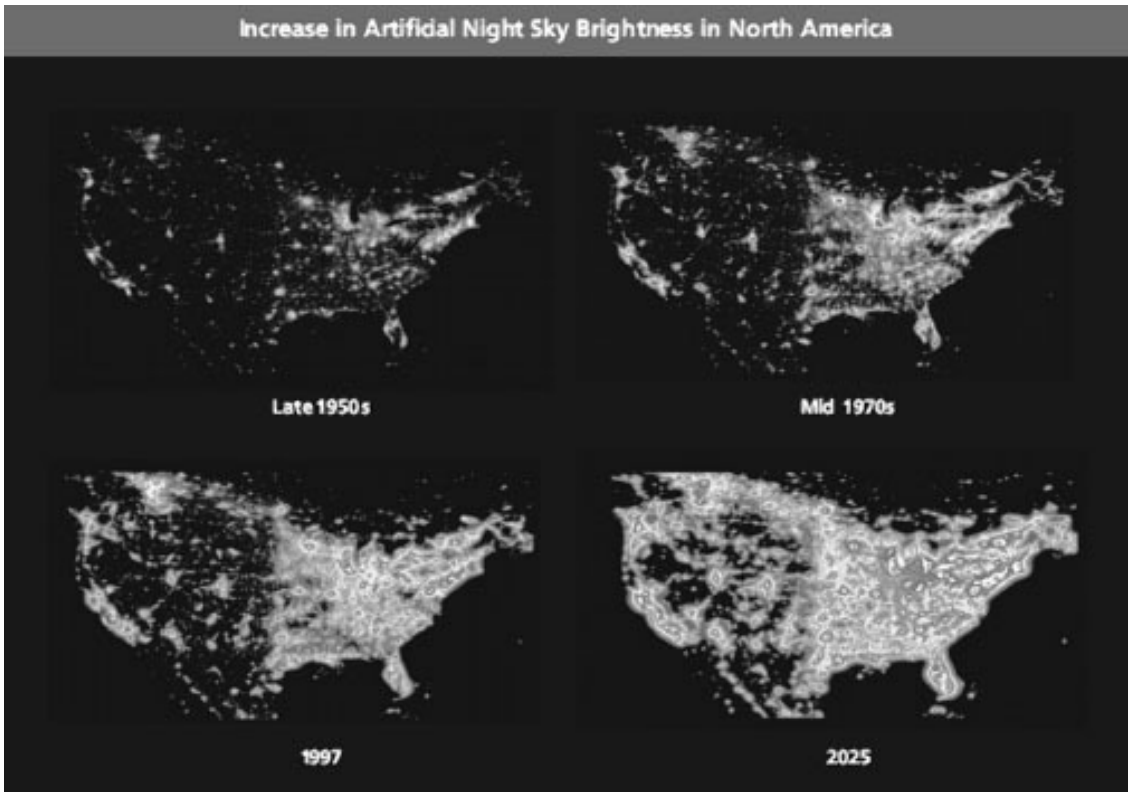
But of course, for all of human history we have indeed imagined. Ancient civilizations from North America to Australia and Peru created constellations not only from groups of individual stars but even from the black shapes made by the gas and dust that lie between Earth and our view of the Milky Way's smokelike stream. And for ages we imagined it might well be smoke, or steam, or even milk—not until 1609 did Galileo's telescope confirm what he suspected, that the Milky Way's glow was the gathered light of countless stars.

In these countless stars, in their clusters and colors and constellations, in the "shooting" showers of blazing dust and ice, we have always found beauty. And in this beauty, the overwhelming size of the universe has seemed less ominous, Earth's own beauty more incredible. If indeed the numbers and distances of the night sky are so large that they become nearly meaningless, then let us find the meaning under our feet. There is no other place to go, the night sky makes this clear.

So let us go dark.

9
From a Starry Night to a Streetlight

It often seems to me that the night is much more alive and richly colored than the day.
—VINCENT VAN GOGH (1888)



The growth of light pollution in the United States from the 1950s to the 1990s, and what light pollution might look like in 2025. *(P. Cinzano, F. Falchi [University of Padova], C. D. Elvidge [NOAA National Geophysical Data Center, Boulder]. Copyright Royal Astronomical Society. Reproduced from the* Monthly Notices of the Royal Astromical Society *by permission of Blackwell Science.)*

The brightest beam of light on Earth shoots from the apex of the Luxor casino's black pyramid in Las Vegas, thirty-nine brilliant blended xenon lamps, each six feet tall and three feet wide (the greatest number of lamps they could fit in the space), reflecting off mirrors and marking, like a push-pin on the night map of the known world, the brightest city on earth. New York, London, and Paris, Tokyo, Madrid, and a slew of cities in China—with their larger geographies and populations—may send more light into space overall than this single desert city in the American Southwest. But the "overall" qualifier is important, for it would be foolish to think there is any brighter real estate in the world than the Las Vegas Strip.

Standing on the corner of Las Vegas Boulevard and Bellagio Drive, I am immersed in artificial light, subsumed in the accumulated glow from the city's thousands of businesses and tens of thousands of homes, encased by peach-colored high-pressure sodium from the city's fifty thousand streetlights, most of which I'd seen from the plane just an hour ago. From the airport the Strip is only a short drive—the Luxor's beam on its south end meets you almost immediately—and in no time you are swallowed by light. Casinos rise bathed by floods, with ten million bulbs illuminating their glittering, flashing, changing signs. Digital screens and LED billboards call out from every corner, SEE OUR SHOWS! RENT OUR ROOMS! PLAY OUR SLOTS! Red lights, purple lights, green lights, blue

—imported palm trees march past the illuminated iron footings of the Tour Eiffel of the Paris, Las Vegas casino, the tower drenched with gold-yellow light from base to tip-top, an exact replica of the real though half the size. A steady stream of headlights bob past, trailed by rafts of bright red tails. On a ruby-colored billboard truck, a blonde in a white bikini smiles. "HOT BABES, Direct to You." Most of the lights want to sell you something, and the Strip has the feel of one big outdoor mall, with canned music piped in and the natural desert pushed out. Some signs are brighter than others, some buildings more brightly lit, but everything is illuminated: The ground at my feet, the clothing on my body, the bare skin of my hands and arms and face, no surface remains uncoated—even the air itself seems full of light—and I walk through its presence as though pushing through an invisible scentless mist. In these first decades of the new century we live in a world that is brighter than ever before in history and growing brighter every year. If any city reflects that fact, it's Vegas.

Which is one reason I have come here to go stargazing. Rob Lambert, president of the Las Vegas Astronomical Society (there is such a thing, yes), has agreed to meet at the famous fountains in front of the Bellagio Hotel, saying, "I've got my telescopes in the back of my truck, so it will be no problem to bring them along." We may not have any luck—there can't be any better example than the Las Vegas Strip of Bortle Class 9, where "the entire sky is brightly lit, even at the zenith." But it's worth a try.

I wander over to the Bellagio, the tall curved casino set back from the reflecting pool housing the fountains, and when Lambert arrives we joke that we have chosen a popular spot, that we will be joined in our stargazing by hundreds of others—though they are here for comedians, magicians, musicians … and fountains—different stars than those we have come to see.

"People don't think about Las Vegas as a place to come look at the stars," Lambert tells me, "but we do quite a bit of outreach. Our slogan is, 'The greatest stars of Las Vegas can't be seen from the Strip.' Our club membership is only about a hundred, but when we have our star parties we have anywhere from seventy-five to five hundred fifty public."

Lambert takes out his laser pointer and cuts a thin green beam toward Orion—or, rather, the two bright stars from Orion we can see. "Okay, so that's Rigel on the bottom and Betelgeuse on the top left." He moves the laser lower to the left. "And there's Sirius, the brightest star in the sky." At first, I'm surprised we can see any stars tonight—this is my first visit to the Strip, and I had imagined the entire sky might be washed out by the lights. "Well, that's almost true," says Lambert. "When you consider that the stars we can see tonight are brighter than ninety-eight to ninety-nine percent of the stars our eyes could see, you start to realize what we're missing."

Behind us the water cannons begin going off, rumbling like distant thunder. The music changes to a kind of weird Italian carnival tune, coordinated with the booming cannons and joined by crashing cymbals. Someone nearby says, "I feel like breaking into song!" When I look to see who said this, I realize Lambert and I have turned so we face away from the fountain show, the only two in the crowd. "The winter Milky Way is actually over us," says Lambert, still looking at the sky, "but you can't see it …"

We agree to walk down the Strip to the Luxor, and as we start our trek south, Lambert tells me that he didn't get started with astronomy until after he turned fifty, that he'd heard some people at work talking about "star parties" and wondered what they were. Next thing he knew he was watching a friend's telescope at such a party, he says, and telling observers what they were seeing. "He had to go help someone with their scope and so he asked me to show people M13 through his telescope. So I said, sure, what's M13? He quickly told me M13 is a globular cluster in the constellation Hercules that is twenty-five thousand light-years away and made up of about seven hundred fifty thousand stars. And so for ninety minutes I told people everything I knew about M13, and absolutely had a ball."

We pass a man blasting solos on a cheap electric guitar, and further down the street the ghost of Keith Moon banging the hell out of a drum set, dozens of nude trading cards littering the sidewalk at our feet. On every block people are shouting into microphones, straining to be heard. Packs of

partiers bump past, yelling their thoughts, half of them transfixed by cell phone screens, half staring, dazed at billboards pulsing light-emitting diodes (LEDs), and I'm reminded of how urban developers call signs like these "bug lights"—so bright they draw gawking crowds.

I ask Lambert about the appeal of looking at the night sky. "One of the things that I share with people is that, regardless of what your beliefs about creation are, it's still happening, there are stars being born, there are planets being born, stuff is still going on. For example, our 'challenge object' this month was Hubble's variable nebula, which changes all the time. You can look at it this year, look at it next year, and it's going to be different. And so you actually see things happening up there."

Not from downtown Las Vegas you don't, nor from any downtown in the developed world. While the lights of the night sky are far brighter than anything humans have ever created, all save one are so far away we see them as faint, if we see them at all. Instead, at night, we see the lights of our own making. While few cities have a space as intensely lit as the Las Vegas Strip, it's not just the Strip that makes Las Vegas bright. Here as in every city or suburb, it's the accumulated glow from an array of different sources that has utterly changed our experience of night.

During a recent Earth Hour—the worldwide movement in which cities are encouraged to turn off some of their lighting for an hour to draw attention to energy use—Lambert says he was driving on US Route 95 and was surprised at what he saw. "I was on 95 basically going from the north side of town to the south side, and this is where 95 is elevated above the valley. But when they cut the lights on the Strip there were so many streetlights that it didn't really affect the sky quality. You could tell that the Strip went dark because the hotels were no longer shining, but the quality of the sky didn't change."

In cities all over the world by far the greatest sources of light in our nights come from parking lots and streetlights (and, when in use, sports field lighting). While individually each streetlight might not seem so bright, it's together that they make their mark—in the United States alone, some sixty million cobrahead streetlights blaze all night, every night, most still drop-lens high-pressure sodiums glaring their trademark pink-peach. We light our parking lots—think shopping centers, restaurants, hotels, stadiums, industrial areas, and the like—primarily with metal-halide lamps emitting intense white light. Add to these two sources a mix of auto dealerships, gas stations, convenience stores, driving ranges, sports practice fields, billboards, and residential neighborhoods and you have any given city's recipe for bright.

In general, bright lights lead to more bright lights, as with one corner gas station trying to outdo another. If you imagine a single light in an otherwise dark room, then turning on other lights around it, you see how the first light—bright in the context of the dark room—is now swamped, and in order to be noticed would have to become brighter. In Las Vegas, the ironic truth is that were the city's streetlights less numerous and less bright, the casino lights would actually appear more impressive.

Still, it's hard not to be impressed by the Luxor's beam, equal to the light of more than forty billion candles. In 1688, when the king of France decided to make a dramatic show of his power by illuminating Versailles, the Sun King shining in all his glory, all he could muster was twenty-four thousand candles. Granted, that is a lot of candles, and Versailles must have been beautiful—which is a word that at least for me is not so quickly applied to the Luxor's beam. But the intensity of this casino light is undeniable, and I can't help but stare. Though I'm staring too at what looks at first like sparkling confetti floating in the beam's white column.

"Bats and birds," Lambert says. "Feeding at their own buffet."

He's right. Dozens of bats and birds, drawn from desert roosts and caves, swooping and fluttering amid the casino's buffet of insects and moths attracted to the light. And how convenient, yes? Maybe not. In addition to the destruction wrought on the insects and moths, the Luxor's beam like a siren's song draws the bats and birds from their natural feeding habitat, causing them to expend so much energy flying to the casino that by the time they return from the journey they have nothing left to feed their young.

The sight reminds me of Ellen Meloy's essay "The Flora and Fauna of Las Vegas" and its concluding image: "Out from nowhere," Meloy explains as she stands outside the Mirage watching the casino's volcano erupt, "a single, frantic female mallard duck, her underside lit to molten gold by the tongues of flame, tries desperately to land in the volcano's moat … Unable to land in this perilous jungle of people, lights, and fire, the duck veers down the block toward Caesars Palace. With a sudden *ffzzt* and a shower of sparks barely distinguishable from the ambient neon, the duck incinerates in the web of transmission line slicing through a seventy-foot gap in the Strip high-rises."

