

# WIRE

MAY 2020 ■ STAY SAFE



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# HOLD THE LINE



**We've never shown** fear of the future at WIRED. Times of great change, of apparent chaos, are just punctuation—the end of one paragraph and the beginning of a new one. Our stories, our design, even our vocabulary has always encrypted a message: Don't be scared. Be excited. Living in the future is fun.

You're frightened now. So are we. At the time of this writing, half a million humans are confirmed to have the disease Covid-19. More than 20,000 have died. By the time you read this, those numbers will seem quaint.

But our message has not changed. Don't be scared. Hold the line.

Hold, also, to this: When humanity hits a crisis, it always looks to science for help. Not because scientists are perfect, or even smarter on average than other humans, but because science is one of the best ways humans have come up with to reliably understand how the world works and how to fix it when it's broken.

The really important thing about science, though, is that it lets people understand the world *together*. Scientists don't just discover things. They write about them in agreed-upon formats, construct experiments and collect data in convincingly logical ways, and use a vast distribution network to share what they know. Science is a force for civilization.

You're scared right now because it seems like that civilization might be falling apart. The leading scientists in the United States seem sidelined. It feels like people who clearly don't understand something aren't listening

to people who do. Consensus, that feeling of togetherness, shatters. You think you might be alone—not just that you might get sick but that no one is coming to help you.

But they are. They will. If we hold the line.

Society is about to change, and no one can be sure how. But your fear is also the result of a playbook. Good scientists give an honest accounting of their own uncertainties, but when scientists point out that powerful people are doing dangerous things, those people dilute the critique by emphasizing the uncertainties. It's a hell of a good juke, and it has been going on for so long—pretending cigarettes don't cause cancer or that burning petrochemicals doesn't destroy the planet—that it can seem as if scientists can't ever really know *anything*, that we have no real basis for a shared understanding of the world or for any responsibilities to each other.

Intensive care units are overflowing. A brand-new disease is killing people we love. But we have to remember that inside that storm, faith—in each other and in the scientists and medical workers who are dedicating their minds, all over the planet, to the work of understanding and fighting this virus—is the antidote to fear. Their work needs time, which means we all have to work, together, to slow the virus's spread.

Covid-19 wasn't the first killer disease of the 21st century. It isn't even the first coronavirus—in 2003 and 2004, severe acute respiratory syndrome, SARS, killed 774 people around the world. Since 2012, Middle East respiratory syndrome, or MERS, has killed 858 people. The numbers seem small now, but they were a signal that a respiratory virus could run the planetary table. Some countries prepared; the United States didn't.

Now we're all looking to the scientists again. They're on it.

This disease showed up in December 2019. By January 10, the new virus's genetic sequence was online. Labs around the world soon learned to test people to see if they were infected (a ball quickly dropped by a hobbled American public health system). Now scientists have found dozens of existing drugs that are promising. The first human trials of a vaccine have started. Immunologists have found antibodies that work against the virus and are hoping to test synthetic versions in people by summer. More data will help epidemiologists learn how to let people who've been sheltering in place go back to work, to rescue the economy. (That's going to require *a lot* of testing to see who's sick and who has recovered.)

We can do this. In the 1950s a sociologist named Charles Fritz jump-started the academic study of disaster with a single, vivid insight: People in crisis help each other. Elites panic about riots and looting, but most of us just try to help the people nearest us. And then we help the ones a little farther out, and then farther again. The center holds; the gyre widens. A government can do things to make all that happen, and in a better timeline, it would. Sadly, we don't get to choose a timeline. Luckily, we do get to choose a government.

Now we're all in a disaster together, even if physically apart. Things will seem like they are getting worse. Stay home. Don't spread a virus. Don't be scared. Buy scientists time. Living in the future is hard, but it will be fun again—maybe even better.

We just have to hold the line. —Adam Rogers, senior correspondent

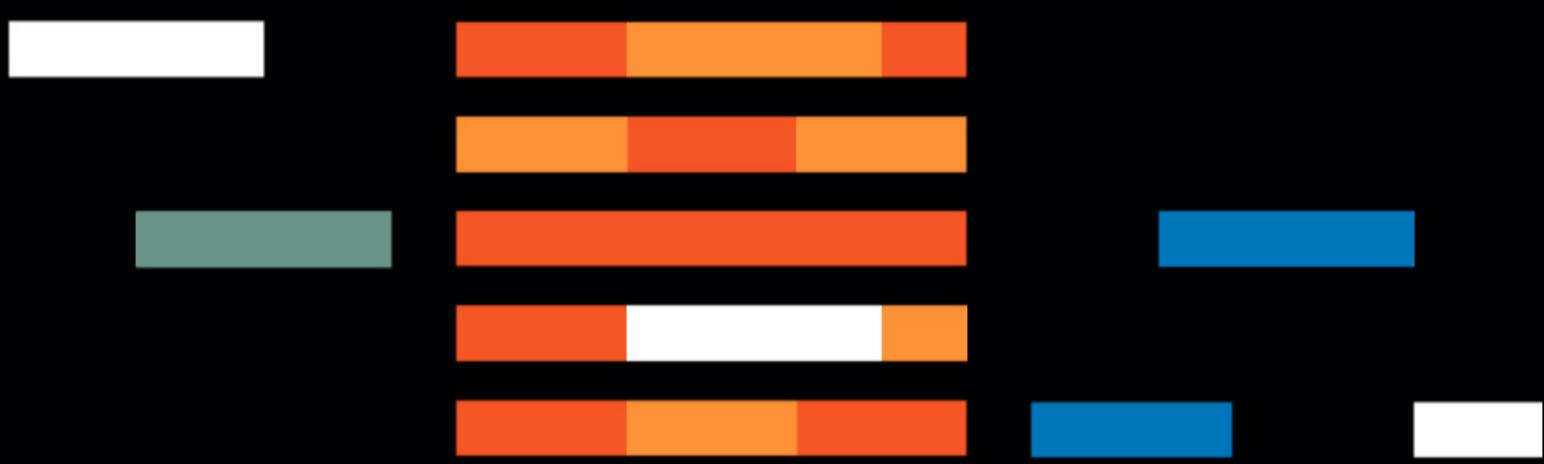
WHAT MAKES YOU YOU?



MESS WITH THE BIOLOGICAL

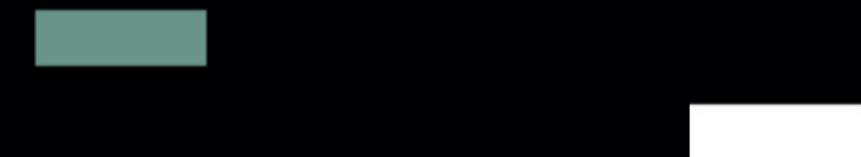
JELL-O

IN JUST THE RIGHT WAYS,



AND THE STRUCTURE OF THE SELF

REVEALS ITS



FRAGILITY.

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## **THE INFLUENCER**

India, the world's largest democracy, is now the world's largest experiment in social-media-fueled terror. Inside the rise of a Hindu vigilante in the age of WhatsApp and Modi.

by Mohammad Ali

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### **WHAT HAPPENED TO LEE?**

A genius coder lost himself. For a long time, no one knew why.

by Sandra Upson

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### **OUTRUNNING MYSELF**

At age 44 I ran my best marathon ever, thanks to tech, training, and confronting my past.

by Nicholas Thompson

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### **CODE OF THEIR OWN**

Survivors of trafficking shed old identities.

Images by Maria del Rio and Alma Haser  
Words by Lydia Horne

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### **TOSSED FROM THE ARK**

How a nearly extinct porpoise could save other imperiled species.

by Adam Elder



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**BEYOND FAST**

# ELECTRIC WORD

- P.03 Letter from WIRED  
 P.10 Rants and Raves

# ON THE COVER

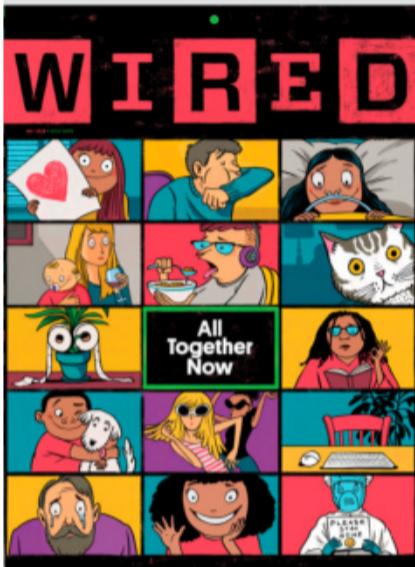


Illustration  
by Zohar Lazar

**About the Cover**  
 Zohar Lazar distills the essence of our new reality—and the new windows that define our lives—into moments of love, silliness, sadness, and poignancy, highlighting the fact that we're all in this together.



# MIND GRENADES

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by Virginia Heffernan  
 P.16 What the Future Needs From Us Now  
by Paul Ford  
 P.18 When Government Fails, Makers to the Rescue!  
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Stay clean, sane, and productive



# SIX-WORD SCI-FI

- P.96 Very Short Stories  
by WIRED readers





**Michael Spence.** Nobel Laureate in Economic Sciences.

# Will the world always be this unpredictable?

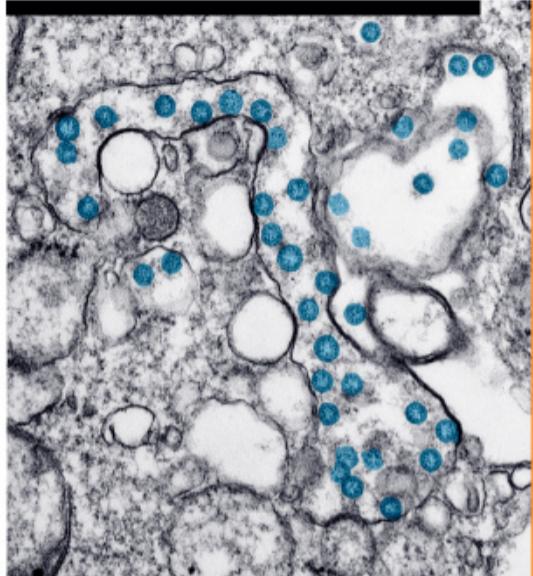
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## RANTS AND RAVES



### All Together Now



Translated literally, the word *pandemic* means “pertaining to all people.” As of this writing, the novel coronavirus has spread to 196 countries; it’s a crisis that we are facing as an entire planet. When Covid-19 appeared in China, our science team understood the implications and turned their full attention to the topic. (On January 13, Megan Molteni wrote: “A task force of Chinese researchers has identified the microbe causing the outbreak. The culprit, they say, is a virus never seen before in humans—a newly discovered member of the coronavirus family.”) Within days of the virus spreading, nearly every reporter and editor at WIRED was working on a related story. As of late March, we’d published near 200 articles on the topic. And readers responded. You can find our pandemic coverage at WIRED.com; we are providing unlimited free access to all Covid-19 public health stories.



### Readers share their grief, hope, ire, and support:

**RE: “SOCIAL DISTANCING: HOW MANY PEOPLE IS TOO MANY?”**

**“Wedding and family reunion canceled. Health more important.”**

—Mickey Nelson, via Facebook

In response to the article “Your Covid-19 Questions, Answered,” by Meghan Herbst, Miriam commented on Instagram: “I’m writing from Italy. Everything started here on January 31. It was said ‘It’s just a bad flu,’ then the coronavirus spread quickly, especially in the north. As of today, hospitals are collapsing and assisted breathing is needed in the most vulnerable people, and unfortunately there are not enough intensive-care rooms and respirators. Protect your loved ones, especially the elderly. We in Italy go forward united. We will overcome this and then get up and start again. Maybe appreciating life in its simplicity.”

