

*The Best American Science
and Nature Writing™ 2015*

*Edited and with an Introduction
by Rebecca Skloot*

Tim Folger, Series Editor



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Foreword

WHEN ALBERT EINSTEIN was 16 years old and in his final year of high school, he performed an unusual experiment. He didn't use a laboratory, or any apparatus at all. Instead he conducted what may have been the first of his many *Gedankenexperimente*—thought experiments. He would continue to practice this imaginative yet rigorous sort of musing throughout his life, but in this particular case, the not-yet-iconic thinker wondered what a beam of light would look like if he was running alongside it at the same speed. Many years later, in his *Autobiographical Notes*, Einstein pointed to that first *Gedanken* moment as the origin of the ideas that have since transformed our understanding of the nature of space and time.

This year marks the 100th anniversary of the publication of Einstein's general theory of relativity (and the 15th anniversary of this anthology), so perhaps it's not a bad time to engage in some *Gedankenexperimente* of our own. Here's one: What if the world's political leaders met and engaged in the same caliber of discourse that scientists do, with the same spirit of collaborative problem solving? Granted, it's a proposition far less grounded in reality than Einstein's footrace with light, but let's set aside our incredulity for the moment.

First, our imaginary leaders might prioritize the real challenges facing the planet today, discuss possible solutions, and then—cue the derisive snorts—decide on a course of action and carry it out. Even climate change, the gravest threat facing us, would yield to this approach. We know the source of the problem—we're emitting too many planet-warming gases—and we're certainly smart enough to solve it, and at bargain-basement costs compared with the catastrophic price of inaction. Meera Subramanian's "The City and the Sea" is a remarkable testament to how much just one person can contribute to solving this problem; imagine what a whole roomful could do.

There is evidence that politicians have entertained—at least briefly—this same outlandish *Gedankenexperiment*. Some years ago Shimon Peres, the former president of Israel, toured the European Organization for Nuclear Research in Switzerland, where scientists from 113 countries conduct experiments. Inspired by his meeting with that international community, Peres told the assembled group of researchers (which included a Palestinian physicist) that perhaps the nation-state was obsolete and that the intellectual cooperation exemplified by the scientists at CERN could serve as a model for us all.

Conversely, what if the world's scientific community were to model itself after our political elite? Say scientists formed ideological camps that stymied the efforts of rivals, or denied, despite all the overwhelming supporting evidence, the truth of a theory. Or even worse, what if they waged war, perhaps beneath banners emblazoned with contested equations? Long live $E = mc^2$! Death to the $E = mc$ infidels! This much is certain: there would be no international collaborations and no inventions as remarkable as CERN's Large Hadron Collider, housed in a 17-mile-long circular

tunnel, which allowed physicists to discover the Higgs boson, a particle so crucial to the architecture of the universe that without it none of us would exist. Nor would we have Dennis Overbye's delightful account of Peter Higgs, "A Pioneer as Elusive as His Particle," who predicted the existence of this all-important particle 51 years ago.

Sadly, it's not at all clear which *Gedanken* experiment is the more preposterous: that scientists would abandon reason or that politicians (and we who elect them) would embrace it. Perhaps even stranger than my thought experiment is David Wolman's "The Aftershocks," which tells the story of a benighted political vendetta against seven Italian scientists in the wake of an earthquake. Given the state of the world, then, it's no small miracle that something like CERN and its giant particle collider even exist. Costing more than \$3 billion, the LHC was conceived and built not to generate profit but only to further our understanding of the laws that govern reality. It represents the pursuit of pure knowledge on the largest scale in the history of humanity.

That our civilization, for all its fractiousness, can still manage to build something like the LHC is a sign of enormous hope. Science is an inherently optimistic enterprise, the working assumption being that nature is comprehensible; mysteries can be solved; we can make things better. If we can design a machine like the LHC, which essentially recreates the conditions that existed in the first few instants of the universe, surely we can find a way past problems that we ourselves have brought about.

Late last year, while busy gathering stories to send to Rebecca Skloot, our brilliant guest editor, I received an e-mail from a reader who expressed some of these same feelings about the nature of science:

I have been a fan of this series for years and used it quite a bit when I taught freshmen expository writing to science majors. It seems to me that content has become darker and less hopeful over this time. Of course, I understand that dark days may yet lie ahead and that science is not just a barometer for potential doom but also an agent for change. But for me science is something I have turned to when I have lost all faith in humanity. When I marvel at what telescopes have seen, the mysteries of quantum mechanics, and the philosophical quandaries raised by neuroscience, I get giddy. How bad can the human condition be if we can make these investigations? I suppose I would just like to see a bit more wonder—a bit more magic—in the content and less doom and gloom.

