6

Body, Sleep, and Dreams

Night shift is an entirely different way of life that few people who have not experienced it can understand. We live in a state of fatigue that most people never know, or would want to know.

— Matthew Lawrence (2011)

Far from the natural darkness of any desert canyon, more Americans than ever before face the dangers of our increasing dependence on artificial light. For Matthew Lawrence and some twenty million others—a total that grows every year—the pain of working at night is a daily reality. While not all work Lawrence's 11:00 p.m.–7:00 a.m. shift, all work hours that normally find the rest of us home in bed, or at least home. It's a situation that has scientists increasingly concerned as they unravel the litany of ailments affecting those who work at night—a situation that has the potential to radically alter our relationship to artificial lighting and darkness. But while the World Health Organization's International Agency for Research on Cancer (IARC) now lists night-shift work as a probable carcinogen, and researchers have linked working at night with ailments such as diabetes, obesity, and heart problems, the truth is that nearly anyone living in the developed world is subject to the potential effects of electric lighting at night.

Having evolved over millions of years in light days and dark nights, it's only suddenly, within the past century or so, that we

have disrupted this ancient rhythm. Those who work at night often do so amid constant electric light. But just by going outside at night, we expose ourselves at every turn to streetlights, parking lots, flashlights, signs. In our homes we burn our lights—including television, computer, and tablet screens—right to the moment (and for many, even after) we close our eyes.

The potential consequences of our exposure to all this light at night, scientists say, are enormous.

Take sleep, for example, or rather our lack of it. As Steven Lockley of Harvard Medical School's Division of Sleep Medicine tells me, "At the moment, we worry about diet and exercise and smoking and alcohol as risk factors for our health. As we learn more about the impact of poor sleep, it may outstrip them all." Sleep disorders are now arguably "the most prevalent health concern in the industrialized world," says the University of Arizona's Rubin Naiman, with ramifications that reach throughout society. What does sleep have to do with artificial light and darkness? Close behind the increasing recognition that "every major disease is associated to some extent with short sleep," says Lockley, is the fact that "short sleep also means long light."

Long light—electric light burning into and sometimes through our nights—is a fact of modern life, but we have only begun to make sense of its effects on human physical health. As recently as 1980, medical wisdom held that humans were immune to any effects from electric lighting. New research suggests that far from being immune to the effects of light at night (LAN), humans are highly sensitive, and that in fact when it comes to disrupting our sleep, confusing our circadian rhythms, and impeding our body's production of the darkness hormone melatonin, LAN has the power to dramatically—negatively—affect our body's ancient codes. We increasingly understand that "exposure to light at night is a completely unnatural and alien experience," explains Lockley. "And

our brain thinks it's daytime, because our brain has not evolved, ever, to see substantial amounts of light at night."

Because we have changed our nights so rapidly, so recently, results from the enormous ongoing experiment we are conducting on ourselves—and most intensively on those who work the night shift—are just beginning to emerge.

During the past two decades, as the service industry has exploded in the United States and around the world, more and more people have started to work at night. Most have no choice—their employers (from restaurants to convenience stores to factories) benefit from staying open after dark, or they work in a public safety field (police, hospitals) that society requires 24/7. In developed countries around the world nearly 20 percent of the working population now works at night. While some of these workers profess to be night owls, studies show that fewer than 12 percent of night-shift workers choose to work at night because of "personal preference." Some (8 percent) choose these shifts because of "better arrangements for family or child care," and 7 percent choose the night shift for the better pay that certain professions offer their night-shift employees. But the vast majority of night-shift workers take these shifts because they have to, and thus place themselves at greater risk for physical, emotional, and mental pain and illness. At times for our safety but more often for our convenience, millions of predominantly working-class Americans pay the price for our addiction to light.

When I first spoke to Matthew Lawrence, he explained that, like many schools, Wake Forest has recently moved to a new cleaning system that asks each custodian to do one task repeatedly (as in, again and again and again) rather than be responsible for every cleaning task in a certain building. For example, an employee

becomes "the vacuum specialist" or "the bathroom specialist." Lawrence says management is doing what it can to make the new roles "a profession, rather than drudgery. We're trying to make it into a real profession with real skills and documented achievements and a way to progress, to advance yourself." But he admits that custodial work is "the forgotten career, the forgotten industry." And when I ask if doing the same thing all night gets boring, he jokes, "Yeah, that's why I'm a manager." But then he pauses. "Not just boring but I would almost say soul-destroying, because you go in and put your life's effort into making an area neat and tidy, and you come back and the kids have trashed it again. And the next night they're going to trash it again. Every single day."

I'm thinking about this as I drive to campus just before 11:00 p.m. on a Thursday to meet Lawrence. Simply going to campus at this hour feels odd. Shouldn't I be going to bed right about now? On campus, that's exactly where I imagine everyone I see is headed. That is, except for Lawrence and the dozen custodians gathering in the break room. They look weary already—each shuffles into the room as though he or she has just awoken—and their shifts are just beginning. In fact, they almost certainly have just awoken after perhaps a few hours of sleep. And while Lawrence expresses satisfaction and even pleasure with working all night ("I feel like I own this campus!"), what captures my attention is his description of the physical ordeal that is night-shift work.

"I spent five years with a permanent headache," he explains. "You can be so fatigued, and you really have to learn how to manage it, even down to how to breathe. People on the day shift, they breathe all the time, and they don't even think about it. But when you've got to slug it out and keep moving all night long, you even begin to manage how you breathe and move your arms and legs. And sometimes you get so fatigued....I would lie down on my bed and immediately hit REM sleep and dream psychedelic fantasies and wake up an hour later sweating and my heart pounding like

I had been for a run. That can't be good for you, right?" About his employees he says, "It's beating them up. One or two say it's the best thing, but for a lot of our people it's just very tough."

I tell Lawrence how this makes me think about my love for night, and how the night I love is a voluntary night—I get to choose when to stay up and when to sleep. But..."

He interrupts me with a chuckle. "To be bound to it with chains? It's a different story."

I hear a number of those stories as I follow Lawrence on his rounds. The first is from Joe, a veteran of third shift for the past thirteen years. When I ask how he likes it, he sighs. "Like it? It's okay. It's where the job is. I am trained in music, Christian education, and that never paid well enough. It's a mind-set, pretty much. You either fight it or you say this is what it is and you go with it. See, I work a part-time job also, in the mornings. So I go to bed around two and get up around nine. A lot of time when everyone else is enjoying a beautiful afternoon, you can't. I wake up a lot of nights before coming here and think, Oh, you gotta be kidding me."