About Laurie Penny’s story “Stopping an Outbreak Is Never Just a Fight With Nature. It’s Also a Fight With Culture,” Ted Faber (@snorerot13) tweeted: “The weapon we have in the fight is humanity. I hope we’re up to the task. I believe we are.”

Responding to Brian Barrett’s guide, “How to Work From Home Without Losing Your Mind,” Johnny Diana Candela Arocho, via Facebook, was perplexed: “I’ve been trying to figure out how in the hell people go to the office and stay sane?!”

About “The Coronavirus Pandemic Is Bringing Down Emissions, but Not for Long,” by Matt Simon, Tom Lee wrote via Facebook: “This crisis will establish a negative correlation with atmospheric CO<sub>2</sub> levels and prove, once and for all, it’s human activity that’s causing climate change.”

In agreement with Roxanne Khamsi and her article “They Say Coronavirus Isn’t Airborne—but It’s Definitely Borne by Air,” John Flucke (@jflucke) tweeted: “Describing it in absolute terms is uncalled for and shows a total lack of understanding of infectious disease. All it does is breed misunderstanding and panic.”

A while after Matthew Stoller wrote “Covid-19 Will Mark the End of Affluence Politics,” Yashar Ali (@yashar) tweeted: “Shout-out to all the people who were pulling their hair out from late December through mid-February trying to get people to take the coronavirus threat seriously.” To which Glenn Greenwald (@ggreenwald) added: “One of the most prescient people on this was @matthewstoller, who was screaming at everyone in January ... that Covid-19 would change everything: from elections to the global economy.”

About Steven Levy’s interview with Larry Brilliant, “The Doctor Who Defeated Smallpox Explains What’s Coming,” Ronald Klain (@ronaldklain) tweeted: “When I got picked to be the Ebola response coordinator, my ex-boss, @algore, called me and said, ‘Your first call should be to @larrybrilliant.’ It was the best advice I got, and everyone who has listened to him before or since has been wiser for it.”

There was also this kind tweet from Bryan Vartabedian (@Doctor\_V) about Megan Molteni and Adam Rogers’ guide “Everything You Need to Know About Coronavirus Testing”: “I’ve read dozens of coronavirus things today. This is one of the best and the only one I’ve shared so far.”

And, when WIRED editor Caitlin Kelly tweeted that we stood by our reporting in the article “Trump Caught Google Off Guard With a Bogus Coronavirus Site Announcement,” Jake Tapper (@jaketapper) weighed in: “As do we. Great reporting, Caitlin.”

**Correction:** Our May article “Across the Line” incorrectly stated Jane Seo’s running times for the first and second halves of the Fort Lauderdale A1A Half Marathon. She ran the second half nearly two minutes per mile faster than the first.

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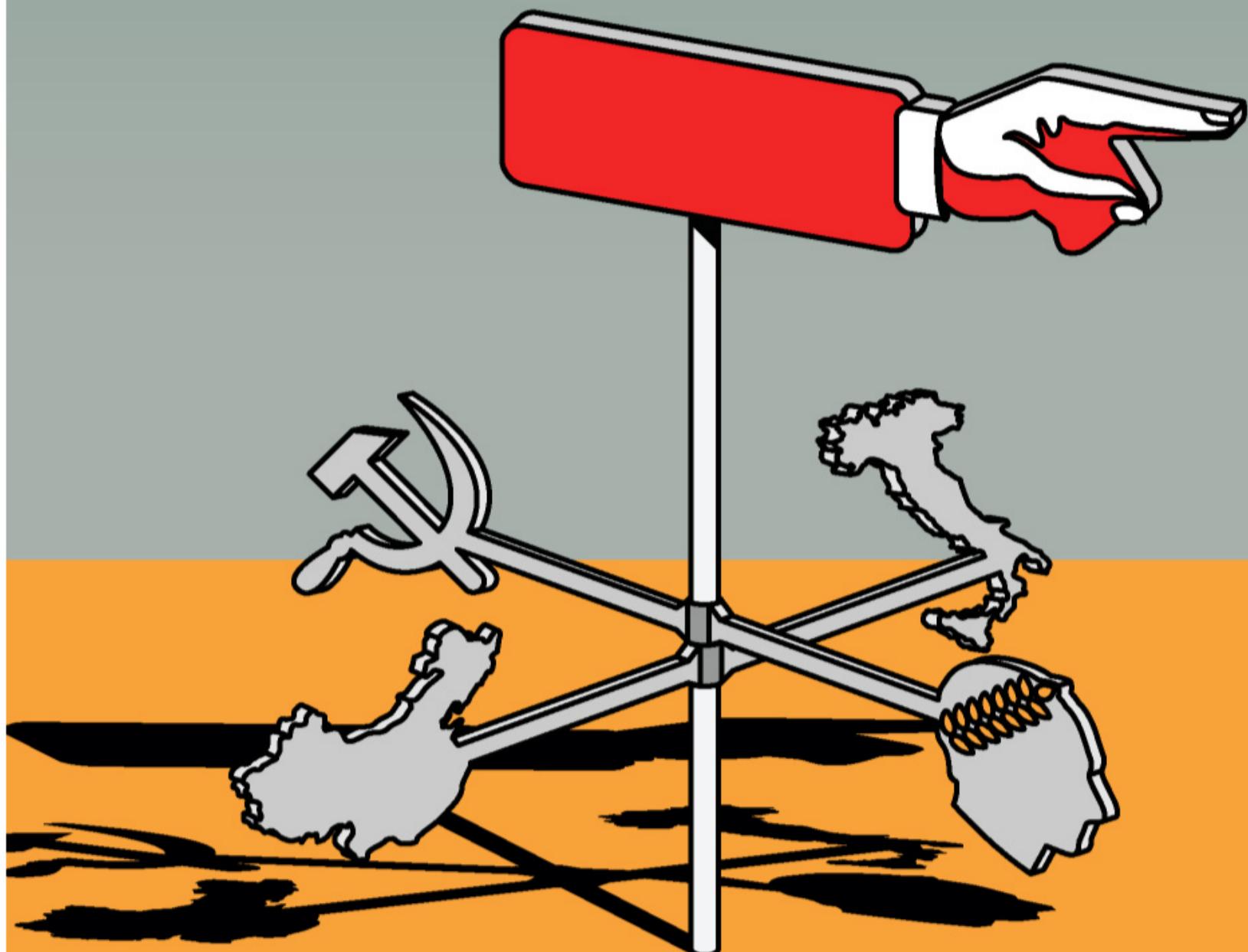
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# WORDS TO LIVE BY

**During outbreaks of infectious diseases, we turn to stories of alternate universes in which history might be turned back. But it's poetry, farce, and consolation that lead us through dark times.**

BY VIRGINIA HEFFERNAN

Pandemics are inexorable—and the canon of plague literature is a chronicle of nature's senselessness and its indomitability. "There was no ostensible cause," wrote Thucydides in 431 BC, about the Plague of Athens, an epidemic of typhus, likely, that laid the city to waste. "Strong and weak constitutions proved equally incapable of resistance, all alike being swept away." ■ Boccaccio also begins *The Decameron*, his masterful collection of tales (c. 1353) told by young adults fleeing Florence for the countryside, with the shock of plague—and subsequent plot twists, whether slapstick or tragic, unfold as if ordained. Anything goes. "Because →



of the chaos of the present age, the judges have deserted the courts, the laws of God and man are in abeyance, and everyone is given ample license to preserve his life as best he may," says Dioneo on Day Six. Earlier, on Day Three, Dioneo launches into ecstatic smut, in which a penis is a devil and a vagina is hell. And on Day Four, Lisabetta buries her lover's head in a pot of basil. In context, that makes perfect sense.

But even as plague years generate twisty new fables, each time a novel pathogen gets on a global tear, existing human narratives are shattered. The old life is reached for, again and again, like a phantom limb. During outbreaks of infectious diseases, including smallpox, Spanish flu,

don't come for one tribe or another; they don't smite a population because it's gone astray; they're neither divine punishment nor a sign of the Rapture.

And as tempting as it is to try to discern why one human gets sick and another is spared, this is not just inhumane, in Procopius' view, it's a lie. Being Chinese or a pagan or a New Yorker makes no difference. Neither does eating junk food or cycling competitively. Procopius: "For much as men differ with regard to places in which they live, or in the law of their daily life, or in natural bent, or in active pursuits, or in whatever else man differs from man, in the case of this disease alone the difference availed naught."

iers might bid defiance to contagion." But contagions can't be defied, it turns out, no matter how many ballerinas and casks of wine are at hand. Ultimately, "Death held illimitable dominion over all."

The famous beginning to Chaucer's *Canterbury Tales*, a piece of post-plague literature likely modeled on *The Decameron*, shows how nature can't be stopped. "When April with its sweet-smelling showers has pierced the drought of March to the root ... then folks long to go on pilgrimages." The pilgrims (having, in this case, survived seasonal viruses) light out to Canterbury nominally to visit the shrine of the saint they believe healed them. In fact, as the prologue indicates, they under-

## **Plagues don't come explicitly for one tribe or another; they don't smite a population because it's gone astray; they're neither divine punishment nor a sign of the Rapture.**

and the current coronavirus, we live by stories of alternate universes in which history might be turned back, the sick healed, the dead brought back, normalcy restored. If only the federal government had made Covid-19 test kits available sooner. If China had acted with greater transparency and dispatch. If we had avoided that spring break party.

All this storytelling can give the agitated mind something to churn on, but obsessing over conditionals can also add to the moment-to-moment burden of preventing sickness and death, and tending to the sick and dying.

Thus, the literature of plagues confronts inevitability along with reeling what-ifs. Published around 550, Procopius of Cae-sarea's account of the so-called Plague of Justinian, which devastated the Eastern Roman Empire in 542, warns that any attempt to extenuate plagues is folly: "It is quite impossible either to express in words or to conceive in thought." Plagues

Plagues are leveling in the extreme, making a rich joke of nearly every human endeavor. In response the plague literature exploits that joke, and often partakes of tropes from a late-Medieval French painting style, danse macabre, in which ominously merry skeletons dance people to their graves. (The dance metaphor has, improbably, resurfaced lately in descriptions of how a population that's been disoriented by an epidemic can lurch between prioritizing health care and prioritizing its economy.)

These danse macabre images spoof human vanity, especially that of the rich, noble, and religious, who believe they're above the vulnerabilities of the body. In Edgar Allan Poe's "Masque of the Red Death," Prince Prospero finds "his dominions ... half depopulated" by a vicious plague, and so summons a thousand nobles to lock down with him in his well-provisioned and thoroughly sealed abbey. "With such precautions the court-

take their pilgrimage simply because it's what one does in spring.

That premise allows Chaucer to launch into 24 barstool stories of farcical misadventures—heavy on the sex, satire, and fart jokes—that the reader comes to understand are also merely ... what one does. Pathogens do what they do, and the damage they cause can't be helped, very like the damage done by Nicholas in the "Miller's Tale," when he "let fly a fart as loud as it had been a thunder-clap." (It "well nigh blinded Absalom, poor chap.")