I think readers of this current volume will find in its pages stories of wonder as well as eloquent and necessary accounts of the world we are altering so profoundly. Within these pages you'll have close encounters not only with scientists but with crows, whales, and hyenas. One guarantee: there will be no shortage of food for *Gedanken*.

I try to read widely while searching for articles for this anthology, but without the help of readers, writers, and editors I would miss many good stories. So lend a hand and nominate your favorites for next year's anthology at <http://timfolger.net/forums>. I encourage writers to submit their own stories. The criteria for submissions and deadlines and the address to which entries should be sent can be found in the "news and announcements" forum on my website. Once again this year I'm offering an

incentive to enlist readers to scour the nation in search of good science and nature writing. Send me an article that I haven't found, and if the article makes it into the anthology, I'll mail you a free copy of next year's edition. What do you think, Rebecca? Can I get you to sign those copies? I also encourage readers to use the forums to leave feedback about the collection and to discuss all things scientific. The best way for publications to guarantee that their articles are considered for inclusion in the anthology is to place me on their subscription list, using the address posted in the "news and announcements" forum.

I'd like to thank Rebecca Skloot for selecting such a wonderful collection of stories for this year's anthology. You won't find a better nonfiction book than her best-selling *The Immortal Life of Henrietta Lacks*. Once again this year I'm indebted to Naomi Gibbs and her colleagues at Houghton Mifflin Harcourt, who make this collection possible. And as always I'm most grateful of all to Anne Nolan, my beautiful wife. I hate to *Gedanke* where I would be without her.

TIM FOLGER

Introduction

A DECADE AGO, at the University of Pennsylvania vet school, I sat on a linoleum floor stroking my dog's head. She was in the 16th of what would become a 20-year life, and she'd just had a small tumor removed from her leg. As she fought to keep her eyes open through her post-anesthetic fog, a veterinarian walked into the room, surgical mask dangling from his chin. He pulled a pair of latex gloves from his hands with two loud snaps, and a woman's voice called out to him from behind a computer screen.

"How'd it go?" she asked.

"Great," he said. "Patient's up, swimming around."

Without breaking stride, the vet tossed his gloves in a trash can and walked toward an exit.

"Wait, what?" I said from the floor. "Your patient's swimming?"

He nodded.

"What's your patient?" I asked.

"Goldfish," he said, as if operating on a fish was something as ordinary as spaying a dog or cat. Then he reached for the door.

"Your patient is a goldfish?" I said. "What did you do to it?"

"Removed a tumor from its nose," he said as he opened the door and started to walk through.

"Wait!" I said, jumping from my dog's side and running toward him with a barrage of questions: *How do you anesthetize a fish? Who pays for this? What else do you do to fish? How common is this?*

As the vet answered my questions, I scribbled notes on the back of my dog's surgery receipt. (You anesthetize a fish using a tub of water mixed with liquid anesthetic, a submersible pump, and a plastic tube that pumps the water into the fish's mouth, over its gills, then back into the tub. Like a recirculating fountain. Fish vets do MRIs, CT scans, bone stabilization, bloodwork, you name it. If you can do it to a dog or cat, you can do it to a fish. People sometimes spend thousands of dollars treating fish they won at the fair or bought for less than \$5. Because they love them.)

After getting the vet's contact information and a promise that I could observe his next fish surgery, I finally let him leave. He'd hardly passed through the door when I picked up my BlackBerry (it was a decade ago) and started typing an e-mail to my editor at the *New York Times Magazine*. Subject heading: "Whoa." A few hours later I had an assignment.

I knew I'd write about fish medicine the moment I heard the sentence "Patient's up, swimming around," because it was a clear example of something I call a "*what moment*." I can trace every story I've written back to one (often several) of these: a moment that grabs my attention and makes me stop and say, *Wait—what?*

Such as, *What? Did you just say your sergeant ordered you to volunteer for a research study on the effects of an experimental drug but didn't tell you what the study was for or what the risks might be?* (Indeed he did, and this wasn't uncommon or illegal.) Or *What? Did you just say you can identify a person's race using a DNA*

sample? (Yep, and he'd built a business around doing so, even though the science didn't support his claims.)

My book, *The Immortal Life of Henrietta Lacks*, started with one moment in a biology class when I was 16: *What do you mean these cancer cells have been alive and growing in labs around the world since the 1950s even though the woman they came from died? And what do you mean her cells are one of the most important tools in medicine but no one knows anything about her except that she was black?*

I visit a lot of science-writing classes to talk with students, and I often tell them that one of the most important skills they can develop as young reporters is learning to recognize “*what moments.*” They happen so often in life, and they're so easy to miss—you're busy thinking about a deadline or a class or when you have to pick your kid up from school—and it takes time to stop and say, *Wait—what?*, and then even more time to be truly present for the answer. But this is essential to science writing: following your curiosity, letting it guide you not just to stories but also through them, to wherever they need to go.