A heavyset woman in her fifties, Sherry has done custodial work at the university for eighteen years, but has only worked the night shift for the past two. "It's been a real challenge," she admits. "It's sucked." But then she says—and I will hear this phrase often tonight, said with varying degrees of resignation—"You get used to it." When I ask what's the hardest part of the job, she doesn't hesitate. "Sleeping in the daytime is the hardest part. My sleep is broke up. Like I go home and try to sleep two or three hours, then I get up, and then I try to lay back down in the afternoon, and that's the hard part. Sundays are really hard because your whole family's together and all of sudden you have to go to bed. I look forward to Friday and Saturday night so I can get my sleep. I look forward to going to bed. It's my best sleep. A lot of people can't sleep on their nights off, but I can really wreck out."

The toughest hours of the night shift, she says, are from 2:00

a.m. to 4:00 a.m. ("Yeah, that's true," adds Lawrence. "Because even if you were partying at night, that's when the party would be over.")

"How do you get through?" I ask.

Sherry says, "Oh, you got so much work that you just can't think about it."

That may be true, but, as Charles Czeisler, professor of sleep medicine at Harvard Medical School, explains, "You can't just order people not to be exhausted when they're working at night." Unfortunately, in our 24/7 society, where airline, automobile, and train traffic continues through the night, that's exactly what's happening. Authorities increasingly cite exhaustion from working the night shift as causing—or nearly causing—catastrophic accidents.

Here are just a few examples. In 2010, an Air India flight carrying 166 passengers crashed upon landing, killing all but eight people onboard, and investigators suspect the pilot was suffering "sleep inertia" after having just awoken from a nap. In 2011, two planes heading toward Reagan National Airport in Washington, D.C., landed without air traffic controller assistance after the controller fell asleep while on duty. He'd been working his fourth consecutive night shift of 10:00 p.m. to 6:00 a.m. The same year, a tractor-trailer slammed into an Amtrak train in Nevada, killing eight passengers, and authorities suspect the truck driver had fallen asleep at the wheel. In 2009, investigators of a crash that killed ten people along I-4 in Florida found that the seventy-six-year-old driver of the tractor-trailer that slammed into several other vehicles never applied his breaks, and blamed a devastating blend of sleep loss, shift work, and sleep apnea. Estimates are that some two million Americans fall asleep while driving on the highway at night, and that 20 percent of automobile accidents occur as a result of sleepy drivers. Those "rumble strips" at the edges of the road? They really ought to be called "wake-up strips" in recognition of their primary purpose.

Headlines like "Fatigue Likely Cause of Fatal Train Crash" are becoming common enough that after a 2011 crash of a coal train left both the engineer and conductor dead, the National Transportation Safety Board (NTSB) issued a report urging the Federal Railroad Administration to take significant action to address the problem. "The human body is not designed to work irregular schedules," said NTSB chairman Deborah Hersman, "especially during the circadian trough." This "circadian trough" refers to the time between midnight and 6:00 a.m. when our bodies have the least energy and alertness—for most of us those hours from 2:00 a.m. to 4:00 a.m. that I'd heard about from the custodians at Wake Forest. Chuck, a thirty-five-year veteran locomotive engineer, explains that trains hauling hazardous material through sleeping communities are often being driven by exhausted men who haven't slept in hours. "If you find a locomotive engineer who tells you he hasn't fallen asleep on the job," Chuck says, "you'll be talking to a liar."

Exhaustion is one result of confusing our body's circadian rhythms, which evolved to the natural rhythm of bright days and dark nights. Circadian (meaning "about a day") rhythms reset approximately every twenty-four hours and control not only our sleep/wake cycle but many aspects of our physiology, behavior, and metabolism, including hormone secretion, body temperature, blood pressure, and other subtle internal rhythms. The brain synchronizes these rhythms based on signals sent by light hitting photoreceptors in the back of the eye, signals that for tens of millions of years could only mean the presence or absence of the sun, and what season it was. In short, light tells the human body to wake up, while also setting our internal clock to expect an eventual period of darkness that will signal a time to sleep. When we're exposed to electric light at night this clock is confused, with exhaustion one of the many consequences.

If you've ever pulled an all-nighter or suffered jet lag, disruption of this clock is what you're feeling. The difference between those of us who occasionally struggle through this feeling and those who

regularly work the night shift is that they subject their bodies to this experience again and again, never giving their internal clock the chance to regain its natural rhythm. As if the resulting exhaustion weren't bad enough, scientists have found it only one in a long list of health problems suffered by those who work at night. "What we're also doing is messing with our internal clock organization," says Steven Lockley, who explains that each of our individual organs has its own clockwork and its own rhythm. "So that means there's a master clock in the brain, the conductor of the orchestra, if you like, and all of the different organs of the body are trying to play the same tune. They're being kept in time by the master clock, but they also keep their own rhythms to make sure the local function is correct. And so, disrupting these internal clocks is likely to be an unhealthy thing to do, because it's going to mess with how the systems have evolved to work together efficiently. And when we start to mess around with these systems, there is more risk of them going wrong."

How might they go wrong? In addition to exhaustion and its resulting increase in sleepiness-related accidents and injuries (including the crashing of trains and smashing of semis, flipping of trucks and bashing of boats, and plenty of rolling of speeding automobiles), Harvard epidemiologist Eva Schernhammer reports that "increases in cardiovascular risk, peptic ulcer disease, a higher abortion and miscarriage rate as well as lower pregnancy rates, higher rates of substance abuse and depression... and higher body weight due to abnormal eating habits... have all been reported in shift workers."

The people most at risk seem to be those who work a "rotating" schedule—the night shift sometimes, the day shift other times—rather than those who maintain a regular night-shift schedule. It's the switching back and forth between sleeping during the day and sleeping at night that prohibits the body from adapting and thus hinders the body's circadian rhythms from adjusting to a new schedule. But consider that the vast majority of those who work a steady night shift revert to a normal day/night sleep schedule on their days off, further confusing their circadian rhythms. Says Harvard's Lockley, "The clock can't adapt quickly enough. It takes about a day to shift an hour, on average. So if you go from a day shift to a night shift, it's a twelve-hour shift, and it will take you at least twelve days to fully adapt. Then when you go from a night shift back to a day shift, it takes you twelve days to go back. And of course very few people work twelve night shifts in a row. Usually they have days off, and on days off they tend to go back to what they did in the daytime." As a result, says Lockley, "Essentially, no night-shift workers are ever adapted to their night schedule."