Oran, the disease-beset Algerian town at the center of Albert Camus' *The Plague* (1947), might benefit from such a thunder-clap breach of decorum. For Camus, it's conformity that leads to death. "The truth is," he writes of the town, "everyone is bored, and devotes himself to cultivating habits. Our citizens work hard, but solely with the object of getting rich." They have not even an "intimation" that another life exists, and they've been so panicked at the

thought of halting commerce that they've contracted and spread the plague. To a cape-swirling midcentury French mind bent on liberation, a human comes to life only when he forfeits the daily commercial grind in favor of more ecstatic ways of living.

But back to Procopius in the sixth century, when he eventually rejected his own observation that viruses can't be explained. He couldn't resist. He ended up laying blame for the virus at the feet of his former employer, the emperor Justinian, in a vindictive, pornographic work that claims Justinian may be a demon, and caused the plague.

If it's hypocritical of Procopius to pin the plague on the emperor, it's also understandable. Blaming Trump for Covid-19 has been a reflex of many who rightly observe that he didn't act fast enough to subdue the novel coronavirus earlier this year. Still, no leader in history has ever responded "well" to a plague—and many, including Pericles and the Roman emperor Hostilian, have died of them.

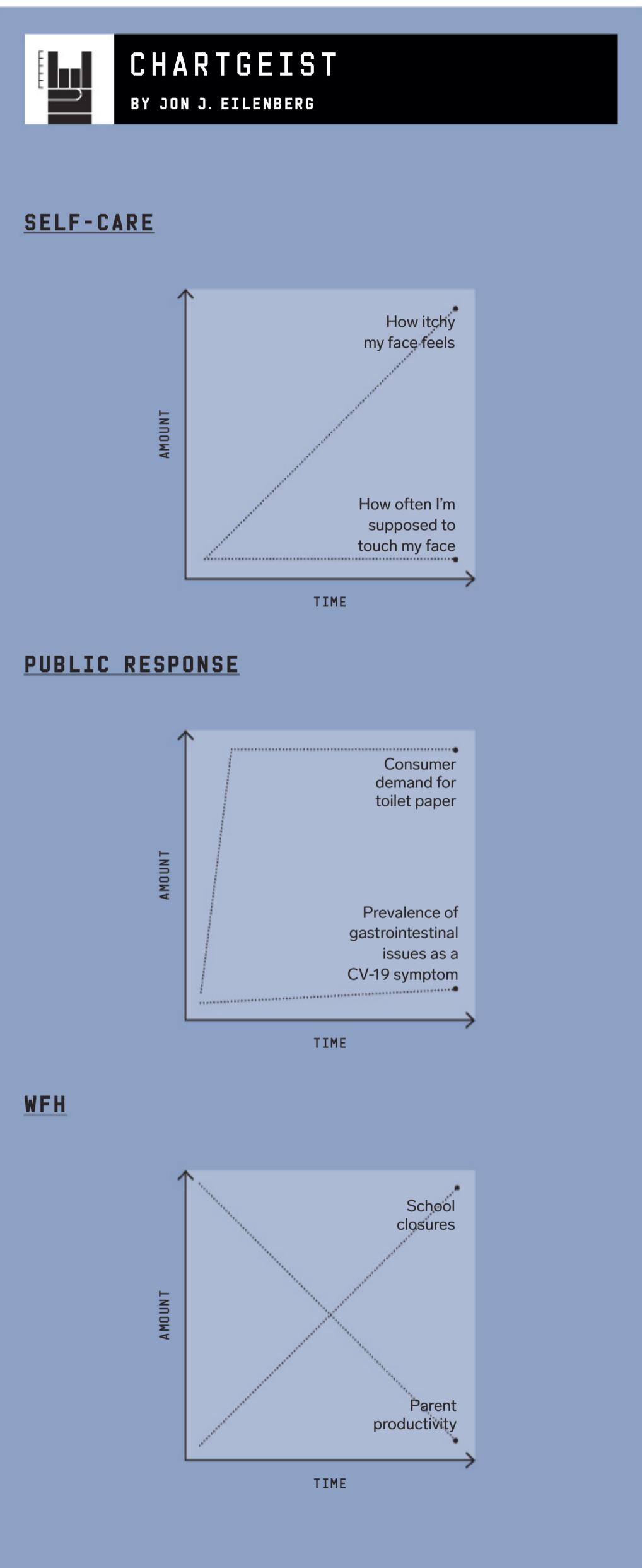
But how's this for a twist in the millennia-long farrago of human plagues? Just last year, having examined a spread of data from pollen samples to papyri to coins and mortuary archeology, scientists and historians concluded that Procopius had *exaggerated* the damage done by the Justinian Plague. Modern scholars have argued that the plague is what razed the Roman Empire; the paper, in the *Proceedings of the National Academy of Sciences*, says no, and even suggests the contagion might have been "inconsequential," causing far fewer deaths than the tens of millions once attributed to it.

Could tall tales of that plague have been a political play by Procopius to destroy Justinian's reputation? We'll never know. The best-laid plans of microbes and man often go awry. Which is why, in plague years or not, we need less propaganda and more poetry.

*A kindly thing it is to have compassion of the afflicted.* That's how Boccaccio begins his *Decameron*, and that medieval aphorism is still the most lucid insight into plagues we may ever have. ■

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VIRGINIA HEFFERNAN (@page88) is a regular contributor to WIRED.





# WHAT WE LEAVE BEHIND

The future doesn't need our monuments. It needs our data—and warnings.

BY PAUL FORD

*Are we going to be OK?* I am asked this, as a cofounder, in many different ways by many people, every day. People have an infinite desire to hear that they are OK. It makes better content than anything on HBO. We hold an all-company videoconference and put up a slide that says “We are OK.” That slide is better than *Game of Thrones*. ■ And we, meaning our little software studio, are, so far. My cofounder is an actual war refugee from Lebanon. He guards the company as if it’s a village under siege. Now his paranoia looks more like wisdom. Because we are a village under siege. Employees get on a big videoconference, dozens of them in little panels onscreen, and share their houseplants. Kids, dogs, cats, birds, and spouses wander in and out of the frame. ■ When you read this, a couple of weeks after I write it, you’ll know how bad it’s going to be. You are a hundred times more knowledgeable than I, and I envy you. Right now the entire country is waiting for the

hospital to call with its test results. Did we flatten? Just as worried as everyone else, I make animated GIFs that say “Remember there are good surprises!” and put them in Slack. It’s my job to be an absolute damned rainbow, a babbling Panglossian cheesy-uncle hopebeast. The first thing coronavirus kills is irony, at least at the level of management.

At night, in my awkward bedroom office, after Slack has gone to bed, I turn to this one Wikipedia page that lists the oldest extant companies. Some of them have made it for centuries, and a few for more than a millennium. Reading it is pure comfort. These institutions have outlasted bad leadership, wars, uprisings, ungrateful employees, and plague. They’re so resilient that their continued existence has become their defining attribute, like the very old veterans of long-ago wars. Each old company does familiar work: construction, brewing, hat making, banking. Food, shelter, clothing, money. The older the culture, the older the companies, with Japan in the lead—Kongō Gumi is a construction firm founded in the 500s (but acquired in 2006).

Back at work, a potential client—they hold big cultural events—emails that they’re pausing their project. *Of course*, I respond. Whoosh goes the economy. Hunched in my chair, wearing bright clothes to lighten the mood, with my voice creaking from a cold (not the ‘rona, I swear), I keep trying to close a deal.

We have this one client who did years of research into global warming and engaged us to build a platform to “share vivid representations of what’s coming.” What’s coming, as you know, is not wonderful. So in we went, clomp clomp with our big digital feet, making software, setting dates, asking for copy for the website. Demonstrating value. Finally this client, voice serious, called and asked us—and this has never happened—to stop working so hard. We need you to do this with us, they said, not for us. Which of course means I have to *think*—the one thing I can’t delegate.

In this case—plucked momentarily out of my world of cheerful grind and forced to contemplate the end of the world, professionally—it came as a weird relief. A welcome chance to look reality in the eye and shake its hand. (This was before the pandemic.) Because we all know it’s coming. We all know that the world is ending. It’s

what makes our society different. Not even the Romans could claim that.

Still, we push ahead. Over the past few decades a number of people, including some very powerful ones, built a clock in the desert meant to run for 10,000 years. It’s a project intended to make people think about long stretches of time, about the longevity of institutions. Obviously, well, that part of the project is not working. But it’s still a big clock and I love it. Tick, tock. I think about it and about the old companies.

sculptures of Ozymandias and leave them in the desert to say to the future, “Look on my Works, ye Mighty, and despair!” But, man, what I really have time for now are those tsunami stones. Science tells us where to put them. We might be alarmed or relieved to see their distance from the shore. Can’t you just see the local tsunami stone committee coming together and pulling a wagon out by the sea and putting that big rock down, because they need to? I want to join that committee.

## **Over hundreds of years, the people of Japan left stones to tell future builders the high-water mark of tsunamis. Some are engraved. They are nice stones.**

Perhaps you’ve seen the long-term nuclear waste warnings, which researchers developed in the 1980s, creating the field of nuclear semiotics. Our radioactive trash will last much longer than any culture, so the idea was to create pictographs and a language to warn our progeny away from atomic waste. Some future person dressed in elk fur with a spear made from a Chrysler bumper will peer at those markings and take a picture with their phone.

Over hundreds of years the people of Japan left stones to tell future builders the high-water mark of tsunamis. They’re ... just stones. Some are engraved. They’re nice stones. And they just left them there.

I make a list of things that can go wrong in our company and rank them by priority and then throw the list away. (Well, I just close the Google doc.) Who the hell knows? It’s an age of surprise.

Are we going to be OK? Sure, *we* are. We make digital things. If you thought people were on the internet too much, wait. You just can’t subtract bits and bytes and swipes and taps from the economy. Not anymore. All we have to do is hold on, adapt, close the deal. But not everyone else will do well. This, too, seems unavoidable, and terribly unfair.

It’s nice to build desert clocks and send cars to space and do all the other things billionaires love to do. It’s fun to build big

Most of my favorite old companies never got too big. They did simple things well, over and over, for lifetimes. The giant enterprises of the moment—Google and Apple and capitalism—will of course one day decay, cresting invisible curves of their own, being swallowed by unimaginably larger things that follow. No one will see it, and then we’ll all see it. It will seem impossible, and then it will be too late. Big things are vulnerable. Small things survive. Like mammals, or viruses.

We came to believe that our recent history is the range of what is possible, and now we are watching charts where the *y* axis can’t keep up with events. For its part, the future is not awaiting our wise counsel. That is the wealthy man’s folly, to believe that people want your wisdom. The future is concerned with itself. The people in that time will abide your wisdom in exchange for safety. They will be amused by our clocks and space cars, but what they will want to know is, how high did the water get, please? They will want data-markers, points in space, warnings. *Mind me*, say the stones. *Stand here when the water comes*. And maybe: *We are going to be OK*. But only for a much larger value of *we*. And: *I hope you leave stones of your own.* ■

**PAUL FORD (@ftrain) is a programmer, essayist, and cofounder of Postlight, a digital product studio.**



# MAKERS TO THE RESCUE

A network of tinkerers comes in handy when government fails.