So bright and so recent—in evolutionary terms the Las Vegas we know today appeared in a sudden flash. The Luxor beam has only been on since 1993, several of the largest, brightest casinos have been built even since then, and the city's longest living residents were born before the first casino signs were illuminated in the mid-1940s. In less than a human lifetime what was almost an entirely dark place grew to the brightest place in the world, its population skipping from eight thousand in 1940 to sixty thousand in 1960 to more than two million today. "Welcome to Las Vegas," reads the famous sign, but only since 1959. Meloy's mallard, the bats and birds caught in the Luxor's beam? In terms of time to adapt, they've never had a chance.

As early as the mid-nineteenth century, some European cities were experimenting with electric light on their streets. As I walk past the Paris, Las Vegas, I think of an 1844 drawing showing a demonstration of arc lighting in the Place de la Concorde of Paris, France, cutting like a train's headlight through an otherwise jungle-dark night, catching in its glare the Place's fountains and a crowd in evening gowns and suits, some grasping umbrellas as protection against the light. Arc lighting was simply too bright for many uses, the first type of lighting that could truly be mentioned in the same sentence as the sun. (And it wasn't too bright simply because people had never seen anything like it. The moment I see a small arc light blazing away at the electricity museum in Christchurch, England, my immediate wish is for an arc welding mask—this was light that clearly could destroy your eyes.) As a result, it wasn't until 1870 that several European capitals installed arc lights on some main thoroughfares. While the intensity of these lights was so great they had to be placed on towers high above the streets, their arrival was met with fascination and pleasure by most (many cities in the United States barged ahead with their installation, for example). They were, it seemed, an answer to our prayers.

The idea had always been to banish darkness from night. As far back as the early eighteenth century, proposals had been made to illuminate the entire city of Paris using some kind of artificial light set high on a tower. The most famous of these was the Sun Tower proposed by Jules Bourdais for the 1889 Paris Exposition that would stand at the city's center near Pont Neuf and cover all of Paris with arc lights. Unfortunately for Bourdais (and fortunately for the rest of the world), his proposal was turned down in favor of one by a certain Gustave Eiffel. But even Eiffel's tower now has spotlights on the top, to the delight of some and the disgust of others.

Understanding how bright arc lights were, it makes sense how ready the world was for the incandescent light bulb. A report from the 1881 International Exposition of Electricity in Paris reads: "we normally imagine electric light to be a blindingly bright light, whose harshness hurts the eyes … Here, however, we have a light source that has somehow been civilized." The change affected not only street lighting, of course. Arc lights had been entirely impractical for domestic houses, but as Jill Jonnes explains in *Empires of Light,* when incandescent bulbs arrived,

wealthy, cultivated women in floor-length, rustling dresses delighted in showing their friends how if you just turned a knob on the wall, the room's clear incandescent bulbs began almost magically to glow, casting an even, clear light. Unlike candles, the electric light did not burn down or become smoky. Unlike gaslight, there was no slight odor, no eating up of a room's oxygen, no wick to trim or smoked-up glass globes to be cleaned.

It was in order to supply domestic customers like these that Thomas Edison in 1882 opened his first power station in lower Manhattan. By 1920 in America, electric service reached 35 percent

of urban and suburban homes, and by World War II more than 90 percent of Americans had electric light. Still, it wasn't until FDR's insistence on the Rural Electrification Act of 1936 that electric light began to reach many areas of the rural United States, and not until well into the 1950s could one reasonably say most Americans enjoyed the benefits of electricity. Since that time, we have simply turned that knob on the wall farther and farther to the right, spreading electric light from city to city, town to town, up onto mountaintops and down into hollers, across the plains and into the desert, from coast to coast.

I sometimes try to imagine living in a city before electricity. How quiet pre-electric nights would have been without cars or trucks or taxis, without any internal combustion engines at all. No radios, televisions, or computers. No cell phones, no headphones, nor anything to plug those headphones into if you had them. How deserted the city with most of the population locked inside their homes, the night left to fears of crime, sickness, and immorality, and best avoided if one could. Finally, and most strangely—the biggest difference from that time to ours—not one single, solitary electric light.

How dark it would have been—imagine leaning out your door and, on the darkest nights, not being able to see more than a few feet in any direction. Historian Peter Baldwin describes as "downright perilous" the streets in early American cities, with few paved and then those only with cobblestones. On nights of clouds and no moon, he writes, "travel was obstructed along the sidewalks and street edges by an obstacle course of encroachments: cellar doors, stoops, stacks of cordwood, rubbish heaps, posts for awnings, and piles of construction material … In 1830 a New York watchman running down a dark street toward the sound of a disturbance was killed when he collided blindly with a post." What lights did exist were intended only as beacons or guides rather than to illuminate the night. The New York street lanterns burning whale oil were in 1761 merely "yellow specks engulfed by darkness," and even more than a hundred years later its gas lamps were still "faint as a row of invalid glow-worms."

In *Brilliant,* Jane Brox tells of how American farm families, after they first got electric light, would turn on all the lamps in their house and drive out a ways just to watch it glow. Who can blame them? To go from the stink and dark and danger of kerosene to the clean well-lighted place brought by electricity—at the speed of light, no less. I would back away to admire the view as well. But soon it will be the rare person in the Western world who hasn't spent his or her entire life bathed in electric light, and no one will remember what night was like without it.

In the United States, our bright nights began with the first electric streetlight in Cleveland, April 29, 1879. But it was in New York City that the "possibilities of nighttime lighting first entered American consciousness," writes John A. Jackle in *City Lights: Illuminating the American Night.* "Once adopted there, its acceptance was assured almost everywhere." Thomas Edison returned to New York after a trip in 1891 to Europe proclaiming, "Paris impresses me favorably as the city of beautiful prospects, but not as a city of lights. New York is far more impressive at night." Broadway was always the first, always led the way. It was the city's first street to be fully lit at night, first with whale oil lamps, then gas (1827), then finally electricity (1880). In a drawing from *City Lights* of Madison Square in 1881, arc lights on a tall pole shed light on an otherwise dark city scene of strolling couples, a horse-drawn carriage, telegraph poles and wires, and—in this famously windy part of the city—a man in the foreground who seems about to be blown over by the light as he crosses the street, cane in hand. By the 1890s, Broadway from Twenty-third Street to Thirty-fourth Street was so brightly illuminated by electric billboards that people began calling it The Great White Way.

These days, walking from lower Manhattan, it's not until I get to Thirty-first Street that I reach anything close to the bright white streetlights I had expected. Until then I'm in what feels, at least late on a summer Sunday, like a forgotten part of the city. With the theater district and advertising lights moved far up the street, the once bright Way is far more mild than Great, much less White than gray.

But once in Times Square, all that changes. Flashing digital signs, billboards, colored lights—from Forty-second to Forty-seventh is the brightest—and there is no night sky. I don't mean I can't

see many stars, or even that I can't see *any* stars, I mean there appears to be no sky. Yes, above me, there is a blackish color—but with no points of light or any other indication of being alive. Instead, I feel as though I'm in a domed stadium. The light from the digital billboards simply drowns the white streetlights that lower on Broadway seemed so bright. I can honestly say it feels as bright as day. Maybe a cloudy day, but day nonetheless. Certainly, it no longer feels like night.

And by that I mean it no longer feels dark.

In fact, at least in terms of darkness, "real night" no longer exists in New York City, or in Las Vegas, or in hundreds of cities across the world. According to the World Atlas of the Artificial Night Sky Brightness, created in 2001 by Italians Pierantonio Cinzano and Fabio Falchi, two-thirds of the world's population—including 99 percent of people living in the continental United States and western Europe—no longer experience a truly dark night, a night untouched by artificial electric light. Satellite photographs of the earth at night show the dramatic spread of electric light over the globe—even without a map to show political boundaries, many cities, rivers, coastlines, and country borders are easily identifiable. But as impressive as these photographs are, they don't show the true extent of light pollution. Cinzano and Falchi took NASA data from the mid-1990s and, using computer calculations and imaging, showed that while in the photographs many areas outside cities appeared dark, they were actually flooded by pools of light spreading from the cities and towns around them. On the Atlas, levels of brightness are indicated by color, with white the brightest, and descending from there: red-orange-yellow-green-purple-gray-black. Like the NASA photographs before it, the World Atlas of the Artificial Night Sky Brightness has a certain beauty, but in truth it is a tale of pollution.

Light pollution is the reason Rob Lambert and I could see only a handful of stars from the Las Vegas Strip, and the reason I don't see any stars from Times Square. It's the reason why in the night skies under which the vast majority of us live, we can often count the stars we see on two hands (in the cities) or four (suburbs), rather than quickly losing count amid the more than twenty-five hundred stars otherwise visible on a clear night. It's the reason why even from the observatory deck of the Empire State Building we now see 1 percent of the stars those in 1700s-era Manhattan would have seen.

The International Dark-Sky Association (IDA) defines light pollution as "any adverse effect of artificial light, including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste." Sky glow—on display nightly over any city of any size—is that pink-orange glow alighting the clouds. It's tramping through a two-foot snowfall with the whole town bathed in push-pop orange. It's that dome of light on the horizon ahead though the sign says you've still got fifty miles to go. Glare is that bright light shining in your eyes that you raise your hand to block. Trespass is light allowed to cross from one property onto another. It's your neighbor's security light shining through your bedroom window. It's the lights on the brand-new science building that also illuminate the sororities across the street. It's all over every neighborhood in America, land of the free and the home of property rights. And clutter? A catchword for the confused lighting shining this way and that in any and every modern city.

A long exposure shows birds and bats hunting moths and insects amid the Luxor Casino's beam in Las Vegas. *(Tracy Byrnes)*

The bad news? All mean wasted light, energy, and money. The good news? All are caused by poorly designed or installed light fixtures and our using more light than we need, and all could be significantly and—compared to other challenges we face—easily remedied.

When I think of how light pollution keeps us from knowing real darkness, real night, I think of Henry David Thoreau wondering in 1856, "Is it not a maimed and imperfect nature that I am conversant with?" He was writing about the woods around Walden Pond and how the "nobler" animals

such as wolf and moose had been killed or scared away. “I hear that it is but an imperfect copy that I possess,” he explained, “that my ancestors have torn out many of the first leaves and grandest passages, and mutilated it in many places. I should not like to think that some demigod had come before me and picked out some of the best of the stars.” Some 150 years later, this is exactly what we have allowed our lights to do. “I wish to know an entire heaven and an entire earth,” Thoreau concluded. Every time I read this I think, *Me, too.*

Bob Berman lives in a small town in upstate New York that has no streetlights. “I could never live in a place with streetlights,” he tells me as we wind along a dark two-lane road, joined by a rising moon cast over the ruffled lakes and through bare spring trees, the songs of peepers audible over the sound of the car. We are on the way to the observatory he built by himself. Once described as the country’s most popular astronomer, Berman has written a number of books, wrote the “Night Watchman” column for *Discover* magazine and the “Skyman” column for *Astronomy* magazine, and is known especially for his humorous writing style. Which is not the easiest thing to pull off when you’re writing about astronomy, he says. “Science isn’t inherently funny. What’s funny about Pluto? What’s funny about galaxies, and the cosmos, and the expanding universe? This is not social satire. When I was able to do a column on stupid questions, that was a gift from God.”

“What was your favorite?”

“It’s hard to top, ‘If a solar eclipse is so dangerous, why are they having it.’”

But of course the “stupid questions” column had a serious point to make, that most Americans don’t know much about the night sky.

I used to count myself among that number. I was always drawn to it, but I’d never known its names and numbers, its secret lives. In fact, here is what I did know: planets don’t twinkle and therefore I could supposedly tell them from stars, and two prominent constellations—the Big Dipper (which technically is only part of a constellation) and Orion.

“That’s not bad,” Berman tells me. “The only thing most people know is the moon.”

That I know more than I used to has a lot to do with Bob Berman, and especially his book *Secrets of the Night Sky.* Here’s some of what I learned: One of the stars in Orion, Betelgeuse is “the largest single thing most of us will ever see.” Sure, a galaxy is bigger, but a galaxy is a collection of stars rather than a single thing. Anyway, no galaxy is bright enough to shine through the light pollution that covers most of the developed world’s skies. “Betelgeuse, on the other hand,” writes Berman, “is brilliant enough to bulldoze its way through the milkiest urban conditions.” Or how about this: Rigel, another brilliant star in Orion, “shines with the same light as fifty-eight thousand suns.” Rigel is much farther away than the other stars making up the constellation, and, as Berman explains, if Rigel “were as close to us as the others, our nocturnal landscape would tingle with sharp, alien Rigel shadows, and the night sky would always be as bright as when a full moon is out. Most of the universe would disappear from view.”

The moon tonight, a waning gibbous a few days past full, is bright enough that our view at the observatory won’t be as great as it otherwise might be. When, during its twenty-nine-day cycle, the moon is big enough and therefore bright enough to wipe so many stars from view, most astronomers are not excited to see it. But Berman seems genuinely delighted to roll back the roof of his DIY observatory (which he built, he says, “crazy and wrong”) and point his telescope at the moon. (“Did you make the telescope yourself?” I ask. “No, no, no,” he says. “I wanted a good one.”)

“Here, take a look at this,” he says, and invites me to step up to the eyepiece.

I am not prepared for what I see: the gray-white moon in a sea of black, its surface in crisp relief, brighter than ever before. I am struck, too, by the scene’s absolute silence. It is clearer, yes, brilliantly so, but this moon seems cold, antiseptic—alone in the unfathomable expanse of space. I learned a lot about the moon from Berman’s writing (“it’s more brilliant when it’s higher, when it’s nearer, and in winter when sunlight striking it is seven percent stronger”), and I appreciate this kind of information. But I think our relationship with the moon has more to it than simply astronomical facts. With my

naked eye, on nights the moon climbs slowly, sometimes so dusted with rust and rose, brown, and gold tones that it nearly drips dirt colors and seems intimately braided with Earth, it feels close, part of this world, a friend. But through the telescope the moon seems—ironically—farther away.