Consequently, night-shift workers are often awake during their biological night, a time when their physiology is sending them to sleep. It's worth dwelling for a moment on what this means: This biological drive to sleep isn't something about which we have a choice, and it's not something we can overcome. We can try—guzzle gallons of coffee or energy drinks, muster a chipper attitude or brute sheer will—and it might work for a few hours. But, eventually, sleep is going to win.

And, in going to battle every night with our need for sleep, eventually our body is going to lose.

"The question 'Why do you do this work?' is kind of a moot one, isn't it?" I say to Lawrence after we've made our first stops.

"It's true, they don't see that they have an option in this economy," he says. "But most people are doing it for the sake of their family and their home life."

I hear this from several night-shift custodians, including Lawrence ("I love it," he claims of working all night. "It's the only way of life I have found so far that allows me to meet all the needs of my family"). I hear especially from women that their main reason for working at night is that they can be with their family during the day. As one woman tells me, "It plays havoc on your body. I lost

thirty pounds from the start, and I didn't have it to lose. It makes your body feel run-down, tired, exhausted. But I also have a family, and so I try to get back to a regular schedule on the weekend."

"Have you adjusted?" I ask.

"I don't think I ever will."

Ironically, women who work the night shift actually have much higher work-family conflict than women who work only days. You might think that their being home during the day would help smooth things for their families, but most people working the night shift have spouses who work the day shift, which dramatically cuts down time spent together. Even when they do spend time together, the spouse working the night shift is often exhausted. Although some whom I spoke with joked about it, like the nurse in Nevada who told me her husband thought they got along better because they didn't "see each other as much," I heard the admission that the situation was "difficult at times" far more often.

"I worked first shift for sixty-five years," says a gray-haired man named Mr. Singletary. "But now I'm supposed to flip this body, make it turn into the graveyard shift—and now I know why they call it the graveyard shift. When everybody's asleep, I'm wide-awake. Eating habits, out the window. I don't have breakfast no more—when I'm getting home my wife is already gone to work." Mr. Singletary reminds me of my grandfather—it's not only his age but how he chuckles to himself after nearly every phrase. As though Lawrence and I aren't standing a few feet away, Mr. Singletary wonders aloud about how he will find time to mow the church lawn, the local football field, and his own yard.

"You're just going to have to give up sleep," I joke.

"I'm going to have to figure out something," he says, sighing. "I'm not sure how I'm going to do it." And then, more quietly, "God will show me a way out of it. He will show me a way."

Like many of the other custodians working the night shift at this well-known southeastern university, Mr. Singletary is African American. The custodian who tells me he's "used to it" because he worked from 5:00 p.m. to 5:00 a.m. for years at the local peanut factory? African American. The woman who tells me that for eighteen years she's existed on sleeping two or three hours a day? African American. The man who tells me simply, "Some people's not cut out for third shift"? African American. When I ask him what it feels like, he pauses. "You ever worked third shift before? Okay, well. Wouldn't do me no good to explain it to you, then."

Here lies another truth about night-shift work: Certain segments of our population bear its burdens more than others. Nearly 20 percent of African Americans in the United States work the night shift, for example, and more blacks work it than whites, Hispanics, Latinos, or Asians. In addition, poor and disenfranchised city neighborhoods are often brightly lit in an effort to deter crime, and poor and minority populations disproportionately fill the increasing number of third-shift jobs. As scientists affirm the connections between the flood of electric light at night and a long list of health problems, working the night shift stands to become another public health issue that certain segments of our population will deal with—and suffer from—more directly than others.

By the end of my time with Lawrence, nearly 1:30 a.m. on a day on which I woke at 7:00 a.m. and worked my usual schedule, I have grown so tired I can't concentrate on either my questions or the custodians' answers. I can't keep from yawning, either, and when I do they are jaw-stretching yawns that bring tears to my eyes. I'm reminded of a nurse I know who, when she drives home after working all night, closes her ponytail in her car's sunroof so that her head will be jerked upright if she falls asleep at the wheel.

Not to take anything away from exhaustion, obesity, diabetes, cardiovascular risk, or higher rates of abortion, miscarriage, substance

abuse, and depression (to name just a few possible night-shift-sparked sufferings), but it is cancer that scares most of us most, and cancer that may finally get our attention about light at night.

An increasing number of studies over the past two decades have made a compelling case for a link between light at night and cancer, especially hormone-influenced cancers such as breast and prostate. Specifically, it seems that light at night disrupts—that is, suppresses—the body's production of melatonin, which the human body produces only in darkness, and that melatonin plays a key role in keeping these types of cancers from growing. Light from the moon, stars, candles, or fire—none of these are bright enough to cause this disruption. Only electric light does the trick.

This means, for example, that if you get up in the middle of the night and flip the bathroom light switch, no more melatonin. You may be thinking "toilet seat," but inside your brain your pineal gland is thinking "daylight!" None of the scientists I spoke with is willing to say light at night gives you cancer—it will take more studies and data, more thought and consensus. But the research seems headed in a clear direction.

The first published suggestion of a connection between light at night and cancer came from Richard Stevens in 1987. Stevens tells me he literally saw the light when he woke one night in his Richland, Washington, apartment. "I realized that I could almost read a newspaper from the streetlight coming in," he says. "And just by luck, I knew a guy in town who was doing work on light and melatonin, and then I knew another guy doing work on hormones and breast cancer in Seattle. And that was it. I asked myself, What is a hallmark of industrialization if not lighting the night?" This moment led him to develop the light-at-night theory for breast cancer, which he describes in the following way: "increasing use of electricity to light the night leads to circadian disruption which accounts for part of the breast cancer burden in the modern world and rising risk in developing countries." In turn, this theory led him to two key predictions: Because they are

exposed to artificial light through the night, women who do shift work should be at higher risk, and, conversely, blind women should be at lower risk. Both predictions have since been supported.