BY CLIVE THOMPSON

As the Covid-19 pandemic spread across the US, Isaac Budmen and Stephanie Keefe watched closely. They knew what we all did: Protective equipment for health care workers—like those solid-gold N95 masks—were in perilously short supply. Hell, the CDC itself had recommended that, in a pinch, nurses use *bandanas*. They also knew that in Syracuse, New York, close to where they lived, a Covid-19 testing facility had just opened. They decided to help. ■ Budmen and Keefe are the founders of Budmen Industries, which makes 3D printers for architects and artists. They set about designing a “face shield”—a visor with a plastic sheet attached, like a see-through welder’s helmet. It’s only one small piece of protective gear, but a useful one. ■ On the evening of Saturday, March 14, Budmen and Keefe got to work. Their first prototype failed: The fit was too tight, and attaching the plastic was too difficult. By 9 pm the following night, though, they had success. “We tried it on, it felt good, we whipped our heads around trying to make the thing fall off,” Budmen says. They printed a batch and brought them to the county executive’s office. *We need as many as you can make*, emergency managers told him. ■ A local newspaper picked up on it, and demand exploded. “We had hundreds of requests—*Hey, I’m a nurse, we*

*need these,*" Budmen says. Crucially, supply exploded too. They had put their design up on their website, and within days more than 500 people with 3D printers began downloading it to print the visors for their own areas. Budmen and Keefe had kick-started an ad hoc, globally distributed factory producing on-demand protection gear.

For years, the “maker” movement has been encouraging people to try their hand at engineering, building, and crafting. It has produced a welter of quirky hobbyist projects. (Guilty!) But as a quiet side effect, it has also built a latent network of nerds who are very useful in a crisis. And it shows us something—equal parts inspiring and dispiriting—about our state of disaster preparedness.

lives of ventilators. In Italy, when a manufacturer couldn’t produce replacement parts fast enough, a team of engineers used their 3D printer to make them. In the US, a group called CoVent-19 Challenge is trying to design a simple open-source ventilator that could pass FDA regulations. As of March, more than 1,200 designers worldwide had volunteered to contribute ideas.

“People jump in with both feet,” marvels Joyce Arbucias, a Florida woman whose Facebook mask-making group mushroomed overnight. Yet it’s also a searing indictment of federal leadership. It was the US government’s job to prepare for a pandemic, including plans for supply-chain choke points. It didn’t. “Let’s not fool our-

## The new coronavirus has shown us that our traditional ways of doing business in medical tech can fail epically in a crisis.

The good news is that ordinary people are coming to the rescue. When it became apparent that there were not nearly enough N95 masks, for example, sewing hobbyists instantly networked online to coordinate DIY mask-making. Elizabeth Preston, who runs a small quilting business in Orlando, Florida, adapted a simple mask pattern she found on a Facebook group to allow the wearer to insert their own piece of N95 filter material. Within a day, Preston had sewn 20 masks; requests from local health care workers flooded into her Nextdoor account.

“There’s a helplessness that you feel” in the crisis, Preston told me. “It’s like, at least I can do something.”

I wondered if health care folks would scoff at hand-sewn masks. Nope: “Obviously it’s not perfect, but it’s better than nothing,” as Janelle, a home health care nurse, told me. Her sister had scooped up masks for her from Preston’s porch. “I just so appreciate the way that my community has kind of rallied around me.” By mid-March, some hospitals were actively asking for DIY masks; some nurses figured they could use handcrafted masks for non-Covid-19 patients, allowing them to save their precious N95s for the pandemic.

Hackers have also helped extend the

selves. What we are doing is a stopgap,” Arbucias says. She’s hoping that by the time you read this, N95s are widely available. (“I hope I never have to sew a mask again.”)

It also shows a failure of capitalism. Part of the reason we’re short on essential med-tech is closed-source designs, often created to maximize vendor profits, says Canadian doctor Tarek Loubani. His project, Glia, has designed basic open-source tourniquets and stethoscopes that can be 3D-printed cheaply anywhere. “These things should be commodities,” he notes.

Open-source makers, he argues, can produce solutions that rival those of the marketplace. Loubani’s 3D-printed stethoscopes, for example, have been published in a peer-reviewed journal.

He’s got a point. The new coronavirus has shown that our traditional ways of doing business in medical tech can fail epically in a crisis. We need to think hard about what regulations and incentives could ensure a truly innovative and resilient market. For now, though, thank the everyday tinkerers who did what they could. ■

CLIVE THOMPSON (@pomeranian99) is a WIRED contributing editor. Write to him at clive@clivethompson.net.



## WARNING: MAY CAUSE SIDE F/X

What really sets off my allergies this time of year—the start of blockbuster season—is the inflorescence of cinephilia. The welcome boom of meticulously sound-edited explosions is met by a countervailing chorus of gassy Criterion collectors huffing out their blanket disdain for special effects. “The VFX industry is broken!” “CGI is going backward!” “The worm guys in *Men in Black: International* looked way better in the original!” (Get neuralyzed, twerps. Since when did the fourth movie in a commodity sci-fi franchise ever care about out-visualizing the first?) Their complaint is either idiotic, disingenuous, or both. Idiotic because virtual simulacra have never popped more eyeballs. Beyond the tools showcased by big-budget effects-fests, like ray tracing and VR filmmaking inside Unity gaming engines, even the best of what the snoots call realist cineMAH exploits VFX—from the scene extensions in *Parasite* and the backgrounds in *Roma* to the editing stitch-ups of *1917* and *Dunkirk*. It’s disingenuous, meanwhile, because these complainers are so inconsistent. They point and guffaw at a de-aged Will Smith, a marvel of a digitized human, but when a shabby Mona Lisa deepfake moves her quasi-smiling lips? They scream and flee faster than fin-de-siècle theatergoers at the arrival of a train. How does it make sense to trash-talk Hollywood breakthroughs while simultaneously prophesying the end times at the flicker of a face swap? Because, in truth, cinephiles don’t hate special effects. They’re scared of them. In the pits of their fraudulent souls, they fear that, someday soon, they’ll no longer be able to tell real from fake. Reality check: They already can’t.

# HOW TO KILL A CORONAVIRUS

**Even a bug this ruthless has a few fatal weaknesses of its own.**

The race is on to find a cure for Covid-19. Researchers are testing new vaccines, resurrecting old drugs, and repurposing treatments originally developed for other diseases. Things are moving fast; by the time you read this, the situation may have changed (for the better, we hope). So how are scientists thinking they'll fend off this tiny viral adversary? Here are a few lines of attack. —SARA HARRISON

## Lock It Out

Each particle of the new virus, SARS-CoV-2, is studded with spikes, which allow it to attach itself to a human cell, poke a hole, and burrow inside. Like the germ that caused the SARS epidemic in 2003, it sticks to a protein on human cells called ACE2, which is especially prevalent in the lungs and small intestine. (SARS-CoV-2 is at least 10 times stickier than its cousin, which may account for its rapid spread.) One way to stop the invader is to keep it from attaching in the first place. This is what your immune system tries to do—it sends out antibodies that gum up the spikes so the virus can't stick to ACE2. But there are other ways of achieving the same effect.

**1**

Make a vaccine. For powerful, long-lasting immunity, a so-called live attenuated vaccine is the gold standard. It contains a defanged version of the virus that your immune system can use for target practice—but it can also cause infection. That's why many researchers are working on vaccines that contain not the whole virus but just the outer spikes. Mixed with immune-boosting molecules called adjuvants, they'll elicit a safe antibody response.

**2**

Take antibody-rich blood plasma from people who have survived Covid-19 and inject it into newly infected or at-risk patients. Plasma won't teach the body how to fend off the virus, and one injection won't last forever—but it could be a good way to prepare health workers before they head to a hot spot.

**3**

Flood the zone with decoys—synthetic molecules that look like ACE2 and draw the virus away from vulnerable cells. This strategy slows the virus's reproduction and protects lung cells from damage.

**4**

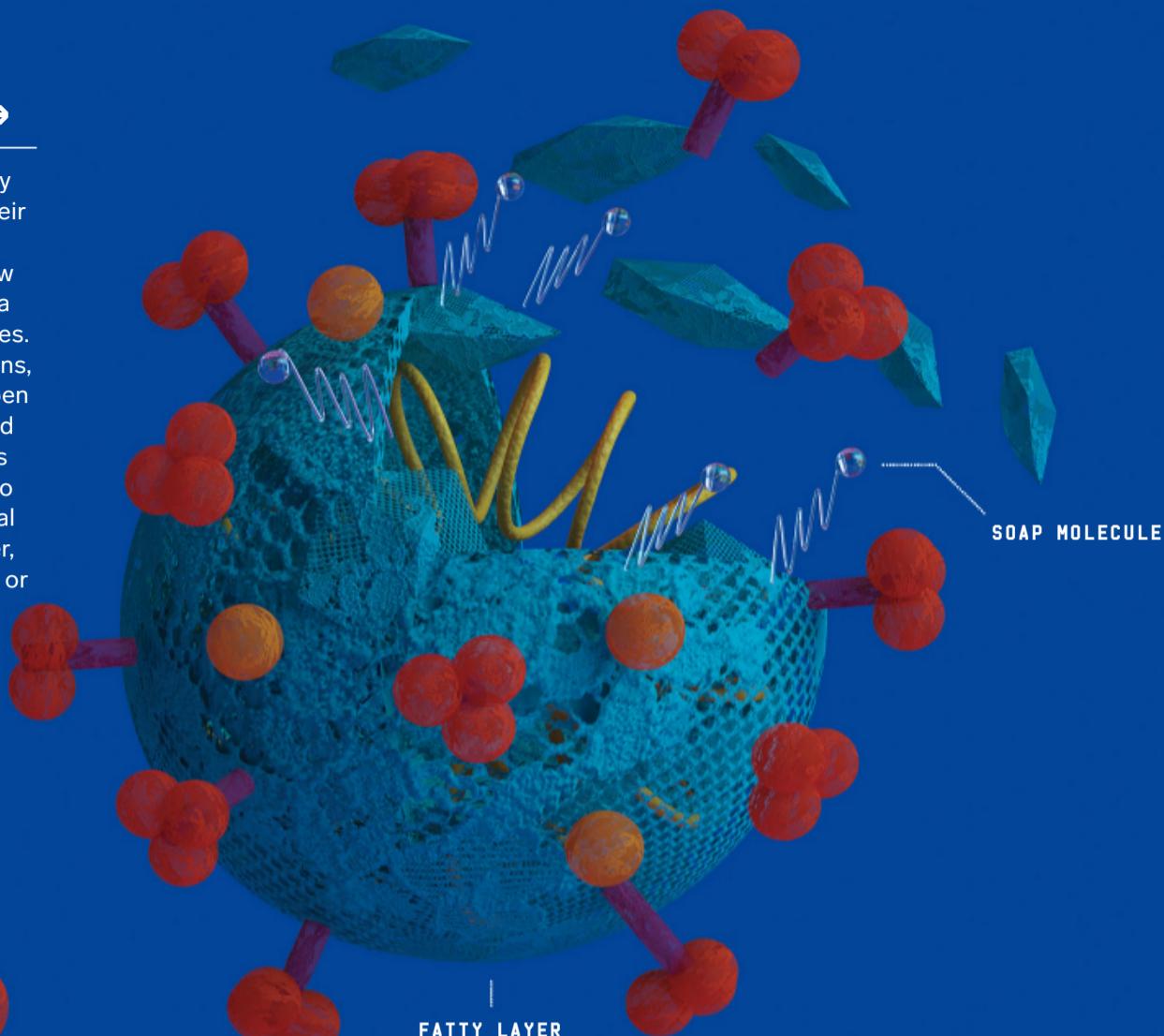
Invent drugs that hinder ACE2. In theory, these compounds would work on both SARS and Covid-19, stopping the viruses from sticking to cells. But ACE2 plays a number of other roles throughout the body; it helps regulate blood pressure, kidney function, and even fertility. Messing with it could have dangerous consequences.