"So now we'll go to Saturn," Berman says. Using both arms, he moves the large white telescope as though leading a dancing partner, turning it slightly to the east, then steps up the ladder and adjusts the view. "Now we're talking," he says. When I look through the scope, though, the bright tiny object is dancing around, and the image is blurry. Berman takes another look and makes some more adjustments, explaining as he does the key elements for viewing the night sky: transparency, darkness, and "seeing." Yes, that's what they call it. "You would think astronomers would come up with a more technical term," he chuckles, "but no, all around the world astronomers are saying, 'The seeing is a three point five tonight.'" Seeing reflects the effect of turbulence in the earth's atmosphere on the sharpness and steadiness of images—good seeing if the atmosphere is steady and calm, bad seeing if it is especially turbulent. A quick way to check seeing is how strongly stars twinkle: The more the twinkling, the worse the seeing. Berman tells me that bad seeing is one reason why no major observatories have been built east of the Mississippi for more than a century. The good "seeing" atop mountains in the desert has drawn astronomers west.

"Take a look at that," says Berman, climbing down. "Wait for the moments of good seeing—when it steadies up." Waiting for that—for good seeing—is exactly what an experienced observer will always do, he says. "I remember once when I was about twenty-four, and it was thirteen below zero, and my beard was frozen, I just stood there for three straight hours waiting for those moments when there would be steadiness and you could see ring within ring, detail that even photographs don't show. That's what observers have done for centuries."

As I wait for good seeing, I think about what Berman's just said. While humans have always watched the sky, modern astronomy has its origins in the lands we know as Egypt and Babylon, in the third and second millennia before Christ. People then were looking to the sky for signs and omens (though of course they were looking in other places, too; "the entrails of sheep were of special interest," writes historian Michael Hoskin). Eventually, the cosmology that developed—the classic Earth-centered Greek model of the universe—would dominate Greek, Islamic, and Latin thought for two thousand years. During the Middle Ages, astronomy in Europe was truly in the Dark, and not in the way modern astronomers would like—we have Islamic astronomers to thank for keeping the craft alive. That's the reason so many stars have Arabic names; one Islamic prince named Ulugh Beg, who lived from 1394 to 1449 in Samarkand in central Asia, catalogued over a thousand individual stars himself. And when, in 1609, Galileo Galilei (1564–1642) turned his handmade telescopes toward the sky, human observation of the cosmos changed forever.

When the "seeing" settles and Saturn comes into view, I can't help but say, "Oh my God!" To the naked eye Saturn is simply a bright starlike object—interesting, perhaps, but nothing more. But seen through a telescope it's a soft yellow marble with wide, striated rings—exactly as in photographs, but this time alive.

"Over the years more than a thousand people have looked through that telescope," Berman says. "And with Saturn, people always say one of two things. They either say, 'Oh my God!' or they say, 'That's not real!'"

That's not real—what a curious response. I've had other astronomers tell me the same thing, or say that people will question whether the astronomer hasn't placed an image of the planet into the telescope somehow. The fact that people are seeing something with their own eyes has incredible power—you can see photographs of Saturn a thousand times and be somewhat impressed, but see it for yourself and you don't soon forget.

The most beautiful starry night I have ever seen was more than twenty years ago, when I was backpacking through Europe as an eighteen-year-old high school graduate. I had traveled south from Spain into Morocco and from there south to the Atlas Mountains, at the edge of the Sahara desert,

to a place where nomadic tribes came in from the desert to barter and trade, a place that when I look on a map I can no longer find. One night, in a youth hostel that was more like a stable, I woke and walked out into a snowstorm. But it wasn't the snow I was used to in Minnesota, or anywhere else I had been. Standing bare chest to cool night, wearing flip-flops and shorts, I let a storm of stars swirl around me. I remember no light pollution—heck, I remember no lights. But I remember the light around me—the sense of being lit by starlight—and that I could see the ground to which the stars seemed to be floating down. I saw the sky that night in three dimensions—the sky had depth, some stars seemingly close and some much farther away, the Milky Way so well defined it had what astronomers call "structure," that sense of its twisting depths. I remember stars from one horizon to the other, stars stranger in their numbers than the wooden cart full of severed goat heads I had seen that morning, or the poverty of the rag-clad children that afternoon, making a night sky so plush it still seems like a dream.

So much was right about that night. It was a time of my life when I was every day experiencing something new (food, people, places). I felt open to everything, as though I was made of clay, and the world was imprinting upon me its breathtaking beauty (and terrible reality). Standing nearly naked under that Moroccan sky, skin against the air, the dark, the stars, the night pressed its impression, and my lifelong connection was sealed.

When I tell Berman about Morocco he says, "A sad corollary to that story is when my wife's mom visited us once. And she had spent her life living in either Long Island or Florida, light-polluted places. We heard the car drive up, heard the trunk close, heard her wheel her luggage to the house, and when she came in she said to Marcy, 'What are all those white dots in the sky?' And of course Marcy said, 'Those are called stars, Mom.'"

"I've heard people say such things," I laugh, "but I can't believe they're true."

Berman leans back and calls, "Marcy, do you remember when your mom said what are those white dots in the sky?"

"Yep."

"Do you think she was kidding?"

"Nope."

Seeing stars is something Bob Berman has done all his life. And here in upstate New York, the sky still offers a wonderful view.

"We get down to about magnitude five point eight, five point nine, where you see a good twenty-five hundred stars," he says, referring to the scale astronomers use to describe the brightness of individual stars. "Theoretically, three thousand stars are visible to the naked eye at one time, but, in truth, since the overwhelming bulk of stars are fifth and sixth magnitude—the fainter you go, by far the more stars there are—and because extinction near the horizon is so great, the truth is faint stars stop at about ten degrees from the horizon and you lose a swath."

We adopted the idea of magnitude from the ancient Greeks, who called the brightest stars "first magnitude" and the dimmest "sixth magnitude." When modern astronomy put precise measurement to the Greek magnitude idea, a few of the brightest stars actually turned out to have minus numbers, such as Sirius (-1.5). But these values are all relative, reflecting only how we see these stars from Earth. The brightest star in the history of the universe could be fainter than faint if it's far enough from our view.

It's commonly accepted that the naked-eye limit is magnitude 6.5, though some observers report magnitude 7.0 or better. As Berman writes,

There are few brilliant stars, many more medium ones, and a flood of faint stars. This hierarchy continues with a vengeance below the threshold of human vision. Recent advances have allowed telescopes to detect stars of magnitude 29—more than a billion times fainter than anything the unaided eye can perceive! This is very faint indeed: The light from such a star equals the glow of a single cigarette seen from 125,000 miles away.

But a light-polluted sky renders all this meaningless, of course, as the greatest wealth of stars lie in the larger values of magnitude, exactly the magnitudes erased by artificial light.

"My feeling," says Berman, "is that an observer needs to see four hundred fifty stars at a time to get that feeling of infinitude, and be swept away, and go, 'Oh, isn't that beautiful.' And I didn't make that number up arbitrarily—that's the number of stars that are available once you get dimmer than third magnitude. So in the city you see a dozen stars, a handful, and it's attractive to no one. In the city you say, 'Oh, there's Vega, who cares?' And if there's a hundred stars in the sky it still doesn't do it. There's a certain tipping point where people will look and there will be that planetarium view. And now you're touching that ancient core, whether it's collective memories or genetic memories or something else from way back before we were even human. So you gotta get *that,* and anything short of that doesn't do it."

Humans have long found in stars like these the familiar shapes that reflect our lives. For modern viewers these shapes sometimes make absolute sense, as with the scorpion of Scorpius, or the hunter Orion. The same is true of an asterism like the Summer Triangle, a shape made of bright stars from separate constellations: Vega from Lyra, the Lyre; Deneb from Cygnus, the Swan; and Altair from Aquila, the Eagle. But then there are the many constellations that puzzle us with their amorphous shapes and illogical identities, as though they are the eternal result of some ancient Greek joke. A good example is Auriga, with its bright star Capella, which lies just above Orion, readily apparent to any stargazer. How many of us would identify this shape as a charioteer? And Auriga is one of the easy constellations; try identifying Monoceros, the Unicorn, or Cetus, the Sea Monster, which both lie near Orion as well. With an image in mind (a good astronomy book or smartphone app helps), some of the ancient figures like Cassiopeia and Perseus may appear, but others (Ophiuchus, the Serpent Holder—which is hard to say, let alone see) are almost surely never to register.

Still, things could be worse, or at least more complicated. In 1627, the German astronomer Julius Schiller attempted to Christianize the sky by replacing the names of the constellations with the names of characters from the Bible. Thus the twelve constellations of the zodiac became the twelve disciples, and the constellations from the Northern Hemisphere were replaced by characters from the New Testament and those in the Southern Hemisphere with characters from the Old Testament. For better or worse, his idea never caught on. Not so lucky were the southern skies, where many of the constellations reflect the fascination of European explorers from the sixteenth, seventeenth, and eighteenth century for the practical new inventions of their time. Such inspirational constellations as the Air Pump, the Draftsman's Compass, and the Chemical Furnace live on today, as do the creatively named Telescopium and Microscopium. But not all is lost in the Southern Hemisphere, at least for children and those childlike at heart, all of whom can forever delight in pointing to the nautically inspired Puppis, the Poop Deck.

In order for us to see the stars in anything close to their possibilities—whether the awe-inspiring numbers Berman talks about, or in constellations both familiar and ridiculous—we need darkness. But how dark is dark? My hunch is that for most of us there are basically three levels. First, there is dark as in, "It's night, so it's dark." This is the standard notion of night's darkness, and it corresponds to around Bortle 8 down through Bortle 5. Next, at least for anyone lucky enough to find him-or herself in an area that would correspond to Bortle 4 or 3 or 2 (or, certainly 1), there is really dark, as in, "It's really dark out here." And finally, there is for some people a level of "darkness" that equates to "Vegas, baby!"

The reality, though, is far more complex. This is the message from Bortle's scale and the World Atlas of the Artificial Night Sky Brightness—we don't know what real darkness looks like, because we seldom ever see it.

One place to see real darkness in Manhattan is at the Museum of Modern Art, in Vincent van Gogh's *The Starry Night.* Unless Van Gogh's oil on canvas from 1889 is traveling as part of an exhibition, it hangs at home on its MoMA wall as fifty million people pass by every year. On a

Saturday morning I stand near Van Gogh's scene of stars and moon and sleeping town, talking with its guardian for the day, Joseph, as he repeats, "No flash, no flash," "Two feet away," and "Too close, too close" again and again as people from around the world crowd near. "What's the appeal of this painting?" I ask. "It's beautiful," he says. "What more can you say than that?"

You could rightly leave it at that. But I love the story this painting tells, of a small dark town, a few yellow-orange gaslights in house windows, under a giant swirling and waving blue-green sky. This is a painting of our world from before night had been pushed back to the forest and the seas, from back when sleepy towns slept without streetlights. People are too quick, I think, to imagine the story of this painting—and especially this sky—is simply that of a crazy man, "a werewolf of energy," as Joachim Pissarro, curator at the MoMA exhibition Van Gogh and the Colors of the Night, would tell me. While Van Gogh certainly had his troubles, this painting looks as it does in part because it's of a time that no longer exists, a time when the night sky would have looked a lot more like this. Does Van Gogh use his imagination? Of course—he's said to have painted the scene in his asylum cell at St. Remy from studies he'd done outside and from memory—but this is an imagined sky inspired by a real sky of a kind few of the fifty million MoMA visitors have ever seen. It's an imagined sky inspired by the real sky over a town much darker than the towns we live in today. So a painting of a night imagined? Sure. But unreal?

In our age, yes. But Van Gogh lived in a time before electric light. In a letter from the summer of 1888, he described what he'd seen while walking a southern French beach:

The deep blue sky was flecked with clouds of a blue deeper than the fundamental blue of intense cobalt, and others of a clearer blue, like the blue whiteness of the Milky Way. In the blue depth the stars were sparkling, greenish, yellow, white, pink, more brilliant, more sparkling gemlike than at home—even in Paris: opals you might call them, emeralds, lapis lazuli, rubies, sapphires.

It's remarkable to modern eyes, first of all, that Van Gogh would reference the stars over Paris —no one has seen a sky remotely close to this over Paris for at least fifty years. But stars of different colors? It's true. Even on a clear dark night the human eye struggles to notice these different colors because it works with two kinds of light receptors: rods and cones. The cones are the color sensors, but they don't respond to faint illumination. The rods are more finely attuned to dim light, but they don't discriminate colors. When we look at a starry sky, the sensitive but color-blind rods do most of the work, and so the stars appear mostly white. Add to this that we seldom stay outside long enough for our eyes to adapt to the dark, and then the fact that most of us live with a sky deafened by light pollution, and the idea that stars come in different colors seems wildly impossible, like something from Willy Wonka or Lewis Carroll (or Vincent van Gogh). But gaze long enough, in a place dark enough that stars stand in clear three-dimensional beauty, and you will spot flashes of red, green, yellow, orange, and blue.

You may even feel as the Dutch painter did, that "looking at the stars always makes me dream."