In the early years, Stevens found more skepticism of than support for his theory, a period he describes in his article "Electric Light Causes Cancer? Surely You're Joking, Mr. Stevens," a well-told chronology of the "journey...from electric light to breast cancer." But in 2001 he was among the authors of two papers in the *Journal of the National Cancer Institute* that showed "a significantly increased risk of breast cancer in women with a history of night work," an event that Stevens calls "the turning point for the LAN/breast cancer topic."

Next, two important developments took place, one that would demonstrate the dramatic effects on tumor growth by the presence of melatonin in our blood, and another that would show the precise wavelengths of light that maximally suppress melatonin.

In the first, David Blask did key research, published in 2005, showing that human blood taken during the night in the dark (and therefore high in melatonin) slowed the growth of human tumors growing in rats, whereas blood taken during the day or at night after exposure to light (and therefore low in melatonin) did not slow the growing cancers at all. The consequences are that suppression of melatonin by exposure to light at night may then increase cancer growth rates if you already have a tumor, or may increase the risk of one developing. "This experiment," explains Stevens, "is as close as ethically possible to a direct test of whether LAN influences breast cancer growth in women."

A few years prior to Blask's work, in 2001, research spearheaded by George (Bud) Brainard of Jefferson Medical College determined the wavelength of light that most affects melatonin production in human volunteers to be blue. This finding complemented an amazing discovery, published in 2002, by David Berson and colleagues at Brown University, of a new photoreceptor cell in the ganglion cell

layer of the retina—a part of the eye that was thought not to be light-sensitive—the first such discovery in 120 years. When isolated in a petri dish, this cell also most strongly responded to blue light. Because we have studied the human eye for thousands of years, we thought we knew everything about it, including how it detected light. Essentially, we believed that there was only one pathway through which light was directed to the body, and that this was through the rods and cones that give us vision. But Brainard's experiments were inconsistent with this understanding; there had to be a whole new way of detecting light for the circadian system, separate from vision. The newly discovered cells, called intrinsically photosensitive retinal ganglion cells (ipRGCs), had nothing to do with vision per se but rather were dedicated to detecting light to determine the time of day and time of year, and in the process, resetting circadian rhythms. Brainard found that while "any sort of light can suppress melatonin... light composed of blue wavelengths slows the release of melatonin with particular effectiveness." The new photoreceptor cell's peak sensitivity turns out to be at a wavelength of about 480 nm, which happens to be the color of a clear blue morning sky. In evolutionary terms, that our body's ability to know day from night is highly sensitive to this wavelength makes perfect sense.

The problem is that everywhere in the world—in our computer screens and tablet screens, in our indoor and outdoor lighting—we are using more and more blue light. More than 1.5 billion new computers, televisions, and cell phones were sold last year alone, and incandescent lights are being replaced by more energy-efficient, and often bluer, LEDs. "Blue" light refers to one place on the spectrum of light, and we see (or sometimes don't—think x-rays or infrared light) different colors of light because of their different spectral makeup. Unfortunately, it turns out that the wavelength of light that most directly affects our production of melatonin at night is exactly the wavelength of light that we are seeing more and more of in the modern world.

If these links prove true, the ramifications could be huge. For example, imagine if we can link the blue light of computer or television screens at night to breast cancer, the causes of which continue to befuddle scientists. Each year in the United States alone some two hundred thousand women are diagnosed with breast cancer, and some forty thousand die. Says Richard Stevens, "It could be twenty or thirty percent of breast cancer. I'm not saying it is, but it could be." George Brainard agrees: "Even if lighting is at the root of only ten percent of breast cancer cases, what we learn may help thousands and thousands of women."

While these new findings about blue light may in time lead us to change our ways, in the end, researchers caution, the root problem is not the type of light but the fact that it's there. As Steven Lockley says, "People are now concerned about the type of light, rather than being concerned about the use of light at night overall. They're missing the point. Blue LEDs or white LEDs have a place. Other lighting has a place. But all of it has to be reduced at night. They're worried that if we change to LEDs, lighting will become a problem. The problem's there already, however, because our nights are not dark."

While night-shift workers suffer the most extreme examples of circadian disruption, light exposure at night has the potential to affect everyone living in industrialized society. For example, Schernhammer found that it's not only women who work the night shift who have lower levels of melatonin but women in general (and men—other studies have linked LAN with increased rates of prostate cancer). That is, even if we're not working the night shift, we are staying up later, exposing ourselves to light at night in ways that our bodies haven't evolved to handle.

The question is how much—or little—light does it take to confuse our circadian rhythms and disrupt our production of melatonin? Are we endangering ourselves even in our homes, even in our bedrooms? Does merely sleeping with artificial light coming through

the window or seeping under a closed door spell trouble? Researchers warn that while it has been shown that levels of light produced by bedside lamps, computer screens, and tablet displays are detected by the brain and suppress melatonin, the direct evidence linking light pollution and health is in its early stages.

When I ask him about this, Stevens agrees. "Before 1980 it was thought that humans were different, we were not susceptible to light at night no matter how bright, that melatonin rhythm was just fine. Then in 1980 there was a seminal paper in the journal *Science* that changed everything. But that was with very bright light. The amount of light at night that the scientific community agrees can suppress melatonin in people has been going down, down, down. But we don't know whether chronic very low light coming in from the streetlights or whatever, we don't know what effect that has."

We haven't begun to understand all of the health effects of our living amid the flood of light at night, a flood most of us are so used to we don't question it. But if we could clearly say that electric light at night gives you cancer, or at least harms you, the whole situation changes. I asked Harvard's Lockley if he thought that, based on what we know now, it was fair to think that these connections exist.

"I think that is fair. As a scientist, I can only report what is found experimentally, and those experiments have not been done. And that's why I use the terms 'possible' and 'likely.' But the multiple shift-work studies that have shown a link, coupled with the laboratory data, are good evidence to believe that there is a link even in the absence of an unequivocal clinical trial. The WHO [World Health Organization] classification as a probable carcinogen is as high as you can get without actually proving, beyond a shadow of a doubt, that shift work causes cancer."

Of course, we know some causes of cancer. We have no doubt that asbestos causes mesothelioma, for example, and that's why WHO ranks it a Type One risk. Type Two risks—the level at which the WHO has placed shift work—until recently included

breathing diesel fumes or being exposed to UV light, both risks that have since been moved to Type One.

Researchers only hesitate to identify shift work as a Type One risk because there simply is not a test we can do to measure its effects absolutely. Yet we accept the connection between UV light and skin cancer enough to support a sunscreen industry worth some $650 million worldwide, even though, as Lockley says, "It would be unethical to do a study where people are purposely given UV light to see if they get cancer."