SPIKE FROM VACCINE



## Kill It on Contact →

All viruses wear heavy-duty protein coats to protect their precious genetic material from the elements. The new coronavirus sports an extra outer layer of fatty molecules. That's great news for humans, because it's easy to tear open with soap or alcohol-based disinfectants. (Soap works best, and you don't need to bother with the antibacterial stuff.) Without its fatty layer, the virus dies. Wipe it away or wash it down the drain.



## Sabotage It From the Inside

A virus's sole purpose in life is to hijack the machinery of its host cell and force it to make viral copies. By changing how that machinery operates, it's possible to stymie the virus's attempts. Drugs that were developed to fight other ailments could have off-label applications for Covid-19.

1

Chloroquine phosphate, used for decades to treat malaria, changes the pH level in human cells, making them less acidic—and less hospitable to certain viruses. Researchers are exploring whether SARS-CoV-2 might be one of them. Chloroquine can also reduce the lung inflammation that kills some patients with severe Covid-19 infection. One problem: The line between a therapeutic dose and a fatal one is razor-thin.

2

A class of drugs called protease inhibitors, long used to treat HIV and hepatitis C, disrupt the viral replication process. Proteases are like molecular scissors; once inside the host cell, SARS-CoV-2 uses them to slice long strands of protein into usable chunks. Without these scissors, the virus's life cycle can't continue.

3

Another class of medications targets an enzyme called polymerase, which strings together copies of the virus's genetic material, RNA, inside the host cell. Two promising candidates in this category—remdesivir, originally developed to treat Ebola, and favipiravir, first deployed against the flu—impersonate the building blocks of RNA and get incorporated into the chain. Once they're there, the polymerase can't add new pieces, and replication halts.

# A STAR IS BORN

Fusion energy gets ready to shine.

BY LAURA MALLONEE

Until 1920, humans had no real sense of how the sun and stars create their vast amounts of energy. Then, in October of that year, Arthur Stanley Eddington, an English astrophysicist, penned an essay elegantly titled “The Internal Constitution of the Stars.” “A star is drawing on some vast reservoir of energy by means unknown,” he wrote. “This reservoir can scarcely be other than the subatomic energy which, it is known, exists abundantly in all matter; we sometimes dream that man will one day learn how to release it and use it for his service.”

From that moment, scientists began the quest to harness unlimited, carbon-free power on earth. They’ve built more than 200 reactors that have tried to slam hydrogen atoms together and release fusion energy. It’s a dream perennially called delusional, impossible, and “always 20 years away.” In 1985, recognizing that no country had the will to solve the world’s most complicated puzzle alone, Ronald Reagan and Mikhail Gorbachev called for an international effort to give it a go.

In 1988, engineers began designing the International Thermonuclear Experimental Reactor, now just ITER. Along the way, 35 nations have split the \$23.7 billion price tag to construct its 10 million parts. Now, surrounded by vineyards in France’s Saint-Paul-lès-Durance, the 25,000-ton machine is set to be flipped on in 2025.

The isotopes butting heads will be deuterium and tritium. To get the atoms whipping around the inner chamber of the Russian-nesting-doll-like machine, a magnet will drive 15 million amperes of electricity through them. They’ll also be zapped by 24 microwave generators and three semitruck-sized particle guns, until they reach 270 million degrees F and, *avec optimisme*, crash into each other, releasing heaps of energy. There’s no guarantee ITER will achieve fusion by 2035, as scheduled. But Edward Morse, who teaches nuclear engineering at UC Berkeley, says it’s the “only viable” hope we have to secure the energy we’ll need over the next millennia: “It’s Rosemary’s baby. We have to pray for Rosemary’s baby.” And if it fails? As Eddington wrote, if man “is not yet destined to reach the sun and solve for all time the riddle of its constitution, yet he may hope to learn from his journey some hints to build a better machine.” ■

LAURA MALLONEE (@LauraMallonee) writes about photography for WIRED.





This Poloidal Field Coil Winding Facility is one of 39 buildings on ITER's 445-acre campus. Since the isotopes creating the fusion energy will be 10 times hotter than the sun, two layers of magnetic coils ringing the machine will keep them caged within. That silver doughnut is a cryogenic chamber that will stress-test the coils.

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# Film Buff

This street-friendly shooter checks all the boxes: top-tier image quality, responsive controls, and a portable design that oozes retro charm. —Scott Gilbertson

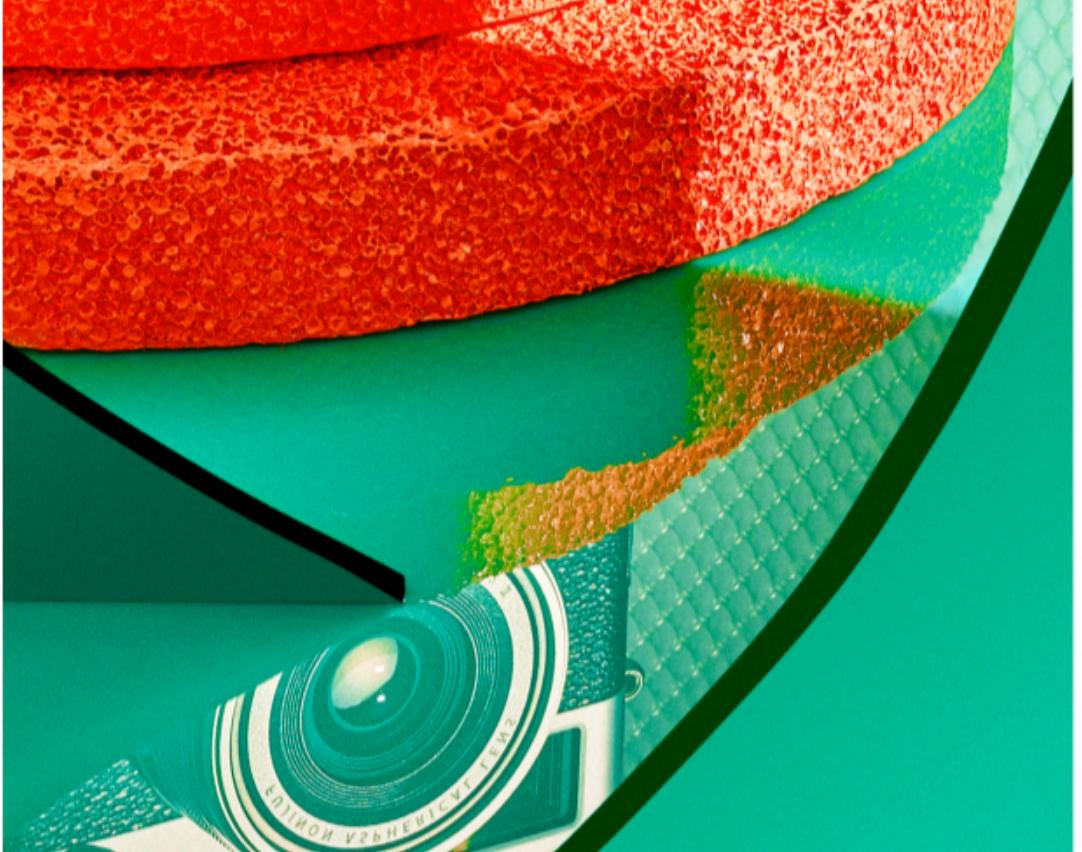
**FETISH**



\$1,399

## FUJIFILM X100V

Each of the four previous cameras in Fujifilm's iconic X100 series of digital compacts has been easy to carry, simple to use, and capable of producing fantastic photos. The latest iteration, the X100V, drives the dart even deeper into the bull's-eye. The design is centered around a new f/2 lens that keeps the image sharp all the way to the edge of the frame while absorbing every available photon. A new tilting screen allows easy shooting from the hip (attention street photographers!) or overhead. Along with a speedier autofocus, brighter hybrid optical/electronic viewfinder, and a wider array of manual controls, that means you're more likely to capture the shot that's in your mind's eye. The output of the 24-megapixel APS-C sensor is aided by the subtle filtering of the camera's digital film simulations. I know what you're thinking, but this ain't Instagram; they match the look of the company's beloved negative film. I can never choose between monochrome and color, so I shoot in film-simulation bracket mode to capture the same shot in three variations. Call it my indecisive moment.



# Spitting Images

These portable printers connect to your phone over Bluetooth and make wallet-sized prints you can hang on the fridge or sanitize and share. —Scott Gilbertson

\$99

\$99

## FUJIFILM INSTAX MINI LINK

The Mini Link doesn't use paper; it prints smartphone photos directly onto Polaroid-style 2.4 x 1.8-inch instant film, and the results look great. The Instax app is easy to use, and in addition to still photos, it can print a single frame from your favorite home movie. When friends come over, up to five of them can connect their smartphones to the Mini Link and upload an image; the printer will arrange them all on a single sheet of film.

TOP 3

\$95

## POLAROID MINT

Like many pocket-sized photo printers, the Mint uses Zink technology—that's short for "zero ink." Instead of printing with ink from a cartridge, each 2 x 3-inch sheet of Zink paper (\$10 for a 20-pack) has layers of dye crystals that are activated by heat. The Mint produces great results on Zink paper, though sometimes the blacks are a bit more like charcoal. Polaroid's phone app offers plenty of choices for filters, frames, and stickers, but it lacks the tiling feature of HP's printer.





# Sphere Factor

**These compact 360-degree cameras capture everything around you, then give you tools to serve up shareable edits of your videos.**

—Julian Chokkattu

\$TBD

**VECNOS**

**Best for: Gen Z creators**  
 This slim camera is advantageously simple, both in looks and in function. There are just three buttons: one to turn the camera on and two to control it. The unique design uses four lenses—three that look sideways and one that points straight up—to capture a spherical view of everything happening around you. Sync the camera to a phone to use the mobile app, which lets you see what you're recording and do some basic editing, including centering the field of view on one slice of the panorama. Then, share videos and photos directly to social platforms like TikTok and Instagram. When the camera arrives this summer, we expect the video to be high quality—the Japanese startup that makes the device is the same team behind Ricoh's best-selling Theta 360 cameras.



HEAD TO HEAD

**INSTA360 ONE R****Best for: Cinematic thrill-seekers**

The One R's modular design allows it to transform into whatever camera works best for your adventure. The three lens modules, including a 4K action cam and a 5K wide-angle camera codesigned by Leica, snap onto the red battery plate. The dual-lens 360 attachment, however, uses two fish-eyes to capture an image-stabilized, all-encompassing view of your stupid human tricks. Once you load the footage into the Insta360 mobile app, its AI-powered object tracking recognizes your main subject and keeps it centered in the frame. The app also has the ability to render the company's \$20 selfie stick accessory invisible; the result looks like the camera is just floating a few feet in front of an outstretched arm.

\$450

Insta360



TOP 3

# Wild at Heart

Don't rely on a delicate smartphone for those #OutdoorAdventure moments. Get a rugged camera that laughs in the face of danger. —Jess Grey



## RICOH WG-70

Ricoh's latest entoughened camera has special modes for optimizing colorful foliage and pristine snowy vistas, but it loves getting up close too. A "digital microscope" mode shoots detailed macro photographs, thanks to a ring of LEDs around the lens that illuminates intimate encounters. When you take it underwater (it can withstand depths down to 45 feet), the mode lets you try to get as close as 1 cm away from those triggerfish.