But this morning at MoMA I am here to see two paintings, the second so little known that the museum doesn't even have it on display. It's through the kindness of Jennifer Schauer, who oversees the paintings in storage, that I get to see it. She marches me past *The Starry Night* to a room in which many paintings that the museum has no room to display are kept; 75 percent of the collection is here. Schauer looks at a label or two and then pulls out a fencelike wall on which the painting I've come to see hangs. And here it is, blazing away: Giacomo Balla's *Street Light* from 1909. For me, the fact MoMA has its view of a starry night on display every hour of every day, while this brilliantly colorful painting of an electric streetlight is hidden in backroom shadows, is deliciously ironic. This may be the only place in the city where the streetlight has been put away while the starry night continues to shine.

Here is a painting of the very thing that makes Van Gogh's vision of a starry night such an unrealistic one for most of us. In both paintings, the moon lives in the upper right corner, and for Van Gogh, the moon is a throbbing yellow presence pulsing with natural light. But for Balla, the moon has become a little biscuit wafer hanging on for dear life, overwhelmed by the electric streetlight. And

that, in fact, was Balla's purpose. "Let's kill the Moonlight!" was the rallying cry from Balla's fellow Italian futurist, Filippo Marinetti. These futurists believed in noise and speed and light—human light, modern light, electric light. What use could we now have of something so yesterday as the moon?

"It's lighting itself up," Schauer says. On a canvas three times the size of *The Starry Night,* with a background of darkness painted sea blue-green and brown, the electric lamp radiates rose-mauve-green-yellow in upside-down Vs. The lamppost is a candy cane of those same colors, while concentric circles of the colorful Vs reverberate with resonant light. Here is an optimistic vision of what electricity would mean, not only a night brighter than what we'd known but one more beautiful as well. Indeed, were this what electric lighting had eventually come to be, Balla's reverence would be absolutely understandable even in our day. But of course, as my host says, "New York is never dark enough to see this."

And so here, fifty meters apart, hang two paintings that span a bridge of time when night began to change from something few of us have ever known into the night we know so well we don't even notice it anymore. Done in the southern French countryside at the end of the nineteenth century, Van Gogh's is a painting of old night. Done in the city at the start of the twentieth century, Balla's is a painting of night from now on. With time, electric lights like the one Balla portrayed would spread across western Europe and North America, perhaps inspiring the popularity of Van Gogh's painting as they did: As we lost our view of our own starry night, our view of his became more and more fantastic—this old night he had known and loved and experienced by gaslight.

8
Tales from Two Cities

The secrets are very simple. Blend light with the surroundings. Don't annoy the birds, the insects, the neighbors or the astronomers. If City Hall gave me money to do whatever I want, I'd teach people about the beauty of light.

—FRANçOIS JOUSSE (2010)

Gas street lighting first took flame on Pall Mall in London in 1807, with the light hailed as "beautifully white and brilliant." Within a decade more than forty thousand gas lamps lit over two hundred miles of London streets, a scene described by a visitor as "thousands of lamps, in long chains of fire." When, by 1825, the British capital was the most populous city in the world, no other place on earth was as extensively lit, or as bright.

Though "bright" depends on whom you ask. To the nineteenth-century eye—which until that time had never seen streets lit by more than candle lanterns or oil lamps—gaslight would have been unquestionably bright. But to our modern eye, gas lamps can seem questionably dim—you might wonder if they're even working. This isn't only perception—modern Londoners (as well as city dwellers all over the world, including 40 percent of Americans) live amid such a wash of electric light that their eyes never transition to scotopic, or night, vision—never move from relying on cone cells to rod. With gaslight, they did—the nineteenth-century eye saw gaslit nights with scotopic vision, and so what would seem to us incredibly dim seemed to a Londoner at the time the perfect artificial light, with "a brightness clear as summer's noon, but undazzling and soft as moonlight," one that created "a city of softness and mystery, with sudden pools of light fringed by blackness and silence." London ranks now as one of the brightest cities in the world—a white-hot splat on the World Atlas of the Artificial Night Sky Brightness. Nonetheless, I have come to the city to see if, even so, amid all that light, that "city of softness and mystery" remains.

I have a hunch it might, as London is still home to more than sixteen hundred gas lamps, most in the famous parts of town north of the Thames such as Westminster, the Temple, and St. James's Park. British Gas, which has direct responsibility for twelve hundred, employs a six-man gas lamp team made up of two gas engineers and four lamplighters, each of whom tends to four hundred lamps. Though they no longer need light each individual lamp, a task Robert Louis Stevenson described in 1881 as "speeding up the street and, at measured intervals, knocking another luminous hole into the dusk," the lamplighters make a circuit from lamp to lamp that usually runs about two weeks, cleaning the lamps, relighting pilot lights, winding the timers. Stevenson mourned the lamplighter's impending fate from the imminent arrival of electric light, writing, "The Greeks would have made a noble myth of such a one; how he distributed starlight, and, as soon as the need was over, re-collected it." Greek myth or no, the modern lamplighter's job is a popular one, with positions seldom changing hands.

On a crisp December evening, I join two members of the British Gas team, Gary and Iain, at St. Stephen's Tavern near Westminster Bridge, meeting amid the locals packed wall to wall, ties loosened and coats on their arms, before going out to see some of the best of the lights. About their affection for the lamps, both men are unabashed. "Once you get involved you fall in love with it," Gary says. And Iain, who moved to London from Glasgow, Scotland, tells me, "When I came down here I'd never seen a gas lamp before. I was totally taken by the history, and I found myself walking along the streets looking at electric lights thinking, *Bastards,* why is that not gas?"

London does seem to have an awkward relationship with its remaining lamps. While national heritage laws protect the lamps from being removed, apparently nothing in those laws protects them from being overwhelmed by electric light. On the edge of St. James's Park I saw what seemed to epitomize the situation. There stood a Victorian lamp fixture with perfectly good and glowing gaslight.

Immediately to its right, less than two feet away, stood a taller, newer lamppost with a glaring electric light of no design but far more light. While certainly this back-to-back placement of gas and electric isn't uniform in London, rare is the street, park, or courtyard lit only by gaslight, and it's easy—if you're a fan of gaslight—to see this as an opportunity missed. As Iain says, "There's no doubt that electricity is a better way to do it, but you also can't deny the romance of gas lamps."

Both men consistently see evidence of the gas lamps' enduring public appeal. "You'd be surprised how many people walk by the lamps and don't bat an eye," says Gary. "But as soon as we go out and put up a ladder on them, everybody stops and starts taking photographs." Why do gas lamps appeal to us so? Part of it is simply that they are not as bright as electric lights—about as luminous as a 40-watt incandescent bulb. Part of it is that we like the Victorian fixtures; we like that style. Part of it is that gaslight's lower temperature offers the red-orange color of an open flame, which we're far more drawn to than bright white light. And finally, when you see a gas lamp on St. James Street in Covent Garden, or anywhere in London, you feel connected to the past—that nostalgia, that feeling of "so this is what it was like." Brightness, design, color, history—gaslight creates a beauty not better than electric light, but different.

One place to experience this truth best is around Westminster Abbey. The private courtyard behind the abbey known as Dean's Yard is lit by gaslight, and, yes, it's much darker than you might expect from a city square. In fact, it takes a few minutes for our eyes to adjust after walking from the pub past Parliament and the abbey. But as our eyes grow used to the darkness, the light becomes perfectly bright. As Gary says as we look around, "You can see what you need to see. It's not daylight, but it's a lovely effect."

The effect, though, is subtle. If your objective is to light a football stadium, for example, you won't be happy with gaslight. When electricity first came to European streetlights, the public realized just how subtle the gaslight they'd grown used to was. You get the sense that some observers felt as though they'd been tricked. Said one Londoner, "Gas lighting had no effect whatsoever on the brightness of the street; it was not turned on at all for three evenings and nobody noticed the least difference." Said another, "as soon as we look away from the broad thoroughfare into one of the side streets, where a miserable, dim gaslight is flickering, the eye-strain begins. Here darkness reigns supreme, or rather, a weak, reddish glow, that is hardly enough to prevent collisions in the entrances of houses … In a word, the most wretched light prevails." You can't blame nineteenth-century folks for feeling this way, and few of us today would willingly switch from electricity back to gas. But while we would never think to use gaslight to do the job of electric, we too often use electric lights to do the job of gas. You see this on Westminster Bridge, for example, where the lights seem far too bright, casting glare into the eyes of walkers, cyclists, and drivers. How much more beautiful would that bridge be if it were lit by flickering flames? And it's not that when we overshadow the gaslight we haven't a choice. If gaslight were deemed not bright enough for pedestrians, then waist-high, well-shielded electric lights could easily provide any walker the safety he or she needed while still allowing for the ambience created by the gaslights. Seeing London's gas lamps amid the city's already bright night raises the question of how we might genuinely appreciate all the benefits of electric light while at the same time avoiding what Stevenson called "that ugly blinding glare." In the face of such ugliness, he argued, "a man need not be very … epicurean if he prefer to see the face of beauty more becomingly displayed."

Stevenson wrote "A Plea for Gas Lamps" near the end of the nineteenth century, when arc lights were increasingly in use in Europe and the United States and the writing was clearly on the wall for gas lamps. His was not a tirade "against light" in general but rather a caution against what he saw as the uncontrolled, uncomfortable brilliance of the new electric lights. He wrote with admiration about how, with the coming of the "gas stars" in the streets, those streets were better places, and the lamplighters were good people, even if every once in a while, "an individual may have been knocked on the head by the ladder of the flying functionary." (I ask Gary about that. "Try not to," he says.) But

now, with electric light, these lamplighters and their lights were to be replaced by "tame stars" that "are to come out … not one by one, but all in a body and at once," that is, with the flick of a switch. While wanting to "accept beauty where it comes," Stevenson cautioned against what he saw as "a new sort of urban star … horrible, unearthly, obnoxious to the human eye; a lamp for a nightmare!"

The technology we use to illuminate our nights has come a long way from those first arc lights, but I wonder if Stevenson's caution to us might be the same: While light at night is welcome, can there be such a thing as too much? In doing away with darkness, what beauty do we lose?

For hundreds of years this city was dark or nearly so, and I want to see if I can find more of that old London and the beauty it hides. I've chosen an old hotel in an old part of town where I can come and go by foot at any hour. For it's walking I have in mind, in the middle of the night, with Charles Dickens.

In "Night Walks" (1861), Dickens wrote, "Some years ago, a temporary inability to sleep … caused me to walk about the streets all night." Dickens had walked "at half-past twelve" during the "damp, cloudy, and cold" London winter, figuring that with the sun not rising until half-past five, he had plenty of time to explore. I have come to London in winter as well, during the longest nights of the year, and when I wake at 2:20 a.m., I can't help but smile.

I dress warmly but go unarmed and without light—no flashlight, no headlamp, no torch. The hotel has some five hundred rooms, most booked, but none of my fellow guests join me as I trot down the stairs from the fifth floor. The hallways and stairs are as bright as in every hotel in the world and will remain that way through this middle of the night, this lost time after 1:30 a.m. until maybe 4:00 that feels more like yesterday and not yet tomorrow. In the lobby, I see no one but a custodian vacuuming near the front door's sliding glass. He doesn't see me until I'm almost to the door, then offers a look of *What? You're going out there?*

I'm first on the Strand—one of London's oldest and most well-known streets, on a cold December night, maybe 25 degrees—and then alone on Waterloo Bridge at quarter to three. West down the Thames, Big Ben and the Houses of Parliament stand dark against the gray charcoal London sky. Big Ben's round white face stands lit, as does the blue London Eye, the Ferris wheel on the river's south bank. Above, I count twenty-four stars. Behind, looking east, amid apparent smoke and steam, the unlit silhouette of St. Paul's Cathedral, the view a close copy of the famous photograph from the Blitz. That is, except for the skyscrapers going in behind, and the intense white lights off Blackfriars Bridge coming straight into my eyes.

Dickens describes the Thames as having "an awful look, the buildings on the banks were muffled in black shrouds, and the reflected light seemed to originate deep in the water, as if the specters of suicides were holding them to show where they went down." The river has claimed countless lives over the centuries, including those of eighteenth-century slaves jumping overboard to avoid their fate and six hundred passengers drowned in a paddle steamer sinking in 1878. I walk down the stony bank to the edge of the black water, the Thames feeling up close like a still wild presence at the heart of the frantic modern city. Tugs and barges and boats lie anchored, a yellow light in one illuminating a man coiling rope. Though the river still sees activity from police boats, fireboats, boats used by tourism companies, and—most significantly—barges used for civil engineering projects, times are changing quickly for the men who work on those barges that ply the Thames at night. In *Night Haunts,* Sukhdev Sandhu quotes a man who remembered that, when he was a child, "there were so many boats on the Thames that it was possible to skip from boat to boat all the way from one side of the river to the other without getting wet." These bargers, Sandhu writes, now "move through a river that appears to them to have been razed and colonized by outside forces, its soul abducted." Sandhu argues that while "Londoners take the Thames for granted … the bargers, especially after midnight, feel as though they have been unshackled from the city, its soot and heaviness, its noise and overbearing solidity. They breathe in the fumes of freedom, bathe in the tranquillity of the dark waters through which they gently move." It wasn't long ago, says Sandhu, that "the nocturnal river

was swathed in darkness; now, even at its farthest reaches, car parks and grand shopping complexes are sprouting up, their light leaking out onto the Thames and denting its darkness."