Regardless, he says, "even if I can't prove to you right now that that light through the window does you any harm, there's no need to have it. Why take the risk?"

From Interstate 694 in the outer suburbs north of St. Paul, Minnesota, I exit toward the bright red "Emergency" spelled across a dark brick hospital building. Under the parking lot's high-pressure sodium pink-orange lights a woman pushes a man in a rickety wheelchair, while two teenagers in the car next to me pump death metal out their open windows. In the waiting room, bloated blue ankles emerge from a patient's print dress, the floor shines with fresh ammonia scent, and three teenage girls giggle in the corner. At the reception desk a small blond woman answers the phones and presses blinking buttons while two enormous male security guards shift their bellies back and forth in tight black uniforms and watch for trouble.

Ever since I'd started reading studies linking night-shift nurses and breast cancer, I'd had the idea to visit an ER. I wanted to hear from nurses what it was like to work at night, and I wanted to ask if they knew about the studies. I thought it ironic that the most well-known cases of night-shift workers and the effects of light at night focused on health-care professionals. And, having spent time with campus custodians, I was curious to spend time with people who probably had more choice about working at night than they do, and who certainly were making more money.

Soon the ER doors swing open and my host, Michelle, a nurse for twenty years, takes me first to drop my jacket in the staff break room, where coffee, slushies, energy drinks, soda pop, and cookies stand ready to transport me through the night. This ER has thirteen rooms (though no bed #13) in a square, the nurses' stations and doctors' desks clustered in the middle. White coats and tennis shoes, people staring into computer screens. Near the ceiling on each wall a digital bulletin board tracks admitted patients, ranking each 1–5, with 1 meaning "you're dying," says Michelle, 2 meaning "you're really sick" ("chest pains are 2," she explains), 3 meaning "pretty typical—you need to be seen urgently," and 4 and 5 meaning broken bones and other minor wounds. The board helps everyone know what things need to be done and are being done, Michelle says. So far tonight, there are no 1s.

A forty-three-year-old mother of two, Michelle is a blond Minnesotan of Norwegian heritage. In comfortable scrubs and a light brown sweater, a necklace of ID cards, and a stethoscope around her neck, Michelle tells me she loves working at night and always has. "Before I had kids, I was a professed night owl. If I was in the middle of a book that I couldn't put down I would be up all night reading until five thirty in the morning and I would jump when the paper was delivered. I was always a night person."

The notion of the night owl is one I've heard from a number of people, but no one has professed it as freely as Michelle has. ("Not everybody has a love affair with nights like I do," she admits.) But what about this? Are some people built to be up all night? It turns out there is some truth to the notion (and its morning-loving opposite, the "lark") in that the length of the biological clock varies somewhat from person to person. For example, some people have a clock that cycles closer to 23.8 hours, while others cycle at closer to 25 hours, with the former tending to be morning types and those with a longer cycle tending to be evening types.

Age has a lot to do with this, too. One classic example: the difference between a nineteen-year-old college student's epic struggle to get to a 9:00 a.m. class, and the relative ease with which his fifty-year-old professor who's been up since 5:00 a.m. gets there. It turns out that it's actually natural for teenagers to want to go to sleep at two, three, four in the morning, which means that making them get up for school at seven in the morning is the equivalent of making a forty-year-old get up at three o'clock every day—in other words, cruel. That said, the fact someone might be a night owl doesn't make her immune from the effects of staying awake all night. "There are individual differences," says Steven Lockley, "and some adapt better than others. But virtually no shift worker is properly adapted. They might be slightly further down the continuum (of circadian disruption) than the people who are not as able to adapt to shift work, but they're still being affected."

"Tell him what you honestly think," Michelle says as she introduces me to Chris and leaves to check on patients. "I paint a pretty glorious picture of the night shift." Chris, a forty-year-old nurse in pale blue scrubs, tells me she likes working nights, too. At least, she did until her hours were changed two weeks ago, from 7:00 p.m.–3:30 a.m. to 9:00 p.m.–7:30 a.m. She's been miserable since. "The other night I thought I was going to die," she says. I tell her that's certainly how I would feel with her schedule. But isn't she used to it? "I've worked nights for twenty-one years," she says. "And I think it's just a neurotic way to live. I don't think it's normal. For instance, I have diabetes, so I probably would be in better health if I didn't work nights. My physician has certainly told me that. It's really not normal. I don't think it's very good for you. If I'm up all night, I notice my blood sugar is different. And when do you take your meds—do you take them like you're a day person or a night person? So that's been a big issue. Another thing, your motivation really goes down. I've been saying I want to go back to grad school for about ten years. I'm able to function in normal daily living—wash

the dishes, clothes, drive my kids around—and I don't feel like I'm forgetful necessarily, I just don't feel like doing a lot."

"See, I don't know any different," says another nurse, Marilyn, who's come over to join us. "I started for convenience reasons, for daycare, when my kids were little. Now I just like the hours better. I have no trouble sleeping during the day. As a matter of fact at this point I sleep better during the day than I do at night. But I don't have little kids at home anymore."

"You're not worried that a four-year-old is going to burn the house down?" Chris laughs.

"No, I am not worried." Marilyn smiles. "Me and the dogs sleep all day together. I could care less. I've adjusted to it, I think. It is a very different lifestyle. People who have not done it don't understand. My kids, it's all they've ever known. To have a mom home every night and weekend would be weird to them. It's how we've always done it."

"I do it for convenience reasons," Chris says. "I'd say money is not a good motivator for night-shift people."

"Oh, no, no, no. Money has nothing to do with it," Marilyn says.

"Some people say, 'Oh well, you night people, you make a better wage than we do.'"

"That's not why we do it."

"It's not worth it," says Chris.

"It's not worth it," Marilyn echoes. "The people who do it want to work those hours. Nobody does it for the difference in pay, that's for sure. That does not make it worth it, trust me."

Chris leaves us (she's the triage nurse tonight, and it's time to update the digital bulletin board), and I ask Marilyn what *does* make working nights worth it.

"I love the atmosphere, the different personality of the people who work at night. The teamwork is better because there's fewer people here. It's more laid-back. We don't have administrators running all over. Plus," she says, "I'm in awe of people who can get up at five a.m. and go to work. I would rather stay up all night than get up at five a.m. And I also love to be home during the day and do my shopping when everybody else is at work."