**Nikon Coolpix W300**

The consummately rugged Coolpix W300 can withstand dives of up to 100 feet without any additional protective gear, so it's the best option for the scuba set. Built-in image stabilization means details are captured sharply, taming the shakes of your wildest adventures. The camera can also tag the photo metadata with its internal altimeter and compass, adding brag-worthy contextual detail to vacation slideshows.

**\$399**

**Olympus TG-6**

The latest in a long line of rough-and-tumble pocket cams from Olympus, the TG-6 pairs a waterproof, crushproof exterior with a wide-aperture lens that does exceptionally well in low light—on dry land or up to 50 feet underwater. It can keep shooting in temperatures down to 14 degrees Fahrenheit, and the nitrogen-filled, fog-proof lens helps keep the picture clear during sudden temperature shifts, like when you take it out of your cozy pocket to capture a snowy sunset.

**\$449**

# Post Mates

**Shooting an Instagram story from the beach? The latest TikTok dance challenge? Add effects, filters, and other flair to your social videos with these apps. —Michael Calore**

**APP PACK**

<b>RTR0</b> 	<b>MAGISTO</b> 	<b>FUNIMATE</b> 	<b>INSHOT</b> 
This app from Moment—the folks who make excellent snap-on smartphone lenses—comes with prefab filters created by filmmakers (including Shorty Awards finalist Ani Acopian) that give your videos a vintage Hollywood vibe. Swipe to pick a filter, choosing between Noir's moody monochrome, Aria's '60s swank, or the scratchy, desaturated color of Ranger, then shoot your clip. There are no editing tools, but the simplicity is the point. Non-paying users get the three filters mentioned above, but a \$15 per year pro account unlocks 11 others, and new options will be added monthly. Sorry Androids, Rtr0 is iOS only.	Sure, you could storyboard and edit your own video, but why not let an AI do the heavy lifting? Load your clips and still photos into Magisto, then pick the style you're going for: Urban, Movie Trailer, Wedding Bliss. The app uploads your visuals to the cloud, where automated editing software mashes together a video that looks like something a motion-graphics virtuoso would create, complete with music that isn't half bad. A premium account (\$60 a year) ups the number of available style templates from 23 to 36 and gives you the ability to lengthen your videos from a breezy 75 seconds to an epic 10 minutes.	Funimate is the most whimsical option of the bunch, with its myriad methods for adding animated text, green-screen-style backgrounds, and pulsating psychedelic glitches to your social videos. You can upload any MP3 track and dance to it, then add a super-slo-mo effect to your dramatic hair flip. The app contains hundreds of transitions and effects; \$50 a year grants access to all. There's a curated social network feed built into the app that appears to be populated entirely by extroverted teens, but adults can ignore it and publish straight to Instagram, TikTok, or a WhatsApp group text.	The closest thing to a straightforward video editor in this roundup, InShot (shown on screen above) is the app to use if you care less about animated effects and more about adding professional polish to your clips. Trim and merge footage, add some subtle transitions and color filters, and layer on whatever music you want—you can even sync your edits to the beat. Upload straight to TikTok or Instagram, or save your video for sharing elsewhere. There are enough free effects and transitions for you to go full David Lynch, but \$10 a year unlocks everything, gets rid of the watermark, and nukes the persistent (and terrible) in-app ads.

P R A D A

P R A D A  
B L A C K



B L A C K

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CARBON



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# The Reel Thing

**Film photography liberates us from digital intermediaries to pursue an unfiltered connection with our own creativity. —Jonathon Keats**

**Confirmation comes** time and again. Film refuses to die.

When Polaroid abandoned instant film in 2008, a 39-year-old fan named Florian Kaps showed up at an event commemorating the shuttering of the last factory and convinced the company's production manager to join him in making their own product. Kaps' film company, Impossible Project, was so successful that it eventually bought the Polaroid brand name and branched out to make instant film cameras as well.

In 2012, Kodak discontinued Ektachrome, its popular 35-mm slide film. But a nascent audience of shutterbugs drove the company to revive Ektachrome five years later; Kodak's film business saw year-over-year growth of 21 percent in 2018.

Today dozens of first-rate films are readily available at your local Walmart, including Kodak's traditional black-and-white Tri-X 400, Fujifilm's versatile Fujicolor Pro 400H, and, of course, the newly reissued Ektachrome. Buying these films by the cartful, hip designers now tote around cheap

Lomo and Holga cameras, relishing the lens flare and light leaks. And then there's Shane Balkowitsch, a Midwestern nurse who never picked up a camera until he saw the spectacularly detailed images made on glass with wet-plate collodion photography, a labor-intensive process used by photographers before roll film became available in 1888. After mastering the essentially obsolete technique, he's made portraits of celebrities, including one of Greta Thunberg in which she appears to be a visionary time traveler.

The long tail of archaic technologies is normal. Some people still use typewriters and phonographs, never buying into their replacements. Others, like Balkowitsch, fall for old-school methods when they discover communities of committed antiquarians.

Yet more than mere legacy is needed for an outmoded technology to become popular. The standard explanation for retro trends, which has been used to account for the return of vinyl records and analog film, is that the future is coming on too fast. And as much as rapid-fire advances seem

unavoidable, the arts can provide a refuge. Nostalgia is a balm.

Just look to the plethora of digital filters that make your shots look like film. The Huji app purposely corrupts perfectly exposed smartphone pics with simulated light streaks (and a faux 1998 date stamp). The more sophisticated VSCO emulates the color gamut of dozens of films, many out of production, so you can set your phone to capture a shot with the high saturation of Agfa Ultra 50 or the soft skin tones of Kodak Portra 150NC.

But as closely as software can imitate a vintage rig, and as well as it may hide the fact that you're shooting on an iPhone 11, people still crave the real thing. Digital simulations don't satisfy us, and that points to a deeper reason for analog's persistence.

Smartphone photography is fast and easy because it's aided by algorithms. Although skill still matters, the number of variables involved in taking a photo has been engineered to a minimum. That can make digital photography feel cold and artificial, and the digital photographer more like a tool than an artist. Those filters we add, then, personalize pictures that are generically exact already. The algorithms that tweak colors or fake a lens flare let you be imperfect, but only in a perfectly calculated way. Your phone still pwns you.

The popularity of analog photography can be seen as a reaction to this pwnership—and a manifestation of anxiety that most everything we do is executed by software intermediaries that make decisions on our behalf. Like our smartphone cameras, our Echos and Teslas try to second-guess our desires, as do the social networks where we post our photographs. We're not in control and not fully genuine.

Analog photography is dignifying because it's out of the hands of the algorithms, which means it affords you the freedom to make your own mistakes. Suffering the consequences of human error is paradoxically liberating, and a great picture can provide a rush equivalent to winning a marathon.

A couple of years ago, when Huji was released, *Time* asked photographer Stephen Shore what he thought of digital filters. He dismissed them as gimmicks, remarking that a photograph "is good because of the decisions the photographer makes."

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JONATHON KEATS wrote about video surveillance in issue 27.11.

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PHOTO BY PAUL RAESIDE

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#### DIY SANITIZER

## Hands On

**No Purell? No problem. When disinfecting gel sells out everywhere, you can just make some yourself with stuff you (hopefully) already have at home.—Boone Ashworth**



Before you start, wash all the tools you're going to use with soap or dishwashing liquid, otherwise you could contaminate the whole thing. According to the Centers for Disease Control and Prevention, your sanitizer must be at least 60 percent alcohol to be effective. But it's better to get way above that. So to get started, find a bottle of 99 percent isopropyl alcohol. That's best. (Sorry, your typical vodka and whiskey are too wimpy.)

#### Gel Us

In an emergency, you can make an effective sanitizing gel with just the contents of your medicine cabinet. Mix 3 parts isopropyl alcohol to 1 part aloe vera gel. Add a few drops of tea tree oil to give it a pleasant scent (and align your chakras).

#### Aerosol Spritz

This recipe is more complex, but it's the one recommended by the World Health Organization. It makes a more potent (and less sticky) spray. Mix 12 ounces of isopropyl alcohol with 2 teaspoons of glycerine. (You can buy jugs of it online.) Mix in 1 tablespoon of hydrogen peroxide, then 3 ounces of water that you've boiled and then cooled—use less water if your rubbing alcohol's concentration is sub-99 percent. Load the solution into spray bottles or wet a paper towel to use it as a wipe. Add a splash of scent-rich essential oil. Just don't use lavender—everyone uses lavender, and your sanitizer is superior.

Finally, the WHO recommends letting your concoction sit for at least 72 hours. That way the sanitizer has time to kill any bugs you might have introduced during mixing.

## HOUSE RULES

# Remote Control

No matter why you're working at home, breaks and boundaries are your friends. —Brian Barrett



We all know by now that social distancing is an effective way to slow down a pandemic, and companies are doing the right thing by asking their employees to work from home during public health scares. But staying productive in the same place you sleep, eat, and play with the cat isn't easy. As someone who has worked remotely since before Slack was a proper noun, I am here to tell you: Setting boundaries will go a long way toward keeping you sane.

First, it should be said that being able to work from home is a luxury, full stop. Too many people don't have that option, which is especially worrying in a time of precarious health care and rapidly spreading disease.

For the lucky among you who can work from home, the following tips can set you up for success.

#### GET DRESSED

Let's get personal: Put some damn clothes on. It's tempting to roll out of bed and blob over to your laptop in your pajamas, but it's a trap. If you're dressed for sleep, it's going to be a lot harder to get your brain up to a canter, much less a gallop. More important, if you don't get up, take a shower, brush your teeth, or get dressed, you're breaking the cardinal rule of working from home: Set boundaries.

#### DEDICATE SPACE

Do not work from the bed. Do not work from the couch—not even from the futon. (If those are the only options available, no worries.) Just try to find anything that keeps your laptop out of your lap for most of the day, even if it's just the coffee table. It

helps with focus, yes, but also batteries get hot. Where you actually set up shop is up to you—I usually work at my kitchen counter—but the point is to clearly define the part of your house where work happens. You'll actually get things done when you're there, and it might help you disconnect when you're not.

#### GO OUTSIDE

I make it a rule every couple of days to spend a few hours at a coffee shop. It's a change of scenery and a good excuse to get some fresh air, and it provides the IRL human interaction that Zoom meetings do not. If that's not feasible—for pandemic-related reasons—walk around the block. Got a dog? I hear they like to go outside. It's easy to stay locked in position all day. Don't! Sitting is terrible for your health and mind-numbing when you're staring at the same wall all day.

#### GIVE THEM SOME SLACK

The best way to approach Slack while working remotely, for both your work life and sanity, is to use it more than functionally. Check in with people, even if you don't have a work-related reason to. Share dumb tweets. Don't be afraid of italics and exclamation points. It'll never be the same as grabbing a midday coffee or a beer after work, but it helps to remind people that you exist. And when the conversation does center around work, know when to switch from Slack to Zoom. Sometimes a two-minute face-to-face is more effective than 2,000 typed words.

#### NO TV

Sorry. Unless you already work in an office that has CNN or CNBC on all day, no television. You are not as good at working with that background noise as you think. And that one little break to catch up on *Better Call Saul* will turn into a binge. This applies to video-games, books—anything but music, really. If you wouldn't do it at the office, don't do it when you're WFH. Boundaries, people!

#### PREP YOUR SNACKS

Look, you're going to snack. Constantly. It's something to do! Why type when you can chomp? But keep something remotely healthy on hand—the crunch of a baby carrot is a satisfying stress reliever. That way, when you do finish off a bag in one sitting, it wasn't a heavy dose of Guy Fieri's Double Salt Fajita Pringles. While we're on food: Cook enough dinner to have leftovers for lunch at least a couple times a week. Homemade sandwiches get boring fast.