Back west past Waterloo Bridge, I pass through an arcade of shops that was packed when I ran through this morning, my path a zigzag splash through puddles and past thick coats and couples and three-generation families. The embankments—this south side called "the Albert" and the north side called "the Victoria"—were built in the nineteenth century to control flooding by forcing the Thames to keep a set path rather than continuing its ancient seasonal weave. Now, this south bank is utterly deserted but absolutely lit. The only people I see are one security guard and one garbage collector. I make my way up and over Westminster Bridge, continuing along the South Bank toward Lambeth Bridge, looking across at Parliament. Until midnight, amber floodlights illuminate the Houses of Parliament, but in the middle of a winter's Sunday night, the old building stands dark from tip to tail. No lights in the windows, steam from only one among the many chimneys. With the clouds behind lit by streetlight glow, the building and towers stand in silhouette as though lit by moonlight centuries ago.

Dickens writes of crossing over Westminster Bridge and visiting the abbey, where he sensed "a wonderful procession of its dead among the dark arches and pillars." I feel the same way looking across the river at Parliament. By daylight, even floodlit, this is an old building in the present, but with its floodlight makeup removed, and placed in silhouette against the winter's sky, centuries fade and shadows come alive. Looking across the water, I imagine its ghosts coming down to the rooftop of the building in which they once walked. Whether you're in London or in the countryside or in your own bedroom, turning out the lights—especially the electric lights—can take you back in time.

From Westminster I walk to the corner of St. James's Park and around its curving boundary on Horse Guards Road, behind the Cabinet War Rooms and No. 10 Downing Street, crossing over The Mall and jogging up the steps past an enormous granite column topped by the bronze statue of a tremendously resolute Duke of York, and stop on Carlton House Terrace. If you want to see a street lit by gaslight, this is a good one—with no electric lamps in the way, the gas illuminates the street in soft golden flare. I continue on to Pall Mall and take a right down this famous old street, past rows of distinguished buildings, an open second-story window revealing a wall of ancient books—brown, crimson, black at the spine—and two third-story windows, drapes drawn, dim glow behind.

I think of Virginia Woolf and her essay "Street Haunting: A London Adventure," from 1927, in which she claims "the greatest pleasure of town life in winter" is "rambling the streets of London." Her story tells of using the excuse of needing to buy a pencil in order to get out and walk. "The hour should be the evening and the season winter," she says, because "the evening hour … gives us the irresponsibility which darkness and lamplight bestow." By irresponsibility, I like to think she means freedom. "How beautiful a London street is then," she writes, "with its islands of light, and its long groves of darkness."

I would like to have seen that London or, better yet, to see a modern London with "long groves of darkness" blooming with subtle "islands of light." Some eighty-five years after the publication of Woolf's essay, her equation has been reversed. Now, long groves of electric light give way only periodically to pockets of gaslit beauty or darkness. My visit here is the first time I experience a feeling that I'll have in several other cities and towns, especially in Europe, so rich with centuries of built history: how much more beautiful the nights could be here if more attention were paid to light and darkness. It's not that the London lighting doesn't have its moments—Parliament from across the Thames, for example—but in general the lighting relies on floodlights plastered against building walls, with the result a somewhat patchy appearance, especially compared to the subtle and more uniform lighting I will see in Paris. The opportunities for creating and enhancing the beauty of London at night are enormous—its gaslights and human history give it such an advantage over most cities in world—but for now these opportunities remain, for the most part, unrealized.

From Pall Mall to Trafalgar Square by 3:55, the "look right, look left" painted at intersection crossings, the black cabs slowing by, a row of sleeping red double-decker buses, Admiral Nelson immortalized with spotlights. Then, once again, the Strand. And lastly, Covent Garden.

This was the old market of London for hundreds of years, first outside the city walls, then at the city's edge. Dickens closes his essay by visiting "Covent-garden Market" which he finds on market morning "wonderful company. The great wagons of cabbages, with growers' men and boys lying asleep under them, and with sharp dogs from market-garden neighbourhoods looking after the whole, were as good as a party." The sense of a party in Covent Garden has a long history. An engraving from 1735 titled "Drunken Rakes and Watchmen in Covent Garden" features said rakes in tricorner hats, with swords drawn, their arms around ladies. A dog barks in the corner, lanterns lie smashed on cobblestones, the watchmen enter with their staffs a-swinging, giving one rake a serious kick in the behind, while a lady plugs her man's nose, and two link boys—who before gaslight "linked" travelers in the street from one lighted location to the next—stand holding their flames in the corner, clearly amused by ridiculous adults. What's interesting, aside from the crazy scene, is that in the background, modern-day Covent Garden is clear. Beyond the swooning face of a petticoated dame, you almost expect, if you look closely enough, to see the Apple Store logo in the shop window under the colonnade. The church with the clock, the clock tower, the passages, the cobblestones, they're all here. The description states, "He and his drunken companions raise a riot in Covent Garden," and funny enough, 275 years later, at just past 4:00 a.m., he and his drunken companions are still here, bellowing about Chelsea football as they lead each other, arms on shoulders, from the last pub to the next.

On the square itself, the gaslight still burns. But several shops are lit so brightly, either window displays or entire interiors, that electric light gushes into the square, flooding the night. To see how lovely Covent Garden used to be, stroll the side streets, Crown Court or Broad Court: gaslight and cobblestones, five-hundred-year-old buildings set close across from one another.

In Covent Garden Market now, night is still here, but morning is coming fast. It's time to walk back to the Strand, to my bed and sleep, and I have a strong feeling that when I return in a few hours the scene here will be changed. Back will be the shopping throngs, cups from Caffè Nero in one hand and shopping bags in the other, gone the ghosts of farmers, their cabbages, their dogs.

A few nights later, I am standing on Île St.-Louis, in the center of old Paris, watching the pale peach glow from nineteenth-century lamps on a bridge over the Seine, the waxing crescent moon rising in a powder-blue lavender sky.

A gas lamplighter in the Parisian darkness of the 1930s as captured by the photographer Brassaï. *(© The Brassaï Estate—RMN)*

There are many bright cities, but only one City of Light, La Ville-Lumière. These days the city's nickname is often translated as "the city of lights," and with good reason, for the lighting of Paris is certainly part of its charm and identity. But if loads of electric light were all it took for a city to be called the City of Light, dozens of cities around the world would be well positioned to steal the title. We don't know the exact origin of the phrase, but we do know it refers to Paris's being the center of the eighteenth-century philosophical movement known as the Enlightenment. That is, the name City of Light has as much to do with new ways of thinking as it does with impressive artificial light.

It turns out that is still the case.

"Very little about this light is spontaneous," says David Downie, an American expatriate and author of the wonderful *Paris, Paris,* who has joined me for a walk through the old city. "It's all studied. Since 1900, they've consciously cultivated their image. Paris was really the first to pioneer this concept of a light identity. Of using light to create an atmosphere." Downie points to the lamps glowing on the short bridge from Île St.-Louis to Île de la Cité. "See the light fixture? It's a pre-1890s gas model with a little chimney, on a footbridge from the 1960s: That's what it's all about. They're playing not just with light but with shadow. The darker it gets, the better this bridge looks." While few would notice this bridge during the day, at night the lighting highlights the beautiful shadow-play on the bridge's underside. "There are a lot of little details that come out at night," Downie says. "They're very careful to make the light just strong enough so that you're not going to trip, but they've understood that they can't blind you. Here, they've created a nostalgic, old-fashioned feel with a warm blanket of light."

One feature of the lighting in old Paris is that there are few streetlights higher than fifteen meters, essentially no lights much above the first floor. The sidewalks and streets and balconies are lit, but above that the buildings fade toward darkness. "This was all studied; they want it to be this way," Downie explains. "The goal here is to create atmosphere, and the darker it gets, the more atmospheric it becomes."

As darkness collects between the buildings, along the Seine, on the rooftops, French doors, and balconies, rising around gold lamplight on the ancient narrow streets of these islands where the city was born, there is an intimacy, an openness—anyone can walk these islands, stand on these bridges, wander through this history, as though the city at night is a dinner party in a wonderful old house full of endlessly accessible rooms. The *fromagerie,* a little bell on the door and soft cheese white paper–wrapped, the *boucherie* windows full of twisted-neck fowl with feathered heads still attached, the Berthillon ice cream shop sending its small cones out into the night like messengers. Pipe organ notes sift through heavy, centuries-old wooden church doors, faux wicker-backed café chairs huddle around espresso-topped tables, a ribbon of moonlight ripples on the Seine's silver skin as it flows under bridges lit yellow-gold marching west toward the sea.

"This is the beauty of the night, a beauty 'rooted in atmosphere' that is not easily explained," explains Joachim Schlör in *Nights in the Big City.* "I start my nocturnal walk with pleasure, and my pulse beats slower in this pleasant darkness."

Walking and old Paris go together hand in glove, one reason so many Americans—used to cities enslaved to the automobile—revel in visiting the French capital. Recently the notion of the *flâneur* has gained popularity, one who appreciates, Schlör says, "the fine art of walking through a city slowly and attentively, one's appreciation bolstered by learning." But in Paris this walking happens not only during the day. In the *noctambule,* a word that in its English form, noctambulist, means sleepwalker but in French has a meaning closer to night owl, we find one who takes pleasure walking at night. The name was first applied to those Parisians who took advantage of the newly gaslit boulevards of the 1830s and 1840s, but for Downie, the quintessential *noctambule* is the eighteenth-century writer Rétif de la Bretonne. In terms of writing about walking at night, Bretonne paved the way, created the path. Downie often will follow Bretonne's old route as he walks around the edge of Île St.-Louis. "Bretonne lived right over there." Downie points. "He'd come out and walk the same way we're walking. He'd sit out at the end of the island and think great thoughts, and then go have his nighttime adventures."

During the years 1786 to 1793, Bretonne walked these streets of central Paris, and published his experiences in *Les Nuits de Paris.* That's only half the title, though. The full title—*Les Nuits de Paris, or, The Nocturnal Spectator,* by Nicolas-Edme Restif de la Bretonne—points to some of the pomp with which Bretonne carried himself. In a drawing on the opening pages of his book, he sports big-buckled shoes and stockings, a cape wrapped around himself, his hair falling to his shoulders, and upon his large wide-brimmed hat an owl (and this owl, with rabbitlike ears and wings spread, has a look of surprise, as though Bretonne has glued the bird's feet to his hat). Bretonne looks like

a character—serious, thoughtful, and slightly ridiculous. And, in fact, that is how he reads. He came from Burgundy, which, at that time, was a totally dark place, and he couldn't get over the bright lights of the big city—in the 1780s, Paris suddenly had oil lamps, and more and more of them. "He was a mad walker," Downie explains. "He was completely bowled over by this idea that he could go out at night and walk around … and see."

This ability to go out at night and see, one we now so take for granted, had its origins in a decree by the French King Louis XIV in 1667 that lanterns be hung on Paris streets. As admirers proclaimed that "the night will be lit up as bright as day, in every street," the king commemorated his brilliant move by having coins minted featuring his profile on one side and, on the other, a statue of a robed figure holding a lantern and, in that lantern, a candle. And that—candles hanging over the streets of Paris—formed the first official system of public lighting in the world. By the end of the century, dozens of northern European cities had public lighting in their streets, some fueled with candles, others with oil. Paris alone lit more than five thousand candle lanterns, though only from October through March—the rest of the year relying on summer's lingering sunlight and the monthly advance of the moon.

Street lighting marked a dramatic change in human interaction with the night. Before this time, the coming of night's darkness signaled the end of working and socializing hours, the sign to come in from outside. As Wolfgang Schivelbusch explains in *Disenchanted Night,* "the medieval community prepared itself for dark like a ship's crew preparing to face a gathering storm. At sunset, people began a retreat indoors, locking and bolting everything behind them." To go out at night was to risk one's life, whether by a criminal's hand or a misplaced step—cables strung across the Seine caught the floating corpses of those who had fallen off the quais or bridges and drowned in the dark. The new public lighting facilitated and acknowledged a changing culture. Coffeehouses were spreading through northern Europe and cafés were staying open later and later, marked by a lantern hanging over the door. Along with stronger state security, these increased opportunities for socialization and commerce joined with the new lights to open the darkness to more and more people. Eating, drinking, working—this opening of nighttime hours radically altered life for northern European city dwellers. By 1800, for example, mealtimes had shifted back by as many as seven hours from those of the Middle Ages. "Nocturnalization," historian Craig Koslofsky calls these changes, the "ongoing expansion of the legitimate social and symbolic uses of the night," was an expansion for which street lighting served as infrastructure.

By midcentury the candle lanterns in Paris had been replaced by a new type of oil lantern, the reflector, or *réverbère,* which used multiple wicks and two reflectors to produce dramatically increased amounts of light. In fact, *réverbères* were enthusiastically hailed as artificial suns that "turned night into day." A report prepared for the Paris police chief in 1770 suggested, "The amount of light they cast makes it difficult to imagine that anything brighter could exist." But for eighteenth-century Parisians it didn't take long for the shine to wear off. "These lights cast nothing but darkness made visible," wrote one Frenchman. "From a distance they hurt the eyes, from close up they give hardly any light, and standing directly underneath one, one might as well be in the dark." Indeed, a century after the Sun King's decree, an Englishman visiting Paris declared, "This town is large, stinking, and ill lighted."