When I started researching Henrietta Lacks, I thought I was writing a book about a woman and her amazing cells, but that changed when I talked to her daughter, Deborah. She told me she'd love it if someone wrote a book about her mother, so the world would know who she was and what her cells did for science. Then she paused, and her voice grew suddenly terrified. “But how do I know you're really a journalist?” she snapped. “How do I know you're not coming to steal my cells?”

“What?” I said. “Why would you think I'd be coming to steal your cells?” And with that, the questions driving my book grew from “Who was Henrietta Lacks and what did her cells do for science?” to include “And why would her daughter think I was pretending to be a writer in order to steal her cells?” It turned out that cells from Henrietta's children had been used in research without their knowledge, just as Henrietta's cells had been; that people had posed as journalists and lawyers to get all sorts of things from them—information, cells—and it had never worked out well for the Lacks family. That second “*what moment*” changed the story completely. In the end, it's not just the story of Henrietta and her cells, it's also (and perhaps most importantly) the story of the enduring impact those cells have had on her family.

“*What moments*” are all about wonder and what we can learn from it, and the stories in this year's *Best American Science and Nature Writing* are filled with them. In “The Big Kill,” Elizabeth Kolbert talks to conservationists trying to stop the destruction of their native plant and bird life through the wholesale slaughter of invasive species. “Let's get rid of the lot,” one character says. “Let's get rid of all the predators—all the damned mustelids, all the rats, all the possums.” Wait . . . What? Mass killing as conservation? The result is an important story about the vast damage we humans cause to animals and the environment when we introduce invasive species and the extreme choices scientists face as they try to fix the problems we've caused.

In 1848, Phineas Gage survived an explosion on a railroad construction site that sent a metal spike through his skull. As the story goes, his personality changed completely after the accident; he lost his inhibitions and became aggressive, even lewd. By studying how the damage to Gage's frontal lobe changed his personality, scientists were finally able to learn what that part of the brain really does. Because of this, he's been trotted out as one of the most famous patients in neuroscience for over a century.

When I first heard his story decades ago, I said the same thing most people say: Wait—what? He survived a giant metal spike through the skull? And a big hole in his brain? Thankfully, Sam Kean followed these questions. It’s an amazing story, one that it turns out may be based in quite a bit of fiction.

In her essay “Curious,” Kim Todd examines what she calls “the nature of the itch we call ‘curiosity.’” This is the very core of the “*what* moment,” those sudden glimpses of the unexpected that grab the imaginations of both writers and scientists, demanding investigation. “Curiosity can be as obsessive as hunger or lechery, swamping the senses,” she writes. “Its subjects seem so frivolous: a baby giraffe, a dodo skeleton, the Surinam toad.” But of course they’re not frivolous, because through them we learn about ourselves and our world. “Intellectual curiosity sparks science, art, all kinds of innovation,” she writes. “Here, in most of 21st-century North America, it is held in the highest esteem. For much of history, though, coveting the secrets of the world and mulling over mushrooms and vipers threatened to drag one from thoughts of God.” As a preacher in the early 1600s warned, “Curiosity is the spiritual adultery of the soul. Curiosity is spiritual drunkenness.” To which I say, *Sign me up*.

For Todd, that moment of curiosity’s spark is the strange appearance of a Surinam toad. In Sheila Webster Boneham’s “A Question of Corvids,” it’s a crow outside a hotel that seems to say “yeeees” when she asks if it’s hungry. That moment leads her on a deeply researched journey through folklore and ornithology, from the U.S. to Ireland to the eastern Sierras, all culminating in a concise, touching natural history of the corvid family of birds. The spark for Rebecca Boyle’s “The Health Effects of a World Without Darkness” was the moment she realized that she can’t see the stars from where she lives because she’s surrounded by too much artificial light. “After journeying millions of years, their light is swallowed by city glare and my porch lantern,” she writes. “Those that make it through will still fail: not even bright Betelgeuse can outshine my iPhone. Yet I am an astronomy writer, a person who thinks about stars and planets all the time. What does my neglect of the night sky say about the rest of humanity?”