#### SHUT IT DOWN

What I miss the most about working in an office is the commute. I realize this may sound unhinged. Yes, traffic is terrible and subways are crowded, but it's nice to have clear separation between work and home, plus some time to decompress. That doesn't exist when you WFH. Quitting out of Slack—or whatever your workplace uses—is a good start. Also, set "quiet hours" on your phone: no work-related notifications between 6 pm and 8 am. Don't worry, if the boss needs you, she knows how to find you. Trust me.

## CLEAN YOUR PHONE

# Wipe Right

Sure, you've been frantically washing your hands—and desperately trying to not touch your face—for weeks, but have you been cleaning that germ-ridden smartphone? —David Nield



Research shows that bacteria are happily breeding on smartphone screens, particularly when people share them with their kids. Viruses can cling to glass surfaces for up to 96 hours. Minimize your risk of coronavirus, the flu, or a bacterial infection through good device hygiene.

You can do a proper de-germing with materials you've already got at home, and it's a good idea to do a wipe-down at least every few days.

#### Skip the Strong Stuff

Smartphones are expensive and delicate, so don't dive in with abrasive solutions and materials. Clorox wipes and the like aren't just excessive; they can eat away at the oleophobic coating that keeps fingerprints from smudging your display. Simple cleaning materials (soap, dishwashing liquid, isopropyl alcohol) are all you need.

#### Rub-a-Dub

Power down the device. Remove the case if you have one (wash it separately), and unplug any accessories. Your main cleaning tool should be a microfiber cloth; Apple specifically recommends a camera lens cloth. Start by just wiping it down with no fluids at all, then add warm, soapy water to the mix. Use it sparingly, and dry the device with a second cloth. Avoid getting the ports and buttons too wet.

#### Don't Blow It

Compressed air is great for blasting detritus out of your keyboard, but it isn't rec-

ommended on phones. The jet of air might interfere with the inner workings of your handset. If your phone's ports are jammed with schmutz, use a cotton swab or toothpick to tease it out—just don't scrape around too hard in there.

#### Dunk Away

If your phone is fully IP68 rated for waterproofing (triple-check those specs!), then you can place the phone in a bowl of clean water. After a few minutes, lift it out to dry on a paper towel. Dab any leftover moisture with a cloth.

#### RTFM

Look online for device-specific instructions. Google says it's OK to use cleaning wipes on Pixel handsets, but use them conservatively and keep them away from the ports and buttons. If possible, buy wipes that have been specifically approved for use on electronics.

Don't stop with your phone. Your laptop, mouse, and keyboard are also filthy. For more cleaning tips, visit WIRED.com/gear.

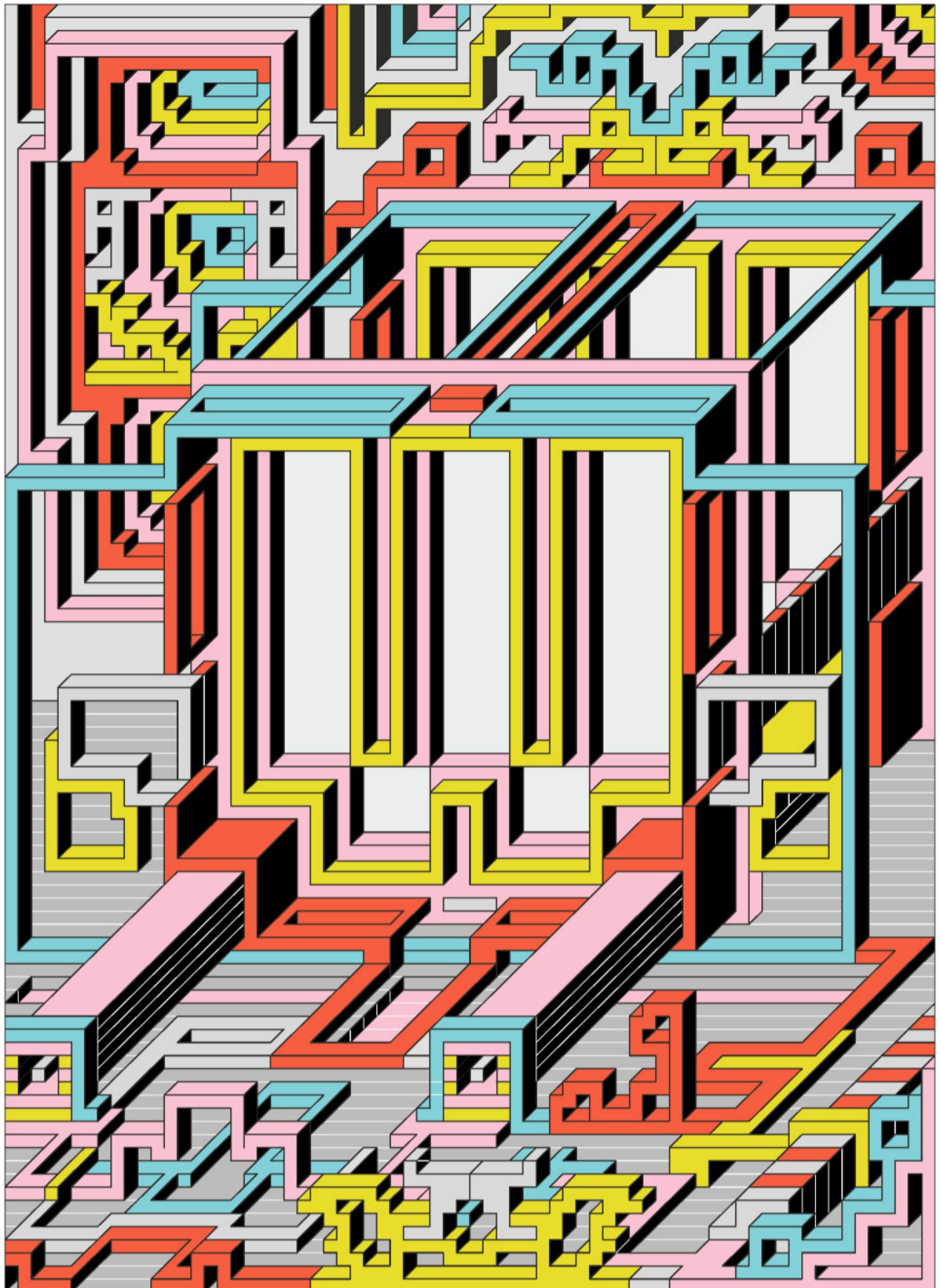


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**WIRED**



**India, the world's largest democracy, has also become the world's largest experiment in social-media-fueled terror. Inside the rise of a Hindu vigilante in the age of WhatsApp and Modi.**

**by Mohammad Ali**





# JENCER



SUPRANAV DASH

PREVIOUS:  
Vivek Premi  
with some of  
his followers in  
Shamli, Uttar  
Pradesh.

## ON

rare occasions, the Indian government—which prides itself on visions of universal digital literacy, online services, and biometrical identity schemes—still conducts certain official communications by radiogram. An operator sitting at a radio transmitter taps out a message, and then a receiver spits out the transmission in another part of the country, generating an instant legal document. And so it was that on December 31, 2015, the superintendent of the jail in Muzaffarnagar District, Uttar Pradesh, received a copy of a radiogram from India's Ministry of Home Affairs, marked "urgent."

The message concerned a particular inmate named Vivek Premi, a local jeweler's son who had recently spent his 22nd birthday behind bars. In the summer of 2015, Premi had accosted a 42-year-old Muslim laborer named Mohammed Reyaz in the nearby town of Shamli. Because Reyaz was handling a calf, Premi accused him of plotting to deliver the animal to local butchers. This counted as a grave allegation: Killing cows is sacrilege to many Hindus and is illegal in Uttar Pradesh. To make matters even worse for Reyaz, Premi was a local leader in the Bajrang Dal, a radical Hindu youth militia that has long waged a vigilante crusade against cow slaughter.

Together with a crew of his fellow militants, Premi bound Reyaz's hands behind his back and paraded him through the most crowded market street in Shamli. A large mob formed, smartphones at the ready, as Premi beat the man into semiconsciousness and flogged him with a belt for more than an hour. "Cow killer! Cow killer! Cow killer!" Premi shouted like a man possessed. Before long, the mob overflowed the banks of the physical marketplace, as videos of Premi's public torture of Reyaz went viral on WhatsApp and YouTube.

Shamli and Muzaffarnagar, which sit in a sugarcane-growing and light industrial region about two and a half hours north of New Delhi, rarely command national attention in India. But when they do, it is often for their communal violence. In 2013 the two districts erupted in sectarian riots between Hindus and Muslims that killed around 50 people and displaced 50,000.

Fearing that Premi was about to rekindle more of the same, the government of Uttar Pradesh—which

was then controlled by a democratic socialist party—moved to act. District authorities arrested Premi and invoked a law called the National Security Act, which allows state governments to preemptively detain people who pose a threat to the public order. (Premi was also charged with rioting, intentionally causing harm, and making insults with an intention to breach peace; Reyaz, who was arrested far more swiftly, was charged with cattle smuggling and animal cruelty.) For months, Premi sat in jail.

But now, with a radiogram from Delhi, Indian prime minister Narendra Modi's central government was stepping in. As it happens, the street fighters of the Bajrang Dal share a parent organization with the ruling Bharatiya Janata Party, or BJP. Both militia and political front were spawned by the Rashtriya Swayamsevak Sangh (RSS), a right-wing paramilitary volunteer organization that advances the cause of Hindutva—an ideology that aims to refashion India into a state for Hindus.

The radiogram declared that the Home Ministry was "pleased to revoke" the state government's decision to detain Premi, and that the young vigilante "may be released forthwith from the jail unless he is required to be kept in jail for any other case."

And so, on the evening of January 15, 2016, a second spectacle played out with Premi at its center, when a crowd began gathering outside the jail in Muzaffarnagar. More than a hundred men milled around in the dusk, hunching into heavy sweaters to ward off the chill. A sickly-sweet odor from the local sugar refineries hung in the air. The men clutched plastic bags of marigold garlands and chatted excitedly amongst themselves. Others fiddled with smartphones. Their ranks included an ultra-right-wing official from the BJP, along with officers from several radical Hindu groups. Despite the cold, their quiet conversations crackled with energy. At 6:15, when the steel gates slid open, they burst into cheers.

A young man in a crumpled white tunic strode out. During his six and a half months in jail, Premi's beard had filled out, and now his mustache curled up at the tips, making his round, boyish face appear older.

Barely able to suppress their joy, his acolytes rushed to greet him. One of them draped a saffron shawl around Premi's shoulders and anointed his forehead with a tilak, the red mark that devout Hindus wear. "*Dekho, dekho koun aayaa! Hinduon ka sher aaya!*" the men chanted. "Look, look who is here! It is the lion of the Hindus!" They hoisted him up on their shoulders, showering him with flower petals as they bore him off into the night.

Premi was equal parts bewildered and excited; at first he thought the crowd was someone's wedding procession. That night, when he had settled in at home, he asked his family for a phone so he could check who had messaged him while he was in jail. Sitting in his bedroom in Shamli, Premi pushed his SIM card into the small socket of a Lenovo A6000+. When the phone screen came alive, he tapped the Facebook button to log in.

Mohammed  
Reyaz, now 47,  
with his wife.  
Reyaz suffers  
from long-term  
health problems  
related to his  
beating at the  
hands of Vivek  
Premi.