For any *noctambule,* Paris held plenty of challenges. The narrow streets had no sidewalks, and death by stagecoach was not an infrequent event. "There are nights when all the disadvantages of a crowded quarter are apparent at the same time," Bretonne wrote. "As I was coming off rue du Foarre, a large marrow bone fell at my feet. Its sharp force and the force with which it was hurled would have made a lethal weapon of it, had it struck me." As his walk continued, he faced a "sheet of soapy water" thrown from a window, then a bucket of ashes. Still, things could have been worse. The city's dirt and pebble streets were lined with sewage and waste, the air filled with a rank stench that we could only imagine by standing in a town dump. Writes historian Roger Ekirch, "The Duchess of

Orleans expressed amazement in 1720 that Paris did not have 'entire rivers of piss' from the men who urinated in streets already littered with dung from horses and livestock. Ditches, a foot or more deep, grew clogged with ashes, oyster shells, and animal carcasses," and "most notorious were the showers of urine and excrement that bombarded streets at night from open windows and doors." William Hogarth's painting of London in *Night*, from *The Four Times of the Day* (1736), might just as well have been a city street scene from Paris: A woman pours a bucket of human waste out an open window onto the back of an unfortunate man who staggers along with his wife. He holds a stick and she a lantern and sword. Oh, and a bonfire burns in the middle of the narrow street behind them.

Amid this dimly lit craziness it might be difficult to believe that street lighting could be a source of bitterness and anger. But in the years before the French Revolution, street lighting was often a thorn in the public's side. From its start, public street lighting had been significantly motivated by the state's desire to gain control over the streets at night, and for many Parisians the oil lamp simply stood for tyranny. When lanterns were at first hung low, they made for easy targets, destroyed with walking sticks. But when the lanterns were then hung out of reach, a new technique emerged, that of cutting the lantern's ropes and letting the lantern smash into the street. At times, like the modern-day smashing of Halloween pumpkins, smashing lanterns was simply a form of entertainment. As Schivelbusch writes, "Whatever the details and methods, smashing lanterns was obviously an extremely enjoyable activity."

While the candle lanterns and *réverbères* are long gone, and electric lighting makes Paris today as bright overall as any city its size, the echoes of such history remain. Though some complain that old Paris has become a museum or even that it's dead, I think it anything but, and I think that especially at night. What's kept alive is the opportunity to add your story to those countless stories before, even to add to your own story if you have been here in the past. Because so much of the old city has been preserved, you can come back to Paris and the night you walked years ago will still be here.

The year after high school, while backpacking nine months through Europe, I remember especially a week in Paris, in the winter, alone. I had lucked out and discovered a small hotel on the Île de la Cité, the Henry IV on the Place Dauphine. I would set out each night and walk for hours through old Paris, the gray-black Seine there to guide the way, the long, gray ministry buildings with rooftops black and windows dark, the French tricolor spotlit in front. I would stand on the Pont Neuf and wonder where this life would lead.

As Downie and I continue our stroll, I tell him that the night I reached the city this year, I took the métro from the Gare du Nord to the Champs-Élysées, near the Arc de Triomphe. A wet snowfall weighed on tree branches and café awnings, crystals sparkling. The snow snarled rush-hour traffic and slowed walkers with its slushy challenge, casting a hush over the sounds of wet tires and boots. The leafless smooth-barked plane trees along the avenue were filled with small white lights, bright with a tinge of sky blue, each with two or three long bulbs like fluorescent ceiling lamps dark except for a periodic slide of light down their length, the movement like one of melting snow sliding down a rock face or roof. At the end of the wide Champs-Élysées boulevard, I wandered past the bright blue-white Ferris wheel (La Grande Roue) set up for the season in the enormous Place de la Concorde, the famous city square where King Louis XVI lost his head to the guillotine and where the spotlit Obelisk—a 3,300-year-old Egyptian column—stands seventy-five feet tall. From the Place I skirted around the locked and deserted Tuileries gardens, which, during the day, fills with couples and families and solo strollers, and found myself among the stone buildings of the Louvre Palace, where black lampposts ring the courtyard with bright light. Then, along the Seine to the Île de la Cité, past the large Christmas tree filled with navy-blue lights in front of Notre-Dame, around the cathedral onto Île St.-Louis, and through the amber-lit Marais neighborhood to my hotel. All told, a walk of nearly two hours, but in that time I saw much of the old city. No museums or galleries or music or events, not even a glass of *vin rouge* or a quick stop at a *créperie.* But the City of Light on a dark winter's eve and nearly for free, the priceless sensation of having returned to something once mine.

"Everything belongs to me in the night," wrote Bretonne. In Paris more than two hundred years later, that truth remains: Everything is accessible, at least to your eyes—monuments, famous buildings, ancient streets. Little is closed off as you walk this city at night. Even—as the lights come on in apartments you pass—other people's lives.

Downie nods. "My wife says it reminds her of an Advent calendar, the way the windows suddenly come to life." We've reached the Place des Vosges, built in the early 1600s, the oldest planned square in the city, lined with grand two-story apartments. "That's a seventeenth-century painted ceiling," he says, pointing. "This city is full of unbelievable interiors, and you only see them at night."

In a neighboring apartment are long maroon drapes pulled back from French doors, the lifted slant top of a grand piano, and in the corner on the wall a stag's head. "Now, speaking of expensive," Downie says, "this is a double pavilion owned by one man, one very rich family. They've owned it for a hundred seventy years. And if you look, see that tapestry? It's a sixteenth-century tapestry. If other lights were on, you would see amazing things because he's one of the most successful auctioneers in the country."

These are rooms into which, during the day, I would never be allowed. But at night, walking Paris, invited into room after room, life after life, I feel welcomed to enjoy the beauty this city offers. And I want to know more.

François Jousse emerges into the Parisian evening as though from out of the shadows, ambling toward me from behind the enormous Christmas tree in front of Notre-Dame. With his bushy beard, red plaid coat, and camel-colored hiking boots, he looks like a lumberjack. It turns out that those boots are key—Jousse likes to walk Paris, day and night, and that's what we have agreed to do: a tour of central Paris so he can tell me about his work. He is immediately jovial, friendly and cheerful, clearly delighted to be talking about lighting the city he loves, albeit slowly in English with a heavy French accent. He begins many of his sentences with "*Alors* …," meaning "So …," before explaining something new. There is much to explain, because there has been so much thought put into the lighting of Paris. And the man who has done much of that thinking, the man who has done so much to create the atmosphere of Paris at night, is François Jousse.

We start at Notre-Dame, where in 2002 Jousse oversaw the completion of a ten-year, multi-million-dollar upgrade to the cathedral's exterior lighting. For several decades after World War II the cathedral was simply spotlit, and then only its façade. Before the war, it had spent centuries in darkness—a Brassaï photograph from the early 1930s, shot from Île St.-Louis, shows the cathedral from behind, lit only by surrounding streetlights, a dark hulking shape as though carved from coal. Not until recently—not until Jousse—did the city take seriously a relighting of one of its most enduring landmarks. "For the lighting of the cathedral we made a competition, a jury with clergy, cultural minister, city of Paris—many people," he says with a slight grin, "and it was very, very difficult." Jousse tells me one idea was to have the cathedral's famous stained-glass rose window lit from within, a proposal of which the clergy disapproved. "They said," Jousee laughs, "we were the devil."

For Jousse, the project of lighting the famous cathedral didn't stop with just the church. When he says "the cathedral," he explains, he means not only its face but everything around the building, the lights of the bridge adjacent to it, the plaza in front of the cathedral. "The concept was to put the cathedral in the center of the island. And to tell a story." For example, Jousse points out how the lighting grows gradually brighter as it reaches the cathedral's top, intentionally drawing the viewer's gaze skyward—toward heaven. And though pleased with the project, Jousse says he didn't get everything he wanted. "I have made also a design for this garden," he explains as we pass the dark courtyard behind the cathedral, "but no money." He then offers a "what-can-you-do" laugh, lowers his gaze, and we're off again, walking to the next stop, stretches of silence but for the crunch and splash of our boots in the snow-crust and melt-slop of the Paris sidewalks.

Speaking of money, the city now spends some 150,000 euros each night for the electricity, maintenance, and renovation of its lighting, a quantifiable reflection of its commitment. But this wasn't always the case. When Jousse took his position in 1981, Paris at night looked little like it does now. As with Notre-Dame, the city's famous monuments and buildings were mostly spotlit, and many others were not lit at all. Over the course of thirty years, Jousse and his associates relit Paris almost entirely—more than three hundred buildings, thirty-six bridges, the streets and boulevards—all with the goal of integrating them into the city, being as economical as possible, and creating beauty. Before his retirement in 2011 as chief engineer for doctrine, expertise, and technical control, Jousse was the man in charge. His car even held a special permit that allowed him to park wherever he wanted in order to better troubleshoot, direct, or otherwise consider how Paris would be lit.

Most visitors to Paris probably notice the beauty of the lighting, but they probably don't notice how carefully that beauty is created—where and how the floodlights are placed, the challenges the lighting designers faced, the amount of energy used. That's just fine for Jousse. In fact, he delights in showing me how he hid many of the projectors so that the lights become part of the building, and the building part of the city. He doesn't want to draw attention to the lighting, nor does he want the lighted building to stand out from the neighborhood. On the sidewalk across the Seine from Notre-Dame, at the end of a long row of green metal stalls—those of the famous *bouquinistes,* the booksellers whose presence here began in the 1600s—Jousse shows me how the first two stalls actually house no books, hiding two spotlights instead. Anyone walking past the bookstalls would never guess the light on the cathedral came from within them.

"Whose idea was this?" I ask.

"This was mine." He laughs.

Jousse sees himself as a historian of technique, and a storyteller using light as his language. As we walk past the Hôtel de Ville he says, "Now I show to you my last design in Paris." He leads me toward the Tour St.-Jacques, the 170-foot Gothic tower that is all that remains of the wonderfully named sixteenth-century Church of St.-Jacques-de-la-Boucherie (St. James of the Butchery). Jousse used the story of Blaise Pascal's experiments with atmospheric pressure as inspiration to develop this lighting design. "I want to make homage to Pascal. The light falls from the top, and when it reaches the ground it makes a splash." And indeed, the light starts brighter at the top, fades as it falls, then brightens and spreads at the tower's base. This blend of artistic thinking with technical solutions essentially describes Jousse's work in Paris—to think about the philosophy behind the light, and then to make it happen. "I want that the building says something with the light," he explains. "But the speaking can be different. Maybe it's an architectural speech, maybe it's a historical speech, maybe it's humorous. Sometimes the speech can be spiritual. Sometimes people say to me, But nobody will understand what the building says. And I say, It's not a problem, the building says something and it's beautiful because the building says something."

At St.-Eustache I see what he means. From a block away the cathedral seems to rise from darkness, its bottom half left unlighted, its top half glowing subtle amber-gold. Jousse smiles. "For the church I want to be sure the light says something. I give the speaking to one designer, and the technique to another. And the first one must say, 'I see the church like that during the night because na, na, na, na,'" he laughs. "It was the first realization with this way of thinking, maybe in the world. And his speech was something like, the church is like a battery of God-energy. During the day the church takes in the energy of God, at night the energy of God comes from inside to go outside."

As we walk closer to the church the bottom half emerges from the shadows, its stone arches lit by ambient rather than direct light. "When you're far away you ask why isn't it lit, but when you're up close you don't ask anymore," he says, clearly satisfied. "There's comfort, and there's ambience. Everything doesn't necessarily have to be lit. On the contrary, it's when you leave things in shadows that you see the light better."

I wonder if the same could be said about light and quiet.

The sounds of city traffic fall away as we walk into the Louvre courtyard called the Cour Carrée, a small square with a circular fountain in the middle, and on the three stories of sandstone and windows the golden light of some 110,000 small (4.5-watt) lamps ("the same number as all the other lamps in Paris," Jousse explains). "It's very beautiful," he says, this time more serious. "C'est magique." The effect created is that rather than the lights shining on the building, the building seems to be emitting the light. "The picture is fantastic. The maintenance is also fantastic." He laughs. The energy for this one courtyard alone costs one million euros per year.

We leave and cross the busy street to a bridge, Le Pont des Arts. "Et voilà," Jousse says. "Another magic area of Paris." Yes, this one a romantic pedestrian overpass made of iron and wood. Jousse says the challenge here was that on this slim bridge there were no good places to put light projectors. "It's a very poetic place," he says, "and if people have projectors in their eyes it's not good. But the city says to me, 'All bridges must be illuminated.' So, I say okay." He chuckles. Jousse solved the problem by placing his projectors under the bridge facing the river, and illuminated the bridge from the light reflecting off the moving water, thus creating a shimmering, beautiful effect.

What does it mean, I ask, to include values of beauty and poetry and love when you're working with light? "It's hard for me to answer," he says, "I'm an engineer, not a poet. But as far as love goes, I would say that's true. Oui, c'est vrai. I'm in love with Paris." He laughs. "If you work on lighting without having any love for what you're lighting …," he trails off, as though there's nothing more to be said. Then: "The love of Paris comes first, the lighting of Paris is secondary."

For our last stop we take the métro up to Montmartre and look down onto the city, the softly lit white curves of the Sacré-Cœur church behind us (another of his lighting designs? *Oui*). The Eiffel Tower stands over the dark city, lit from within by three hundred fifty sodium vapor lights designed to mimic the amber glow of the gas lamps that once lined the interior of the structure. Only three decades ago, just one side of the tower was lit, all the lighting from spotlights stationed by the Trocadéro Palace. Jousse tells me that the energy consumption was huge, and because of the tower's brown paint you couldn't see any details. Then came the idea to light the tower from within. Since then, except for each top of the hour, when twenty thousand white lights sparkle the tower for ten minutes, or on rare occasions (briefly all in red for a visit from the Chinese premier, all in blue to honor the European Union), the lighting hasn't changed for twenty-five years. "And for us it's very conservative, it's classical. It's beautiful like a jewel, but it doesn't change. But it could be worse; it could be a wedding cake. So, sometimes classical is good."