In “The Aftershocks,” David Wolman follows the story of seven Italian scientists charged with involuntary manslaughter for failing to warn the public about an earthquake that killed 297 and injured thousands. “The claim,” writes Wolman: “They had knowingly neglected their responsibility to inform the population about the risk at hand.” The verdict: “For delivering ‘inexact, incomplete, and contradictory information,’ the scientists and engineers were found guilty of involuntary manslaughter. They each received a six-year prison sentence, pending appeal.” What?! Scientists sentenced for not conveying earthquake risk? For conveying “inexact, incomplete, and contradictory” information? Good science is often all about the seemingly inexact process of putting forth theories, testing them, coming up with incomplete or contradictory data, revising your theories, then doing it all again as you whittle your ideas, hoping someday they’ll become proven theories. And if scientists are being prosecuted over “inexact, incomplete, and contradictory” information, then watch out, science writers: Red wine is good for you! It’s bad for you! Meat will kill you! Meat will make you live longer!

At its core, like several other stories in this collection, “The Aftershocks” is about the importance of clear and accurate science communication, the many points at which

that communication can fail as it travels from scientists through the media to the public, and what's at stake when it goes wrong. It's also a sobering reminder of how little most people understand about the scientific process and the concepts of risk and probability.

This is a book filled with questions. What happens when your child is diagnosed with disease no one has ever heard of? Or when you try to unlock—and perhaps even change—traumatic memories? Of course good science and nature writing doesn't just ask *What?* It also asks things like *Why?* and *How?* and *At what cost?* In his story “Waiting for Light,” Jake Abrahamson didn't just write about the fact that some villages in India still live without light, he also asked what impact that has on them, the ways in which they might get light, and what that might cost, financially, culturally, and environmentally. His story and Rebecca Boyle's together illustrate another important job of science writing: highlighting areas of science, technology, and nature that many take for granted while others have no access to it, and asking important questions about the dangers of either extreme: What does it mean, for humans and their environment, to live without access to light? Or to live with relentless inescapable light?

In “Desegregating Wilderness,” Jourdan Imani Keith makes the essential connection between the Civil Rights Act and the Wilderness Act—two landmark laws that celebrated their 50th anniversaries in 2014—to explore the important questions of why access to nature is so often segregated along lines of color and class, what problems that causes, and how we can fix it. We have, she says, “a segregated wilderness, one in which the wild is hardest to reach for the people who, for historical reasons, still have fewer of the financial assets required to get there.” And in “At Risk,” Keith takes a group of urban teens to build trails in the wild, weaving a beautiful essay about “at-risk” youth who are as deserving of protection and access to wilderness as the at-risk salmon in the rivers she helps them explore.

People often think of science and writing as vastly different endeavors, but they're very much the same. They're both driven by curiosity, by noticing small moments—a single unexpected piece of data in an experiment, a sentence someone says in passing, a tiny crack in a rock face—and taking the time to see where those moments might lead, what larger stories they might uncover that can teach us about everything from the tiniest organism to the entire solar system. This is one thing all stories in this collection have in common: they're written by and about people who take the time, and often a substantial amount of risk, to follow curiosity wherever it might lead, so we can all learn from it.

Sometimes those risks mean months or years devoted to research without knowing where it might go or whether it will someday get published, relying only on personal credit cards and a belief that the story or data you're following is important. Sometimes it means tackling controversial topics for which there are no easy answers, like finding a balance point between free enterprise, environmental safety, and public health.

Sometimes the risks are emotional. In “No Risky Chances,” Atul Gawande, a physician, asks one of the hardest questions of all: What does it mean to have a good death, and how can he help patients accomplish such a thing? He realized that rather

than rattling off treatment options and outcome probabilities to a patient facing terminal ovarian cancer, as he'd been trained to do, he should ask questions like "What were her biggest fears and concerns? What goals were most important to her?" What was she willing to endure now "for the possibility of more time later"? For Gawande and his patients, these questions aren't just about good medical care, they're about the importance of story: "Life is meaningful because it is a story," he writes. "No one ever really has control; physics and biology and accident ultimately have their way in our lives. But . . . we have room to act and shape our stories—although as we get older, we do so within narrower and narrower confines."

And sometimes science and nature writers risk their lives to follow important stories. In "Digging Through the World's Oldest Graveyard," Amy Maxmen and the scientists she writes about search for the origins of humanity amid warring tribes in Ethiopia, where paleontologists travel with "two hammers, two shovels, four rifles."

Sheri Fink, a physician and reporter, immersed herself in a Liberian Ebola clinic, "a place both ordinary and otherworldly," to show us the "the rhythms of a single day" in an Ebola outbreak. One patient said to her, "They told me I should be very mindful of others. No touching." But, she writes, "His bed, like the others in the unit, was in an 8-by-10-foot space separated from others by wood-framed walls of tarp, and he shared a latrine with other patients." He cried and told her, "It's too pathetic. I think the world needs to come." And through Fink's incredible eye for detail, and her willingness to go where few others would, she allowed the world to see precisely what he meant.