Amid the various flashing lights and beeps, intercom requests, and swirl of voiced questions and requests making the ER night's soundscape (though, I notice, there is no background music—and not that I necessarily expected it, and what, after all, would it be?), an unseen woman's pathetic wail rises again and again. None of the ER nurses or doctors seems to notice. When a man shouts, "Shut the fuck up!" Marilyn pauses. "That's her husband talking to her, I believe," she says quietly.

"I mean, you do feel tired," she continues. "And a lot of people say they didn't realize how bad they felt until they got off nights. I've had people who have worked nights for a long time tell me that. You have to make yourself get up and get going. You could lie around and be tired all the time. You just make yourself plug on. I mean, I've worked only nights for twenty years, and I know I'm going to be tired because I work nights. You just get used to being tired."

I hear this often from those who profess to prefer nights, or to at least be "used to" them, But however true the night owl idea, the biological truth is that owls are owls, and humans are humans—and unlike the nocturnal bird, we have not evolved to be up all night. As Jeanne Duffy at Harvard's Division of Sleep Medicine has said, "You can't override your biology."

That does not keep us from trying, of course.

"Well, we eat terrible," says Marilyn, referring to what is one of the toughest biological challenges to working all night. "I went to the doctor the other day and they asked when did you last have a meal, and I said, 'Three a.m., I ate dinner.'"

When Marilyn goes back to work I make my way over to talk with Steve, the charge nurse, who has worked the night shift for more than thirty years and, one of the other nurses will tell me,

sometimes jokes, "I'd be a hundred pounds lighter if I didn't work nights." Steve will turn sixty this summer, and, yes, Steve is a big guy.

"I do think there's an issue with weight," he says. "When I entered the field almost forty years ago I was a skinny kid. And trying to keep the weight off is pretty tough. I don't know if it's cortisol or what. I find when I work more nights I'm hungry all the time. And that's not as true when I'm working days."

Nearly every night-shift worker I talked with admitted this challenge. When it's slow you eat to stay awake, and when it's busy you don't have time to eat well, so you just grab "a bag of chips or whatever." As though orchestrated for my visit, in the break room while I talk to Steve one of the security guards is raiding the cookie tray.

Harvard's Lockley cites eating in the middle of the night as a good example of "messing with our internal clock," in this case our metabolic rhythms. "If you eat pizza at two o'clock in the morning," he says, "you're more likely to get more indigestion than if you eat the same pizza at two o'clock in the afternoon. And that's because our body clocks have not timed our digestive responses to be maximal at night; they're maximal in the daytime." So, if a person eats a meal at night, "you're eating at a time when your biology is not able to metabolize the food properly, and so you end up with chronic elevation of insulin, glucose, and fats—which are risk factors for diabetes and cardiovascular disease. And shift workers have those increased risks."

In my visits with those working the night shift nearly everyone admitted to the difficulty of fatigue, but few—even those in health care—were aware of the research indicating that fatigue was only part of the story. As the clock crept past 1:00 a.m. and I waited for Michelle to return to her desk, I thought about a discussion I'd had with a nurse from Albuquerque named Catherine. I'd asked her if she ever talked about the risks with her co-workers.

"No," she said. "Nobody talks about anything like that. In fact, I don't have a problem telling my boss that I want a day shift whenever one comes available, but telling her that it's because I feel like I'm more at risk for breast cancer or whatever—she would look at me like, 'Huh?'

"In my profession it's an expectation that you will work nights," she continued. "Not forever, but in nursing it's just part of the culture that you work nights first. And then once you build seniority, you can apply for day positions as they come open. I never questioned the repercussions of it, because wanting to do hospital nursing, it's just something that goes along with that career choice. That's not really a justification for not being aware. But it's just part of the job."

The difference between Catherine and others I talked with is that she had made herself aware of the risks by reading some articles another nurse had sent her. A single parent in her early forties, Catherine has been struggling working at night. "For the last several months I've been having more and more difficulty, feeling more out of balance. I don't know if you've ever had the experience of having a washer go out of balance. And it goes round and round, it's just flinging around out of balance. That's how I feel a lot of time, like I'm getting swung around and never can get back into a balanced cycle. And at the same time I'm feeling really like I want a change, but I'm not able to justify the money, because it is quite a bit more money—and so feeling that I just need to suck it up. But reading the articles really gave me that extra little bit of information that helped me reach my tipping point and say, There is a reason why I'm feeling this way. There's a reason why I'm feeling depressed. There's a reason why I'm so exhausted and not feeling well many times and many days. And it's not worth the money anymore."

It's the stories of exhaustion that stay with me. Part of that is because in my visits with night-shift workers I have dipped my toe

into how they must feel—my jaw-stretching yawns at the end of my custodial visit come to mind—but most of it is just hearing what these folks endure.

"What would be the best way to describe it?" says another nurse, Heather, when I ask what she means by feeling "all messed up." "It's like I'm there and I know what I'm doing, but two hours from now if I look back, I'll be like, *Gosh, did I do that?* It's like I can't remember. I feel like I'm there but I'm not completely there. Like, it's scary as hell to be driving home in the morning. You get home and you don't even remember driving home. It's like, *Yeah, that's probably not a good thing.*"

Catherine admitted to me that she carries a prescription drug to keep her awake. "That's another reason I don't like this schedule. Because I feel like I have to take things to stay awake, and then I also have to take things to stay asleep, even times when I am just completely exhausted. I think the worst time in general that's consistent for me is when I'm driving home. My drive home is about a half hour, and I feel like it's really dangerous. There are days on a regular basis where I almost fall asleep at the wheel."

Spending time in the ER makes me wonder how the night shift will change—if it will change—if more and more evidence pointing to serious health issues begins to accrue. Certainly we have a need for night-shift workers, in fact we as a society demand it. (As Michelle tells me, "You can't just say, 'Oh, you're dying of a heart attack? Sorry, the hospital closed at 10:00 p.m.'") But how much of the risk endured by those on the night shift is simply the result of convenience or profit? How much is a result of it being the easiest way for administrators to get things done, or of outdated traditions, such as scheduling resident physicians to work thirty-hour shifts twice a week?