When I share my appreciation for the role lighting plays in the story Paris tells, he says, "If you feel that way, then I am very happy." With this, Jousse bids me farewell.

I turn and look out over Paris. From Montmartre, you see the pollution from the suburbs at the edges of the city, their butterscotch orange lights running unleashed into the sky. But the old Paris looks dark, the view a direct result of the rules that light fixtures be directed downward and the lights themselves not be placed any higher than they are. The effect is that of an old city in pre-industrial darkness, though under that canopy you know there lives and breathes a city of light.

When I turn back toward Sacré-Cœur, François Jousse is rounding a corner of the church, his head lowered, his boots returning him to the shadows.

7
Light That Blinds, Fear That Enlightens

After thousands of years we're still strangers to darkness, fearful aliens in an enemy camp with our arms crossed over our chests.

—ANNIE DILLARD (1974)

Rolling hills, gnarly old trees, a creek running through—when I return at Christmas to the suburban Minneapolis neighborhood where I grew up I wait until just before midnight, then head with my dog Luna two blocks south, slip through a tear in the chain link fence, and take a golf course walk. On account of liability fears we're not supposed to be here. But we are, and it's a pleasure, walking in what passes for dark. The city-lit sky and snow-swamped land combine—darker than day, but lighter than night ought to be. The leafless limbs of oaks and maples and the nests of birds and squirrels high in the branches, against the glowing winter sky, are like x-ray images of various animals, of vascular systems and hearts. Some years, solitary owls perch in silhouetted trees, watching me until I notice, then swooping away. Other years, deer crossing a fairway in the distance, or the circular squeal-yipping-bark of coyotes by the railroad tracks. And once, looking back, the weightless drifting prance of a fox crossing the snowy sloping hillside we'd just tread.

To the east the city rises in golds trimmed in royal blues and sparkling reds, silvers, and whites, steam twisting street-level to sky. Sky glow colors the entire eastern horizon hazy orange—and with the south, west, and northern horizons all gray-white, any low-hanging star has been wiped away. Only overhead are maybe four dozen, no more—Orion; the Pleiades; Sirius, the Dog Star. It seems like night here but it's not, at least not as it would be without all this light.

Slipping back through the fence, walking home, we are bathed by corner streetlights and the 100-watt bulbs in "brass and glass" front-door fixtures. The combination of house lights and streetlights and city-supplied sky glow illuminates the four blocks to the street's end, each house defined. It's a scene repeated in every direction and, with rare exception, over the suburb as a whole. It's the kind of suburb in which tens of millions of Americans have grown up learning what "dark" is, the kind of suburb in which one hundred million Americans live. You would never see the Milky Way here, or meteors, or anything close to Van Gogh's wild night, and on Bortle's scale, on its darkest nights, this suburb would be lucky to rank a 7. And still, a few years ago, the people on this street asked for more light.

In the forty years my parents have lived here, there has never been any trouble with crime. That is, the type of crime we fear—the stranger snooping outside the window, sneaking in the back door, doing us harm. Even so, the neighborhood petitioned the city government, and soon five straight metallic poles topped by yellow carriage fixtures had been stitched into the street at fifty-yard intervals. From one night to the next, gone was what had been left of the street my mother had chosen because it reminded her of the dark country roads in Ohio where she'd grown up in the 1950s. "I was against it," she says of more streetlights, "but I was outvoted."

Why? I ask.

"Oh," my father says. "Safety and security."

Sooner or later, when talking about artificial lights and darkness, you come to questions of safety and security. Usually, it's sooner. In fact, the first question at any presentation about light pollution is bound to be something like, "Yes, so it's great to see the night sky and everything, but we need lights for safety." This isn't actually a question, I realize, and usually the speaker isn't really asking but rather stating what we have all been taught is fact. But often that statement has a subtext, too, something like what I found on a Colorado website: "less street lighting means more rapes, more assaults, more robberies, and more murders. It is wonderful to be able to see the details of the Crab

Nebula from your back yard. It is also wonderful to be able to walk down the street without being attacked by a violent predator."

You don't have to look far to find the idea that darkness and danger go together, as do security and light. In Oakland, a city with thirty-seven thousand streetlights, an assistant police chief claims increased lighting levels could help reduce crime because "most of these crooks, when they commit a crime, want to do it in darkness." In Boston, with sixty-seven thousand streetlights of its own, a Northeastern University criminology professor argues that lights act as "natural surveillance" and can reduce crime by 20 percent. In Los Angeles, home to more than two hundred forty thousand streetlights, the city attributes a 17 percent drop in violent gang-related crimes in the areas surrounding parks to those parks' having received new lights. And here in Minneapolis the police advise, "Protect your family, property, and neighborhood by turning on your front door and yard lights," and "Remember: Criminals like the dark, so make sure your yard has lots of light!"

Clearly, plenty of us have been receiving similar advice—we live in a world that is brighter than ever before, and growing brighter every year. Part of that growth comes from an ever-increasing human population, especially in urban areas. But the amount of light we are using per person is growing as well. In the UK, for example, lighting efficiency has doubled over the past fifty years —but the per capita electricity consumption for lighting increased fourfold over that time. We are choosing to light up more things, and we are lighting those things more brightly.

There's no doubt light at night can make us safer, from a lighthouse beam guiding ships from rocky coasts to simply enough sidewalk light to keep us from tripping on cracked cement. But increasing numbers of lighting engineers and lighting designers, astronomers and dark sky activists, physicians and lawyers and police now say that often the amount of light we're using—and how we're using it—goes far beyond true requirements for safety, and that when it comes to lighting, darkness, and security we tend to assume as common sense ideas that, in truth, are not so black and white.

Foremost among these assumptions is that because some light improves our safety, more light will improve our safety more. It's an assumption I will hear challenged again and again. As one lighting professional explained, "Too much light would have a negative effect, because if you look into a light, you can't see anything, you can't see beyond it." Gazing from behind his desk, he paused, "You know, a bright enough light in between us and we can't see each other—and we're sitting across from each other!"

The sky over Concord, Massachusetts, this famous town of sixteen thousand about twenty miles west of Boston, reminds me of the sky above my parents' house near Minneapolis—washed out. (Alan Lewis, whom I have come here to meet, calls it "the great yellow sky.") Of course, this wasn't always so. In 1836, for example, Ralph Waldo Emerson wrote of the stars here:

Seen in the streets of cities, how great they are! If the stars should appear one night in a thousand years, how would men believe and adore; and preserve for many generations the remembrance of the city of God which had been shown! But every night come out these envoys of beauty, and light the universe with their admonishing smile.

This is almost like reading ancient history—stars, seen from the streets of cities? In this passage from *Nature,* Emerson looked for a way to make the point that we take nature for granted—we take life for granted—by finding an example of something so commonplace we don't even see it anymore. What better example than the brilliant starry night over a nineteenth-century Concord lit by oil lamps?

I didn't have to visit Concord to know that its sky holds many fewer of Emerson's "envoys of beauty." But I wanted to talk with Lewis, to learn more about how too much light could actually act in a negative way. A longtime optometrist and former president of the Illuminating Engineering Society of North America (IESNA), the lighting professionals who have much to say about how we light our world, Alan Lewis has spent the last forty years helping to "educate lighting people about how the visual system operates."

For example, Lewis says, most streetlights are actually designed in a way that often causes more problems than they solve.

"Badly designed street lighting, which is probably eighty percent of street lighting, are glare sources," he explains. "That is, they actually reduce the contrast of things you're trying to see rather than increase it, because of this disability glare problem that occurs due to scatter in the eye."

Disability glare from poorly designed streetlights—picture the traditional cobrahead drop-lens fixtures used on most American streets—is the main reason drivers, especially older drivers, have a tough time at night. As we age, proteins in the lens of our eye begin to accumulate, and we lose the transparency we had when we were younger. In the same way that a brand-new windshield is crystal clear but ages over time with accumulated minuscule chips and dings, these proteins reduce the eye's transparency as they scatter the light coming into the eye. The effect is that instead of going to the retina and focusing, the light is distributed across the retina, casting what Lewis calls "a veiling luminance" that significantly reduces contrast.

To optimize vision, Lewis says, the key is to maximize the contrast—the brightness difference between what you're trying to see and the background—while minimizing the amount of light going directly from the light source into the eye, because when light goes directly into the eye the greater portion of it is scattered. "You don't want bright lights coming in from anywhere but the target you're trying to see," he says. "I mean any additional source of light out there, like a streetlight shining in your eye or a headlight coming at you or glare sources on a building just makes things harder to see."

The second major factor in our seeing well at night (or not) is adaptation, the way our eyes adapt as we move from brighter areas to darker areas. Because of the way our streetlights are usually placed, our eyes constantly have to go back and forth. "If you're in a place that's relatively uniformly illuminated by streetlights, then your adaptation remains fairly constant and that's okay," Lewis explains. "But what happens is streetlights tend to get dispersed somewhat willy-nilly and so you leave this bright spot and drive into this dark spot but you're not adapted, and so visibility is actually worse than if you hadn't had the streetlight there to begin with." Lewis compares this situation to walking into a movie theater: the way it takes a few moments for your eyes to adapt. "So, as you move from lighted areas to nonlighted areas visibility can actually get worse. In many cases, an equal level of darkness is better than a sporadic light-dark, light-dark area."

It isn't only streetlights that cause this problem. The worst offenders, he says, are intensely lit places like gas stations and parking lots. About twenty years ago in America, gas stations began to increase the level of lighting, not for any real safety concerns but for marketing purposes. ("People like light, they're attracted to it. There's no question about it," he says.) "You go in and you fill up under a canopy that was highly lit from a marketing standpoint to attract you, rather than a need for vision," explains Lewis. "And then you drive out into a dark road and it may be a minute or two before you can readapt to the darkness, which can be very dangerous."

"Because you might get hit?"

"Generally you're okay," he laughs, "you're in the car. It's the other folks who have to worry."

In other words, it's for marketing purposes (to get you to stop and buy stuff) that gas stations, shopping malls, and car dealerships are lit so brightly—not, as we might think, primarily for safety. If safety were the primary goal for these establishments, Lewis and others told me, they would be lit much more dimly so that the adaptation and glare problems would be reduced. The problem is that if one business raises its lighting level, the others will feel compelled to as well because *by contrast,* their establishment will seem dim and therefore less attractive—even closed.

The same scenario holds true for our society in general. As our surroundings grow brighter, we grow used to that level of brightness, and so anything dimmer seems extraordinarily dim, even dark. This is exactly what happened as artificial lighting developed through the ages. The once glorious oil lamps became dim and disgusting with the advent of wonderful gas lighting, which then became

smelly and awful and unbearably dim the moment we saw electric light. In other words, once our eyes get used to seeing brighter lights, we must have brighter lights.

Roger Narboni, a lighting designer in Paris, explained this concept to me by telling of how he'd been hired to renew the lighting in a very large, very old fish market near Paris, where the business took place between 1:00 and 3:00 a.m.

"The plan was 400 lux on the fish. But when the people selling the fish saw it, they said, This is dull, we can't see the fish. They were used to having big halogen lamps—which were hot lamps that were terrible for the fish, but they were used to them. With the new lights the atmosphere was totally different, and for them it was no good. So they said, Can you raise the level a little? And we said, Sure. And they said, Can we have double? And we said, Wow, double, okay." He laughed. So, Narboni said, they raised the level of lighting to 800 lux, but when the fishmongers came to work they asked if the lights had even been changed. "I took out my light meter and showed them: 800 lux. And they said, Are you sure it's working? Can we go higher? So we went to 1,200, then 1,600, 1,800, and they were never pleased. They kept saying, It's dull, we want more. And finally I said, Okay, forget it, because we're not going to go to 3,000 lux or 5,000 lux or to daytime. This is insane; I don't want to do that. So I quit. And I told them, Your eyes are not able to understand what's going on. And even if we put more, you cannot compare it, and you will ask for more and more and more, and it's like addicts. And they never understood that."

But a fish market in the middle of the night is one thing, I said. What about in the city itself?

"It's the same for the urban city. If you put more lights for safety, very often and very quickly people will say, Oh, we don't see enough, it's not working, people are still being attacked, and we have problems and so we should put more light. And we're going to go up and up and up. There is no limit, because the vision gets accustomed to that and we need more."

The fascinating thing, though, Narboni said, is that this works the other way, too.

"If you go to darkness, the eye opens a lot, you get more focus, and even in a very dark environment you see very well."

It's a fact most of us don't know: The human eye has an amazing ability to adapt to different lighting levels, including levels we normally think of as quite dim. While the human eye will never match those of truly nocturnal or crepuscular (active at dawn and dusk) animals, in dimly lit situations our pupil expands, our iris relaxes, and thirty times more light can enter our eye. Faced with bright lights, the pupil contracts and the iris closes down for protection. But given time to adapt to low light levels—levels that would allow the stars back into our skies and make our streets safer by eliminating glare—we actually see fairly well.

"And I try to tell the politicians, 'Try it and you'll see,'" Narboni explained. "In Berlin it's like that, it's 5 lux and everything is fine. You can see the pavement, you can see the street, and you can walk peacefully."

Then, Narboni echoed the point made by Alan Lewis: "We are mainly driven by contrast. This is the main thing in lighting. So, if you go with a high level of light the contrast will be very poor and you won't feel comfortable. And if you go with contrast you can feel safe even with darkness."