I desperately wish that every writer in this collection who took risks to tell important stories survived the year. Matthew Power was a fearless and talented young journalist. He reported on everything from natural disasters to war zones; he followed what *Men's Journal* called "one man's absurd quest to become the first person to walk the entire length of the Amazon River—floods, electric eels, and machete-wielding natives be damned." He went into Afghanistan to report on the Taliban's destruction of Buddha statues. As his former *Harper's* editor, Roger Hodge, told the *New York Times*, "He was always searching for the human truth beneath the sorry facts. He wanted to live it—live what these people were living." And he did just that, much to the world's benefit.

For his story included in this collection, "Blood in the Sand," this meant traveling to Costa Rica, into the center of a heartbreaking and deadly battle between turtle conservationists and poachers. Two months after this story ran in *Outside Magazine*, Matthew Power collapsed and died from heatstroke while reporting a story about an explorer walking the length of the Nile. News of Power's death filled my Facebook feed as so many mutual friends mourned his loss. We also mourned the incredible stories we lost with him, those "*what* moments" he would have noticed, stories that would have grabbed his vast curiosity, stories that perhaps only he would have risked following.

Writers aren't the only ones taking risks for these stories. I think I hardly breathed while reading Burkhard Bilger's "In Deep," which tells the story of a team working to map the deepest caves in the world: "On any given day, the cave might be home to a particle physicist from Berkeley, a molecular biologist from Russia, a spacecraft engineer from Washington, D.C., a rancher from Mexico, a geologist from Sweden, a tree surgeon from Colorado, a mathematician from Slovenia, a theater director from

Poland, and a cave guide from Canada who lived in a Jeep and spent two hundred days a year underground,” he wrote. “They were a paradoxical breed: restlessly active yet fond of tight places, highly analytical yet indifferent to risk . . . As far as I could tell, only two things truly connected them: a love of the unknown and a tolerance for pain.” Bilger’s vivid writing transports readers deep underground and brings those risks, and the characters who take them, to life.

Like those cave explorers, Cindy Lee Van Dover, the scientist Brooke Jarvis writes about in “The Deepest Dig,” takes incredible risks for her research. She sinks for more than an hour in a submersible to get to the bottom of the ocean. “The view from its portholes moves through a spectrum of glowing greens and blues, eventually fading to pure black,” Jarvis writes. “The only break from the darkness comes when the sub drops through clusters of bioluminescence that look like stars in the Milky Way. They’re the only way for Van Dover to tell, in the complete darkness and absence of acceleration, that she’s sinking at all.” She lands in “a strange land of underwater volcanoes and mountain ranges, of vast plains and smoking basalt spires,” where she’s found, among other things, “concentrations of metals—gold, copper, nickel, and silver, as well as more esoteric minerals used in electronics—that make the richest mines on dry land look meager.” And as Jarvis writes, “Where there’s metal, there are miners, even at the bottom of the world.” It’s a story of fascinating science and the risks required to uncover it, but it’s also about the risks—and potential benefits—of the brand-new industry of deep-sea mining.

I’ve been a fan of this series since its first edition, which my father bought me as a present in 2000. I was in graduate school, just one year into the decade it would take me to write *The Immortal Life*, and I haven’t missed a single edition since. I keep my *Best American Science and Nature Writing* collection on a special shelf near my desk, and over the years I’ve turned to it time and time again for inspiration, entertainment, and education—my own, and that of my students. So I was giddy with excitement when Houghton Mifflin Harcourt asked me to be the series editor this year. Giddy, but daunted.

I’m a science person; I think in terms of data collection and sample size. When asked to rule on the best science writing of 2014, I set out to find and read every such story published, gathering as broad a data set as possible before drawing conclusions. And here’s what I found: while reading a year’s worth of writing about science and nature—with stories of drought, widespread disease, environmental destruction, overfishing, poaching—it’s easy to despair about the future of our planet and all species on it. But I did come away feeling hope for the future of one species: the science and nature writer.

Though the health of the world they’re reporting on is in a fragile state, the science and nature writers of 2014 left me feeling hopeful about human ingenuity, the wonder of science, and our ability to harness it to solve big problems (of our own creation and otherwise). The day after finalizing the selection of stories for this collection, I flew from Chicago to San Francisco, and along the way I saw at first hand the incredible drought we’re facing in this country. As I flew over drying-up reservoirs, lakes, and aqueducts, I thought of Rowan Jacobsen’s “Down by the River” and Meera Subramanian’s “The City and the Sea,” both stories of communities finding

meaningful recovery from water-related disasters, through individual creativity, cooperation between groups too often at odds, and a spirit of working with the forces of nature rather than against them.