"We may be at the same stage now as we were in the 1950s with smoking," says Steven Lockley. "In the fifties, a few people thought smoking was bad, but there wasn't publicly available evidence at

that point. It's only over the next thirty or forty years that evidence accrued to show, without doubt, that smoking causes lung cancer. Thirty years ago it would have been impossible to think of smoking being banned in public places, would have been laughed at. But that has happened. And it's happened because of the secondary effects of smoking on other people. You have the right to smoke yourself to death if you like, but you don't have the right to kill somebody else with your smoking. And so society has decided that those risks, those secondhand risks, are worth legislation and that we'll all now have to abide by them.

"The same could be true of lighting or sleep loss," he says. "The light from my neighbor's yard may cause me problems, just like one person's smoking was giving someone else lung cancer. Similarly, shift workers driving home drowsy after a night shift may fall asleep at the wheel and kill themselves—which is itself bad enough—but is completely unacceptable if they fall asleep and kill someone else also driving on the road. The effects of secondhand light or secondhand sleepiness should be considered in the same way as secondhand smoke. It's only this type of thinking that will prompt real change."

"This is what it looks like during the day in here," Michelle tells me, returning to her desk. "The light levels are the same." On cue, a nurse nearby offers a big yawn, then a quiet "uff da" like a good Minnesotan. (Wiki says, and I confirm, "Uff da is often used in the Upper Midwest as a term for sensory overload. It can be used as an expression of surprise, astonishment, exhaustion, relief and sometimes dismay.") Because I know it is, in fact, no longer day in here, I almost expect everyone to be yawning to tears. Then again, it's only 1:45, not yet between 2:00 and 4:00 a.m.—those toughest hours for staying awake—and I don't see it.

The main thing I don't see, though, is darkness, the natural darkness of the natural night. This emergency room has no windows,

and there's no way to know what's happening in the night outside. It feels like a bunker, deep below the real world. And it's this artificial separation from the natural night that I'm thinking of as I leave the emergency room and drive back across the city, seeing the world differently, terribly aware of the bright interiors I'm passing and of all the many people at work inside.

Sleep. We need it like we need food and water. It's a biological need that we cannot overcome—not for long, at least. And yet many, many, many of us are not getting it: seventy million Americans suffer from disorders of sleep and wakefulness, and of these, 60 percent have a chronic disorder. When it comes to insomnia—the inability to sleep—some 20–40 percent of Americans experience it during the course of a year, one in three in a lifetime. In 2005, the National Sleep Foundation found that 75 percent of American adults experienced symptoms of sleep problems at least a few nights per week.

There is no shortage of books on sleep and sleep disorders, but few focus on the importance of darkness for good sleep, and the possible connections between short sleep and long light. Could our dozens of sleep disorders be directly related to our lack of darkness? At times it seems an obvious connection—we have all these sleep disorders and all this light—but a connection the medical sleep profession has been slow to pursue, let alone accept. Though hospitals all over the country have a "sleep center" to assist patients in solving their sleep disorders, few of these centers have been concerned with light at night.

But that may be changing. I spoke with two sleep professionals who argue that our struggle with sleep has much to do with our disregard for the dark.

"The challenge, at least for Americans, is becoming comfortable again with darkness," says Dr. Vaughn McCall, head of the Sleep Center at Wake Forest Baptist Medical Center. "We don't

know what to do with ourselves when it's dark and we're awake." In a thick Carolina accent, McCall tells me he sees "lots and lots" of insomniacs, most of whom stress over the question, "Why am I awake in the middle of the night?" The understanding that this waking was probably a normal part of the human experience, McCall argues, is one we have lost with the advent of electric lighting. "When you look at diaries from the nineteenth century, you get the sense that a hundred fifty years ago, when it was dark people got in bed, and when there was light they got up. They were entrained more or less to the natural photoperiod. People might be in bed for nine or ten hours at a stretch, though not necessarily with the expectation of sleeping all that time."

In fact, that's exactly what historian Roger Ekirch found while researching *At Day's Close*—in western Europe and colonial North America before electric lighting, people went to bed when the day's light ended and got up when it returned, but without expecting to sleep throughout the night. Instead, on most nights they experienced two major intervals of sleep, called "first sleep" and "second sleep," with an hour or more of "quiet wakefulness" between. Ekirch found that "men and women referred to both intervals as if the prospect of awakening in the middle of the night was common knowledge that required no elaboration." In other words, this pattern did not create panic. Instead, people took advantage of these periods of "quiet wakefulness" to converse with their partner, make love, pursue hobbies, or even visit friends. For many, this time of waking offered freedom and opportunity the day did not allow, true especially for women who finally had time to themselves, free from the day's toils and troubles, patriarchal hierarchies, and burdens. Ekirch discovered a second major difference between modern sleepers and our ancestors: "most members of preindustrial households probably did not drift quickly to sleep. Whereas the current time for lapsing to sleep averages from ten to fifteen minutes, the normal period three hundred years ago may have been notably longer."

To my modern ears, having the time and mind-set to hang out in bed for two hours before sleeping sounds pretty great, maybe even a little decadent. A good book—even if by candlelight? A partner you love, and want to love—especially by candlelight, or maybe with a fire in the fireplace? Maybe you're sleeping outside and the night sky has your attention. But in the twenty-first century, it wouldn't be surprising if there were a medical term for this "condition," or if it were perceived as nearly un-American in its lack of productivity. Indeed, for many, being in bed but not being able to get to sleep can cause pressure to build. It doesn't help, McCall says, that sleep has become idealized, like many aspects of human behavior.

"Take sex, for example. TV and movie portrayal of sex can leave a person feeling very inadequate. 'My sex life is not like that; what does that say about me?' And with sleep, if we overidealize sleep and say, 'If you are not sleeping exactly like this, you must have something very wrong with you,' it holds the wrong standard up. We have created wrong expectations."

I sleep pretty well, I tell McCall, although I definitely feel better if I get eight hours. And I have long dreamed of an ideal schedule where I could stay up into the night until about one in the morning, savoring the quiet and solitude of the dark house, lake, or yard... and then get up at five in the morning to enjoy the dawn. I love the late night, I love the early morning, and I wish I could sleep in the afternoon.

"You should move to Spain," he says.

Exactly. And it's a great idea, except that the Spanish tradition of the siesta is melting away under the heat of expectations from worldwide capitalism that we all be open for business at all hours, and certainly over lunch and into the early afternoon. What might this world be like, I wonder, if we were moving in the opposite direction, encouraging people everywhere to take a couple of hours in the middle of the day to savor eating, making love, and sleep?