Feeling safe with darkness is difficult when we have become so accustomed to high levels of light. As Bob Mizon, coordinator of the British Astronomical Association's Campaign for Dark Skies (CfDS), explains, "We're looking at a whole generation of people—even someone my age, and I'm sixty-plus—who have grown up with lots of lights, and who have grown up with lots of *bad* lights. So people now think that not only is lighting the norm, but that really glary crap lighting is the norm."

Still, a growing number of towns and villages in the United States and Europe have been experimenting with turning off some of their lights, some of the time, in an effort to save energy—that is, to save money. And despite concern about a potential growth in crime, many of these places have experienced the opposite result. In fact, police in Bristol, England, reported a 20 percent reduction in crime, and other English towns have seen crime drop up to 50 percent since lights have been turned

off after midnight. When Rockford, Illinois, decided to switch off 15 percent of its streetlights, the police chief assured the city council that no studies show correlation between lighting and crime, and that he believes lighting doesn't directly affect crime one way or the other. In Santa Rosa, California, which has decided to remove six thousand of the city's fifteen thousand streetlights and place an additional three thousand on a timer that shuts lights off from midnight to 5:30 a.m., the city hopes to save $400,000 a year. The bottom of the Street Light Reduction Program website reads, "Several academic studies have been published on the correlation between street lighting and crime. None of the studies make a direct correlation between increased street lighting and reduced crime. In fact some of the research indicates just the opposite."

Other communities have had mixed success, and not because people are fearful of saving money. After Concord turned off two-thirds of its streetlights, the outcry from the populace was horrendous, Lewis tells me and the town recently voted to turn the streetlights back on, "even though most of it is pretty bad lighting."

How does that make sense—choosing bad lighting over saving money?

"So much of it is people thinking that if there's light it must be safer. And they don't know what to look for, and they don't know what good lighting is, they don't know what bad lighting is." (Lewis later tells me, "The nice thing about educating people about bad lighting is that there's so many examples.")

"And so they just think that if you turn the lighting off crime is going to go up, or I'm not going to be as safe. And none of that actually is true, in fact in many cases street lighting makes things worse not better.

"You read the letters to the editors in the local paper, and that's what they say: You turned the lights out and now I don't feel safe walking on the street anymore, so turn the lights back on so I feel safe. Even if, by the way," Lewis says, "they never walk on the street."

I'm struck by the fact that Lewis is talking about Concord, a town with a history of famous Revolutionary War violence, but with no history of pervasive violent crime. If people don't feel safe in a place like Concord, where will they? We forget that crime tends to be concentrated in only a few places, and most places have no crime at all. This is especially true when it comes to the violent, personal crime that we tend to fear most. In Concord I found a friendly New England town, and not any place where you would expect to be attacked by a violent predator. And yet, here were glaring streetlights that did as much to impair my vision as they did to brighten my way. "They could actually reduce the lighting by about fifty percent in the downtown area," Lewis tells me, "and still have very, very good lighting."

Half a continent away from Concord, in the small northern town of Ashland, Wisconsin (population eight thousand), on Lake Superior's Chequamegon Bay, you find Green Bay Packer jerseys, Day-Glo orange hunting vests, and camouflage hats or pants or jackets almost always within view, and beer and cheese served at nearly every meal. Once a town bustling with Northwoods logging and mining and railroad activity, it has only a single ore dock remaining, unused since 1965, jutting into the bay like a broken Roman aqueduct. A natural foods co-op, a bakery, and the Black Cat coffeehouse share a single block on a single street, and some residents claim you need never go anywhere else. Except, perhaps, for a late-night drive to Tetzner's Dairy outside nearby Washburn to grab a chocolate ice cream sandwich from the freezer and leave your cash in the coffee can near the door. From the surrounding woods, on one of the nearby Apostle Islands, or better yet floating in a sailboat on the lake, the nights are still dark enough to welcome the Milky Way in brilliant detail.

But in town, light abounds. Along the lake on US Route 2 shine rows of "acorn" streetlights, the Victorian fixtures that tend to show up wherever decision makers want a nostalgic look. And in the neighborhoods you find plenty of what are, for residential and commercial buildings, the two most common sources of bright light: the "security light" and the "wallpack."

Whether in alleys, barnyards, backyards, front yards, or driveways, the white 175-watt, dusk-to-dawn security light is ubiquitous in the United States. Drive into the country and they are often the only lights you see. I remember as a child traveling south with my parents from Minneapolis to the southern Illinois farm country where my grandparents lived. If we went at Christmas we traveled long hours after dark, and I would press my face to the backseat glass, cup my eyes, and stare at the stars. Somehow, the solitary white lights that dotted the black landscape seemed part of the romance, like bits of starry sky fallen to earth.

But that romantic view hid the reality: The fact that I could see them hundreds of yards away speaks to the glare these lights cast in all directions, including far beyond the boundaries of the property for which they were meant to provide security.

During the three years I taught at a small college in Ashland, I lived within walking distance of my office and often would take the alleyway five blocks there and back, passing right under a security light. This light was ostensibly designed to illuminate a driveway and a garage basketball hoop, and I used to imagine the swish and clank and splat of a solitary sharpshooter hitting net, rim, and puddle. But I never saw this person; I only saw, from blocks away, the light casting its shadows and glare into neighboring yards and houses. Approaching the light, I would have to shield my eyes, losing whatever dark adaptation I'd gained. I never did ask the neighbors what they thought of this light. My guess? They were so used to it they no longer noticed.

That we don't notice glaring lights anymore has direct ramifications for light pollution, of course, but in terms of safety and security, because we are so used to bright lighting, we won't notice if anything out of the ordinary is taking place. In fact, we won't think to look or even want to look. And if no one is looking, lighting will do next to nothing for security.

For example, think of the many industrial warehouses spread outside every city and small town that stand unattended all weekend, every weekend. With few exceptions they will be ringed with lights, far too often wallpacks—those rectangular-shaped lighting fixtures plastered to the sides of buildings all over the country that blast horizontal light onto parking lots, plazas, courtyards … and far beyond those areas. But without a human presence—without someone watching—those lights do little more than provide illumination a criminal would need. So much so that David Crawford, founder of the International Dark-Sky Association, calls this "criminal-friendly lighting."

The joke I heard in London is that criminals actually prefer to work in well-lighted areas because they, too, feel safer. Studies bear this out: Light allows criminals to choose their victims, locate escape routes, and see their surroundings. Asked in one study what factors deterred them from targeting a house, criminals listed "belief that house is occupied," "presence of alarms or CCTV/camera outside the property," and, to a lesser extent, the "apparent strength of doors/window locks." Nowhere did they mention the presence of lighting.

"It works both ways, you see," the CfDS's Bob Mizon told me. "The people who claim benefits from lighting, they never put themselves in the mind of the criminal—what does he or possibly she need? What does a burglar need, what does a rapist or a mugger need? They need to assess the victim; they need to see what they're doing. I mean, who benefits most from a big security light at three o'clock in the morning? Is it the resident fast asleep indoors, or is it the burglar sorting his tools under the light?"

Makes sense, I said, but when I look at the webpage for the police department in the suburb where my parents live, the first thing listed under preventative measures a homeowner can take: "Home is illuminated with Exterior Lights."

The police in his town offer the same message, Mizon explained: "You must have lights to prevent crime. And when asked about the source of this information, the data, they haven't got any. They just assume it's true. The police are mired in the same degree of ignorance as society."

This doesn't mean that the Campaign for Dark Skies is against artificial light.

"It's not as though we want people stumbling about in medieval darkness," Mizon said, smiling. "I mean we don't campaign for *no* lights. That's crazy. If people want lights they should have them. It's a democracy; people fought and died for it. Let's say everybody in the village votes for street lighting. Great, they must have it. But it's got to be the right stuff. And that's what many people don't realize, that there's lighting, and then there's lighting."

Helping people understand this is a large part of Mizon's job.

"I say to them, look, there are thousands of little villages in England with no streetlights—are they hot spots of crime? No, they are not. And when you see crime on the television or you see people rioting in city centers or fighting each other on the CCTV cameras and vomiting in the gutters, are those dark places? No, they're brightly lit places. They're the brightest places in Britain, and they are the most crime-ridden places in Britain. So what's the conclusion? Does light prevent crime? Of course not, it's rubbish."

Overall, the available studies and statistics back Mizon's claim, and echo what several people told me, that the term "security lighting" is simply oxymoronic because it assumes a link between security and lighting that research does not support.

In 1977, a U.S. Department of Justice report found that "there is no statistically significant evidence that street lighting impacts the level of crime." In 1997, a U.S. National Institute of Justice report concluded, "We may speculate that lighting is effective in some places, ineffective in others, and counterproductive in others." In 2000, the city of Chicago performed a study in which an attempt was made to "reduce crime through improved street and alley lighting." The city found that "there did not appear to be a suppression effect on crime as a result of increased alley lighting." In 2002, Australian astronomer Barry Clark conducted an exhaustive review of the research available and concluded that there is "no compelling evidence" that lighting reduces crime and, in fact, "good evidence that darkness reduces crime."

How shielding our lights cuts out glare and improves our vision (notice the "bad guy" standing in the open gate). *(George Fleenor)*

In late 2008, the Pacific Gas and Electric Company (PG&E) was required by California law to find ways to reduce energy expenditures. In an effort to look into how the reduction of street lighting might do so, company representatives asked for and received an independent review of existing research "relating to any relationship between night-time outdoor lighting and security." The review found no research that presented "sufficient evidence to demonstrate a causal link between night-time lighting and crime" and concluded: "the available results show a mixed picture of positive and negative effects of lighting on crime, most of which are not statistically significant. This suggests either that there is no link between lighting and crime, or that any link is too subtle or complex to have been evident in the data, given the limited size of the studies undertaken."

As Barry Clark argued in 2002, "Where the justification includes or implies crime prevention," lighting costs "appear to be a waste of public and private funds." Updating his review in 2011, he reiterated his earlier findings and wrote, "Given the invalidity of evidence for a beneficial effect and the clear evidence to the contrary, advocating lighting for crime prevention is like advocating use of a flammable liquid to try to put out a fire."

These studies have had little effect, however, on the perception that lighting reduces crime at night, and that more light reduces crime further. Perhaps that's because most of us have never heard of these studies, and so continue to assume a connection between darkness and crime, lighting and security. It doesn't help that a handful of studies directly or indirectly sponsored by the lighting industry or utility companies persist in claiming that lighting deters crime despite mounting evidence to the contrary. By selling more lights or selling more energy, these companies stand to gain the most wherever the lights are brightest. Widespread ignorance reinforced by questionable research has much to do with this, no doubt.

But there's something else going on here, too. You get the feeling someone who says "Then send your wife and kids into the darkness and see what happens, or ask a rape victim what they think" isn't going to be dissuaded by Clark's study or any other study. Dare to question the idea that we need lots and lots of bright lights for safety and, as Martin Morgan-Taylor of the Campaign for Dark Skies

told me in London, “It will often raise quite an aggressive response from people, because it really is the fear of the dark, isn’t it?”

“This most ancient of human anxieties,” explains historian Roger Ekirch, “has existed from time immemorial … Night was man’s first necessary evil, our oldest and most haunting terror.” The reasons—rational, even—that we have feared the dark of night are many: threats from wild animals, attacks from robbers or highwaymen, deadly terrain, and especially fire. Add to those reasons our propensity for irrational fears such as ghosts, witches, werewolves, and vampires and we had plenty of reason to fear the dark. Regardless of which came first—the rational or irrational—as we evolved, those fears were kept intense by the human eye’s limited ability in the dark and our imagination’s vivid ability to see night’s demons all too well. Christianity, which saw Christ as “light eternal” and Satan as Prince of Darkness, further ingrained this view of the world. In the eyes of the church, continues Ekirch, “the devil embraced darkness, literally as well as metaphorically. Night alone magnified his powers and emboldened his spirit. Indeed, darkness had become Satan’s unholy realm on earth.”

But most of us no longer fear attack by wild animals, deadly terrain, or fire at night; nor do we recall our last encounter with a highwayman. And while we love them in movies, we don’t normally fear meeting witches, ghosts, or werewolves in the dark—or at least, we don’t admit we do.

No, now we fear each other.

Three miles northwest of downtown Winston-Salem, North Carolina, the campus of Wake Forest University, a highly ranked school that is home to more than seven thousand students, lies embraced by quiet residential neighborhoods or estates on all sides. This is where I work, where I experience night’s darkness on a regular basis—leaving my office on a winter’s early evening, returning after dinner to hear a visiting speaker, walking with Luna. A leafy tree canopy made of magnolias and maples, dogwood and pines, covers walkways and streets and pedestrian squares, the brick buildings made in the Georgian style. Wait Chapel rises at the north end of the main quad, spotlights on its steeple, while other lighting includes both the old and the new: security lights and wallpacks and cobraheads, but also fully shielded streetlights, “dark sky–friendly” acorns, and other attractive Victorian fixtures. A recently commissioned report on campus lighting states as a goal to “continue the intimate feel of campus.”

“And that means a balance of darkness and light,” says Jim Alty, vice president for facilities. “If you want to be out with your girlfriend, or if you want to talk with a colleague or classmate, you don’t want to be in a brightly lit space that’s making you squint. So our idea is to offer pathways that are well-lit but, once you get away from the pathways, not trying to make it look like Times Square.”

Конец ознакомительного фрагмента.