I'm relieved by the number of outlets (some old, many new) publishing strong science and nature writing. Also by the number of talented writers entering the field, particularly women and minorities, groups that have been underrepresented in all areas of science for too long.

After reading hundreds of science and nature stories, I eventually realized that the task I'd set out for myself—to find and read every single one published in 2014—was impossible. Many are online; many aren't. The amazing Tim Folger, in addition to writing tremendous science and nature pieces of his own, gathered stories throughout the year and narrowed them to a group of finalists. Despite his help and my own deep searching, I'm sure I missed some. But this is good news. It gives me great hope to think that I found so many wonderful examples of science and nature writing—far more than I could include here—and that there are surely others out there I didn't uncover. It also makes me curious to find them.

REBECCA SKLOOT

Waiting for Light

FROM *Sierra*

THE SKY ABOVE northeast India looked like mango skin. It was late afternoon in May, and across a constellation of villages, deliverymen worked to unload their solar-charged lanterns from trucks and bicycles before nightfall. They leaned into dung-and-straw huts, calling, “Lantern, lantern.” They passed the devices to women in colorful saris, to bucktoothed kids, to men in sweat-stained undershirts, lingering while the customer made sure the lantern worked, head angled and skeptical.

As the sky dimmed, the lanterns were hung from the ceiling of every shop, precise white spheres in the darkness. A mustard grinder ran his seeds through his diesel-powered machine. A bangle maker massaged heat into metal until the smell of malleability crept out. Children did homework. Women cooked dal. All were warmed by the day’s trapped energy diffusing from the mud bricks. The next morning the deliverymen would retrieve the lanterns and whisk them back to solar-powered plants to be recharged during the day.

The rechargeable LED lanterns came in 2012, by way of Delhi-based solar energy concern Omnigrad Micropower Company (OMC), which leases them to about 36,000 customers across the state of Uttar Pradesh for \$2.50 a month. When the company first set up shop, its primary focus was using solar plants to power telecom towers, which once depended on diesel generators. But that changed quickly. “As we looked at it closer, we realized the power demand would be larger for the community than for telecom,” said Pär Almqvist, OMC’s chief marketing officer. In addition to the lanterns, the company offers battery boxes that power fans and cell phones, and it will soon become the first Internet service provider in the area. But right now OMC’s mission is all about light: put photons where there are none.

The market for OMC and its two dozen peer companies is huge. Roughly 400 million of India’s 1.2 billion inhabitants lack access to electricity—more than the combined populations of the United States and Canada. Indians without electricity typically use kerosene wick lights, which cause eye and respiratory disease, start fires, rely on sporadically available fuel, and provide about the same amount of illumination as a birthday candle.

That May night I rode out of a village called Jangaon and into the hills. As Jangaon receded, its 800 lanterns blended in with the stars, and I saw in our headlights that the road was disappearing too. It was just whorls in sand now. I caught a passing glimpse of the pearly, vacant eyes of a buffalo. Then the brick wall of a tiny village appeared. This was Aat, an unlighted hamlet hidden amid mango orchards.

“This is the darkest place I have seen in my life,” proclaimed the man sitting beside me in the back seat. He was Ritu Raj Verma, OMC’s boss in the field, head of rollout, a person with an almost religious need to distribute light.

The car stopped, and Verma told the driver to cut the headlights. The prominent dichotomy in Verma’s life was of light and dark, and he was determined that I see

which prevailed here. “You see? Full dark,” he said. “I will make this village glow like a sun. I will bring them the light.” I couldn’t see his face, but I saw his broad head, with a dollop of hair on its crown, silhouetted by the stars and moon out the window behind him.

Over the wall lived the family of Ramswarup Verma (no relation to Ritu Raj), a farmer of 40 with the grooved, leathery face of someone much older. He wakes and sleeps by the rise and fall of the sun, which isn’t as romantic as it sounds. When night arrives and Aat gets dark, the Verma family goes to bed for lack of anything else to do.

Mr. Ramswarup, as he preferred to be called, didn’t expect the electrical grid to reach Aat in his lifetime. “There are many larger villages. We only have four to five houses,” he told me the next night, when I visited him with a translator. His biggest complaint about the darkness was that he couldn’t visit the water pump at night. Without a light, he couldn’t see the snakes.

“With a lantern I will go to the market, my children will study, I will get water from the ground,” he said. “If I get the light, it will change my life.”

We were on a dirt patio of sorts for his goats and buffalo, inside the brick wall but outside his house. We sipped chai. And just as I was viewing Aat through the prism of America, he was doing the reverse.