Unfortunately, that's not the way we're headed. In fact, the second

thing we've done to ourselves, says McCall, is to bring electric light into our private nights, into our bedrooms. "Purely from a behavioral standpoint, that light is the apple in the Garden of Eden that leads us down the road of temptation into doing all the sleep-averse behaviors that we don't need to be involved with, whether it's watching TV or playing on the Internet. With electric lights we have the option of staying up later and compressing our time in bed. And so, suddenly it becomes abnormal to be awake in the middle of the night."

McCall suspects this "option" of staying up later because of electric lights contributes as well to serious sleep disorders such as the epidemic of obstructive sleep apnea. "Usually the primary population risk associated with sleep apnea is obesity. So to the extent that we have an obesity epidemic in the United States, we're going to have a sleep apnea epidemic. Why do we have an obesity epidemic? Lots and lots of reasons. But how does the availability of artificial light impact our eating, what and when we choose to eat? Is this any kind of factor in obesity? If you are living in a log cabin in Minnesota a hundred years ago in pitch-black dark, there's no refrigerator to raid, there's no reason to go get an ice cream and sit in front of the TV."

I'd told McCall about my family's cabin in northern Minnesota. And he's right about the connection between LAN and obesity—research on shift workers has found them at a higher risk of obesity, and a recent study on mice showed this same connection. The problem isn't being awake at night, the problem is being awake at night in the light.

For McCall, this means helping his patients "to be comfortable with being in the dark, not fretting." Because he believes one of the many solutions to insomnia is to make waking in the middle of the night a normal event, he works with his patients to help them change their thinking. "The question then becomes not so much what does this mean, but what do I do with it. This is an opportunity I've been given; what am I going to do with this?"

* * *

For the University of Arizona's Rubin Naiman, the epidemic of sleep disorders is an opportunity to revise our attitudes toward night and darkness. We meet at a restaurant in Tucson, where Naiman makes his home amid the giant saguaro cacti of the surrounding Sonoran Desert. Picture a tall-backed booth with a rustic wood table, two bowls of miso, and two bowls of stir-fry. I know him immediately from his photo—the head of white hair and white goatee give him away.

"What's interesting about darkness is that people think of darkness as being the absence of light. I think of light as being the absence of darkness," he tells me. "You can flip it both ways."

Naiman believes "our habitual use of excessive LAN is the most important overlooked factor in our contemporary sleep and dream disorders epidemic," with the result that "we suffer today from serious complications of psychospiritual night blindness—a far-reaching failure to understand the significance of night in our lives, health, and spirituality." In *Healing Night: The Science and Spirit of Sleeping, Dreaming, and Awakening*, Naiman describes his work as an attempt to restore "a sense of sacredness to our nights" and to improve our "night consciousness."

Night consciousness? It's an idea I will run into again and again: We just don't think about night that much. For example, David Crawford, founder of the International Dark-Sky Association, told me that in addition to wanting to educate "everybody in the world" about the issue of light pollution, he'd simply wanted to "get people aware again that there is a night, and that night is really beautiful and worthwhile to everybody." That basic step of encouraging people to once again be conscious of this time and place where we spend half our life has led Rubin Naiman to a career that has included working through dreams of death and dying with cancer patients and helping soldiers who are suffering nightmares after returning from war in Afghanistan and Iraq. He's frustrated, he says, by the traditional field of sleep medicine, which he sees as tightly framing night, sleep, and dreams as strictly objective and scientific phenomena, and draining these experiences of anything personal or subjective, let alone sacred or spiritual.

"On a philosophical level, sleep disorders make sense," he argues. "We so discriminate against night. We repress it and then push it away. Part of that is a denial that there is anything there worthwhile. For example, a lot of scientists are trying to figure out why we sleep so they can do away with it. It's pesky. We just have to learn how to recharge those batteries."

I'm reminded of the character Seven of Nine from one of the old *Star Trek* series, half-Borg and half-human, and one image of what we imagine sleep could be like in the future: She didn't sleep—she went to Cargo Bay Two and stood inside an energy pod where this green electrical energy flowed into her neck. "She was recharging her battery." Naiman laughs. "There was nothing personal about it. It's a very mechanistic, soulless view of human beings. The presumption is there's nothing down there in night or in darkness that's worth seeing."

The truth, he explains, is that there is dream material; there's a level of surrendering that we don't understand. "If you just consider the possibility that there's something there, then it's really interesting to let go and to sleep. But most people when they descend into the waters of sleep, instead of aiming at the depth of that, they've got their sights set on the morning shore of waking. They really aren't going *to sleep*. It's as if this were an overnight mystery tour, but they are already thinking about where they're going to be the next day."

Naiman says that when he talks with people about this, they begin to consider that maybe sleep isn't just eight hours of being turned off, and to consider instead that they can have a relationship with night, "with all of the demons and angels, all of the qualities that lurk there."

Some of that can happen if people are willing to be touched by nature, Naiman explains, and cites as one example Thoreau's fishing by moonlight in *Walden.* "There's a great scene where he's on the pond and the stars are reflected. And he doesn't know if up is down, if down is up."

I know the scene. Thoreau has drifted off into philosophical reverie when suddenly a fish tugs at his line:

> It was very queer, especially on dark nights, when your thoughts had wandered to vast and cosmogonal themes in other spheres, to feel this faint jerk, which came to interrupt your dreams and link you to Nature again. It seemed as if I might next cast my line upward into the air, as well as downward into this element, which was scarcely more dense. Thus I caught two fishes as it were with one hook.

"It's a beautiful scene," Naiman says, "but it's also a shift in consciousness. So you can get that from nature, and you can also get that internally, I think, when you are willing to consider that there's something in there."

I admire Naiman's insistence that night has its own qualities, that it is distinct from day and not simply day without light.

He nods. "There's this notion that anything alive is in motion, and that's not true. I walk up and down this hill near my house every day and the saguaros are always perfectly still. But when you visit this same place over and over, through spring and summer and fall in the morning, winter in the late afternoon, you see the motion in stillness, the animation, because you see it in a dance with the light and the clouds. It's alive, it moves in a different way. Similarly, I think it's a question of seeing the life in night itself. To do so you have to meet it on its own terms, and you have to get real still to hear it, to feel it, to sense that it's alive."