“How is there electricity twenty-four hours in the United States?” he asked me.

“Are there mosquitoes and flies in America?”

“Do you have mangoes?”

“Is there a dowry system?”

My translator, Manoj, asked if it was true that France is the only country without mosquitoes. I didn’t know the answer.

Then the two of them were talking in Hindi, and Manoj was making a fist with his left hand and shining a flashlight on it with his right hand, slowly rotating the fist. “He is asking how when it is night in India, it is day in the United States.”

I pointed to the night sky and said, “Did you know that a human has walked on the moon?”

Mr. Ramswarup shook his head, his expression unchanging. He didn’t seem to care.

“Do you believe me?” I asked.

“Yes.”

“What are the moon and stars to you?”

“They are the gods.”

We drove away over the bumpy dirt road, which is impassable by OMC’s bicycles and delivery trucks. The company is creating a program to deliver solar-charged batteries by motorbike. Later this year Mr. Ramswarup will lease a lantern that he can keep in his house and repower daily with a newly delivered battery.

For Indians who live in darkness, electricity has long been a mirage resolving just beyond the gridded horizon. In villages throughout the country, utility poles lean and split. Some hold wires, put up by the government decades ago and then abandoned; others were erected by well-to-do individuals who hoped the sight of grid pillars would compel a state body to string wires across them. The poles are a reminder of the dying notion that the only thing separating people from power is a few dozen miles of copper wire.

In fact, one obstacle to full electrification in India might be the institutional faith in the grid itself (or grids—there are four), which fails the consumers who *are* connected to it. India’s grid routinely suffers 30 to 40 percent power loss between the source and end user, mostly from pilferage and technical inefficiencies, and the grid runs largely on coal.

The most promising avenue for powering up India’s rural poor could lie with private companies like OMC, offering solar-powered light via lanterns, household panels, or tiny, self-contained grids. There are 15 to 20 such companies, plus dozens more hyper-local providers, something like the neighborhood barbershops of solar installment. As easily as OMC distributes a truckload of lanterns, another start-up can wire a few dozen buildings to a mini solar plant (called a minigrid) or install solar panels on a single rooftop. The different delivery methods have their own pros and cons, but one of off-grid solar’s greatest advantages is the ease with which companies can tailor their offerings. In a likely scenario, companies would offer combinations of prepackaged lighting, minigrids, and rooftop solar panels.

A successful private-sector industry wouldn’t only power up new consumers using renewables; it would also severely undermine any chance that these people would use dirty power down the road.

“We’ll be building an entirely different system from the bottom up,” said Justin Guay, associate director of the Sierra Club’s International Climate Program.

When all is said and done, one of the coal industry’s favorite narratives—that its ability to provide cheap power to people in need outweighs its nefarious effects—would be cut down by a counterargument that’s 400 million strong.

But the industry needs help from India’s government. Like start-ups in San Francisco and New York, many off-grid companies in India go belly-up before they can get on their feet. “A lot of the companies understand technology, but they don’t understand how to maintain a relationship with a rural customer,” said Sandhya Hegde of investment firm Khosla Impact, which recently put \$2 million into BBOX, a company similar to OMC that works in sub-Saharan Africa, where off-grid solar is booming.

The ones that last need continued financing. While international investors have taken notice of the industry’s potential, domestic banks are hesitant to fund companies whose customers include the poorest people on earth. And those banks need to feel comfortable buying in if the industry is going to grow.

“The local banks are looking for 100 percent collateral, really high rates of interest, and short loan terms. That’s a huge issue,” said Alex Doukas, a research analyst at World Resources Institute. “If you really want these enterprises to scale up, you need to have financial institutions on the ground that understand the business models.”

India’s government is in a position to help, and with Prime Minister Narendra Modi’s recent pledge to bring solar energy to all Indians who need it by 2019, Guay and Doukas hope he rides the cresting wave of off-grid solar by facilitating low-interest loans for both solar providers and their customers. Bangladesh did something similar in 2003, and off-grid has swept the countryside, with 80,000 rooftop systems now being installed a month—a rate that’s rising.

A recent report coauthored by Guay valued the worldwide market for off-grid at \$12 billion annually. That’s for 1.3 billion potential customers who currently live without

electricity, a majority of whom are in India and sub-Saharan Africa. After energy will come Internet access, fans, electric bicycles, and refrigerators.

Then again, the promise of energy for all is a tiresome one in India, where the government has been notoriously bumbling and corrupt. In the 1990s and 2000s, India made an attempt at off-grid solar. NGOs and government entities that no longer exist installed it on rooftops at a highly subsidized rate, and the broken remnants, too expensive for consumers to repair, still stick out of rooftops in Jangaon. But there were no OMCs then. A few years from now, there might be 80,000 new Indian households extending their lives beyond sunset per month. Or there won't. In either case, the people without power will be waiting for someone to make a decision that could change their lives in an instant.

The lanterns arrived in 15-year-old Bhawana Singh's village, just a few miles from Jangaon, in December 2012. They came in the typical way. After sundown one evening, without prior notice, a cart full of them rolled up to a prominent location in the village and was lit up. OMC's Ritu Raj Verma calls this a road show.

"We are illuminating forty, fifty lanterns on top of the vehicle," Verma said. "It looks like the sun rises there. Slowly, slowly, the villagers are attracted toward the light. We give them our lantern in their hand so they can enjoy this light for a fraction of a second."

A year and a half later, Bhawana Singh told me that she uses her family's OMC lantern for studying and crafting. Outside her thatched hut, she leaned in from the dark to catch the lantern's sphere of light and unrolled a colorful strip of bunting that she'd stitched together from discarded yarn and cement packaging. "I made this from the waste," she said.

"Will you sell that in the market?" I asked.

She went to a doorway and pretended to hang the bunting above it. "It is not for selling. It is for the house."

"Beautiful," said Verma.

"What did you think the first time you saw this lantern?" I asked.

"I very much enjoyed it. Now I can study. In the storms, it will not be off."

Before the lanterns arrived, she used a kerosene candle.

"Do you prefer the lantern?" I asked her.

A man sitting nearby jerked to life and pointed to his eyes, indicating the way kerosene fumes made them tear up. Bhawana nodded. Then Verma got into a conversation with one of the Singh men.

I asked him what they were talking about, and he said, "This Malaysian aircraft has been lost. I am telling them that when I would like to access information about that plane, I'm accessing my Internet. I'm not getting a newspaper from Malaysia."

"What else?"

"He is requesting that I create a library for the students over here. But the Internet is the biggest library. It's the electronic library."

"Do you hope that one day you will have electricity?" I asked Bhawana.

"Every year we think electricity will come," she said. "We think the light will come. Only the pillars are there, but there is no electricity in the wires."

"How long have the pillars been there?"

“Four years. Every year since they came we hope they will be turned on.”

“It is the hope of a human being,” Verma added. “Something new is there, and sometime, someday, it will work.” He was getting protective. He had a paternal thing with Bhawana, had kind of taken her under his wing.

Looking around the sky, I found the pillars that Bhawana was talking about—towering, solitary poles. Their silhouettes leaned like giant cacti against the moon.

Bhawana’s younger sister Sonal sat down beside her. She held a painting of a rose that she had made. “What do you love in the world?” I asked.

“We love to study. We love to do embroidery.” They said they wanted to go to college and learn about computers, the future Verma was nudging them toward. They travel 18 miles daily just to attend grade school. It’s a two-hour journey each way, by bicycle and bus.

I asked, “What do you hope to learn on computers?”

“We would like to get all the faraway information,” said Bhawana. There was more talk in Hindi between Verma and the girls. I let it pass for a few minutes and finally asked, “What are you discussing now?”

“I am telling them that in America, everything is done by machines. The tea has been prepared by a machine. When they are extracting milk from the buffalo, it is done by machines.”

Bhawana now asked me a question. “Are you going to feel happy after visiting this village?”

“Will I feel happy?”

I stuttered through something about the merits of living without machines, about the fact that I didn’t know how to do anything because machines did everything for me, how we drank cow’s milk, though I found India’s buffalo milk delicious. Verma didn’t even bother translating. He let me finish and turned away.

A few months earlier Verma had found Bhawana waiting outside an OMC plant in the rain. That is how they met. She stood on the brown road beneath a dark green bough, schoolbag in hand, surrounded by rain, waiting for someone to emerge from the plant who could explain this thing called the Internet. Verma showed her.

Soon Bhawana was using Verma’s computer to look up market prices for sugarcane, mangoes, wheat, and rice so her father, a farmer, could use these as negotiating points. It was a tool for her father’s agriculture business, as practical as a hoe. It fit into the farming lifestyle like the cell phones that enabled people to read weather forecasts, like the portable lanterns they carried into the fields at harvest time, when they worked all night pulling mangoes from big trees.

One of the Singhs brought out chai on a tray. It’s something everyone does here. Chai, fried things, water with sugar mixed in—people always give you the best thing they have. And Verma took the moment to make sure I was noticing the world around me. “See that this is the village,” he said. “See that their roofs are of grasses and all. See mud houses, a few brick. See that you can see the darkness. Only the moonlight is there.”