The young vigilante was not particularly fond of social media. He used Facebook only occasionally, to chat with his cousins on Messenger, and otherwise preferred action in the street. But as soon as Premi accessed his account, thousands of messages started downloading, along with thousands of notifications and requests. He wanted to read the messages, but there were too many. Before he could do anything, the phone froze. He had to switch it off completely.

Later, he found the same crush of mentions and messages on WhatsApp and Twitter, a platform he had barely ever touched. It took him a few days to scroll through it all and to process the scope and character of his new fame. His thrashing of Reyaz had been national news in India, and on social media, Premi found, most people seemed to have defended him. And now the Modi government's decision to free him had brought him back to the national spotlight. Overnight, Premi realized, he had become a household name among the Hindu middle classes of Uttar Pradesh, and many of them shared his convictions: that Hindus were under threat, that Muslims were unrelenting in their conspiracies to turn India into an Islamic state. His new fans seemed hungry for more.

"That was my introduction to the power of social media," Premi says. Despite his initial skepticism toward a medium that was less physical than he preferred, he resolved to seize the momentum. Shortly after his release, Premi took to Twitter. "I am back again," he wrote. "Let me see whose mother's son dares to slaughter cows." By the next year, he had been elevated to the state-level leadership of the Bajrang Dal.

## FOR

six years, from 2012 until 2018, I worked as a staff writer for *The Hindu*, India's largest English-language newspaper. At first I was based in New Delhi, the city where I had spent half of my life. But shortly after Narendra Modi was elected prime minister in May 2014, I decided to take a transfer to western Uttar Pradesh—because I wanted to understand what was really happening beyond the capital's borders.

Polls had favored Modi's chances in the election for some time. But for many Indians—and perhaps especially those in the liberal, anglophone press—his victory was shocking nonetheless. For one thing, there was the sheer, unexpected scale of the rout: Modi's coalition won such a commanding majority that the Congress Party, which had ruled India with few interruptions since independence, was driven into near insignificance. But more than that, it was the underlying truth that was so difficult to absorb. For years,

Modi's reputation had been defined by his history as a far-right Hindu nationalist. His career had exhibited a striking coherence, from his childhood wearing the khaki uniform of the RSS youth corps to his years as a full-time organizer for the paramilitary and his work helping to launch the BJP on a tide of communal resentment. Most of all, Modi had been defined by his early tenure as the chief minister of Gujarat in 2002, when, under his administration, at least 790 Muslims were massacred by Hindu vigilantes in a three-day killing spree, followed by months of unrest. About 250 Hindus also died in the bloodshed.

But somehow, during his more recent years in Gujarat, Modi had managed to rebrand himself as a sunny, pro-business techno-utopian, an abstemious leader with an intuitive grasp of 21st-century infrastructure and social media. An unnerving segment of the Indian and international elite seemed to buy this image. But the even more disturbing implication of Modi's election was that tens of millions of Indians had voted enthusiastically for his original brand: for the virulently Islamophobic, authoritarian rhetoric that his party spewed through lesser officials and, sub rosa, on vast WhatsApp lists. In Delhi, it was hard to come face to face with this vast swath of India. But to do so, I didn't have to go particularly far.

With a population of some 220 million people, Uttar Pradesh, which borders Delhi, is India's most populous state. Beyond its sheer size, it is an important bellwether in the country's fractious democracy. The state is both the core of India's "Hindu heartland" and also home to an estimated 43 million Muslims, the largest such total in the country. And the northwestern corner of the state, where I was headed, was a particularly active fault line of sectarian violence and paranoia.

In the summer of Modi's election, for instance, one particular story from the region had become a blockbuster in the Hindi-language press: In the town of Meerut, a group of Muslim men had allegedly kidnapped a young Hindu woman, brought her to a madrassa, gang-raped her, and forced her to convert to Islam. It was all, the analysis went, an audacious act of "love jihad"—a supposedly widespread conspiracy among Muslims to Islamize India through sex and dating. In the wake of the story, one of the BJP's most incendiary lawmakers in Uttar Pradesh, a Hindu priest named Yogi Adityanath, made the threat of "love jihad" a centerpiece of his messaging.

Meerut happened to be the town where I was moving, so when I arrived, I went looking for the young woman. I found her and learned that she had retracted her report to the police about the gang rape, explaining that her family had pressured her to concoct the account. In fact, she was a teacher at the madrassa and had fallen in love with a young Muslim man who had never pressured her to convert to Islam, she said.

In a touching conclusion to the story, they ended up getting married, and I reported on the ceremony. But much of the Hindi-language press showed little interest in correcting the record.

Instead the media was caught up in a febrile narrative about Muslims that was just beginning to build momentum. Premi's attack on Reyaz that June was an early indicator of its inevitably violent conclusions.

On the world stage, meanwhile, Modi continued to levitate above a set of increasingly macabre contradictions. In late September 2015 the prime minister embarked on a round of mutually adulatory meetings with Silicon Valley CEOs to promote his Digital India campaign, a plan to bring high-speed internet and digital services to all Indians. Shortly after he landed in the US, Modi's government quietly *shut down* the internet across Jammu and Kashmir, the only state in India with a majority-Muslim population, for three days (a test run, perhaps, for longer shutdowns to come).

Then, on September 27, in an open-air town hall meeting with Modi in Palo Alto, Mark Zuckerberg praised the prime minister for his savvy use of platforms like Facebook. "It's fitting that the leader of the world's largest democracy is also setting the example for all world leaders for how they should connect with their citizens," Zuckerberg said. Modi, whose party's social media apparatus had been pioneering the use of incendiary fake news, smiled back.

The first widely reported lynching in Modi's India happened the very next day. Just after nightfall in the northwestern Uttar Pradesh village of Bishahra, a small crowd descended on the home of a 52-year-old iron worker named Mohammad Akhlaq, whose neighbor had accused him of stealing and butchering a calf. Someone used the public address system of a Hindu temple to summon an even larger mob from the countryside. By the time police arrived, Akhlaq was dead, having been beaten, bludgeoned with bricks, and stabbed, and his son was critically wounded. When I arrived in Bishahra soon afterward, several of the villagers I met wondered why Akhlaq's death was causing such a stir; after all, a calf had allegedly died too.

Akhlaq's was the first of eight lynchings that I would cover over the next three years, as my job increasingly came to involve tracking an epidemic of communal violence in full bloom. According to a database

of hate crimes compiled by the Indian organization FactChecker, there were 254 reported attacks against religious minorities between 2009 and 2018; 90 percent of them occurred after Modi came to power in 2014. According to Human Rights Watch, at least 44 people were killed in "cow-related violence" across 12 Indian states between May 2015 and December 2018. Thirty-six of them were Muslims. Since 2015, the term *lynching*, a word with 18th-century American roots, has become part of the Indian vernacular.

The Bajrang Dal was involved in a large number of these attacks—either administering the blows directly, coordinating them through its private social media channels, or simply inspiring them by example and propaganda. Following Premi's brutal assault on Reyaz, dozens of the group's young extremists had been filmed attacking Muslims, enacting the same kinds of scenes that made Premi a viral sensation. Premi's subsequent release from jail helped set the template for Hindu vigilantism in another way as well: It reinforced the expectation that violence in the service of Hindutva would not be punished.

In an analysis of 14 vigilante killings by "cow protection" groups like the Bajrang Dal between 2015 and 2018, Human Rights Watch found that police "initially stalled investigations, ignored procedures, or even played a complicit role in the killings and cover-up of crimes." In April 2017, I crossed into the neighboring state of Rajasthan after a Muslim dairy farmer named Pehlu Khan was attacked and killed there, allegedly by a group of Bajrang Dal vigilantes; the suspects were acquitted, despite the existence of videos showing the attack itself, a dying declaration by the victim naming his attackers, and a confession by one of the accused. (The videos were deemed inadmissible in court on a technicality.)

The flip side of that impunity is that those who bring facts to light often suffer greater consequences. In early September 2017, a journalist named Gauri Lankesh, who had reported critically on Hindu nationalists for years, was shot and killed just outside her house. Over the next couple of weeks, a wave of journalists received death threats, myself included. So I decided to take a break from reporting in India and eventually moved to the United States.

When I settled in New York, though, I kept think-

ing about Premi. During my time in Uttar Pradesh, I had spoken with him over the phone once or twice for stories. And I was aware that his upward trajectory in the Bajrang Dal had become extraordinary. In 2017 he became chief of the militia's student wing in western Uttar Pradesh. And in Shamli, his unit of cadres was seen as state-of-the-art, patrolling both the streets and the internet, doling out beatings in one sphere while conducting surveillance and spreading Islamophobic propaganda in the other. According to the fairly regimented schedule of advancement in the militant group, Premi was in line to become either the head or deputy head of the Bajrang Dal in the state. It seemed that many of the most powerful forces in today's India—the adulation of the Hindu middle classes, the broad scope of social media, and the tacit support of the BJP—were at his back. I wanted to understand how he had been so successful and how the Bajrang Dal really worked.

When I decided to request a face-to-face interview, I wasn't sure how he would respond, since my name reveals unambiguously that I am a Muslim. But he agreed to speak with me, so I traveled back to India in January of 2019.

## JUST

before the third anniversary of his release from jail, I met Premi on a street corner in Shamli. "How have you been?" I asked, trying to pretend there was no cause for awkwardness. He was an imposing figure. A dark tilak shone prominently on his forehead, and his right earlobe flaunted a small silver ring. He wore an ironed white kurta with a sleeveless red jacket and black shoes with white soles; in keeping with conservative Hindu tradition, a tuft of long, knotted hair dangled from the back of his head. And hovering around him was a clutch of fawning young men.

Premi had called a meeting at a local Bajrang Dal office a short distance away, and he invited me to come along. One of the hovering young men started Premi's motorcycle for him—a 2008 Royal Enfield Bullet Classic, with the word *Hinduraj*, meaning

"Hindu rule," etched above the license plate. Another follower looked on adoringly: "Every time he roams across town on the Bullet with the sunglasses on and a tilak on his forehead," the youth said, "cow slaughterers run away."

The Bajrang Dal office sat, like a permanent threat, in the middle of a dense Muslim neighborhood. After dismounting his bike, Premi paused to look up and down each side of the street the way a prison guard might scan a cellblock. The owner of a nearby candy store saluted him with a face that seemed to betray awful fear; other shopkeepers and patrons stared back blankly. "There is nothing they can do," he said as we went up the stairs to his office. "I have fixed many of them." By "fixed," he meant "beaten."

Many Bajrang Dal offices occupy former *dharamshalas*, or Hindu guesthouses for religious pilgrims. Leaders of the militia have taken them over, arguing that the buildings must remain in service of Hinduism. This one was about 80 years old, with patchy cement betraying its age. Inside the office, six members of the Shamli unit of Bajrang Dal sat on floral-print sheets spread out on the ground, glued to their phones. As Premi walked in, his aides looked up to greet him with invocations of "*Jai Shri Ram*," or "Hail Lord Rama"—the war cry of Hindutva activists.



Settling down on a cushion in the center of the room, Premi briefly addressed the public thrashing that had made him famous, saying that he had no regrets. ("I had to show that if a butcher slaughters a cow, we will deal with him," he later explained.) But cow slaughter, Premi went on, was no longer a high priority for the Bajrang Dal in Uttar Pradesh—because the new BJP government was taking care of it.

In 2017, Modi's party had gained control of Uttar Pradesh and appointed Yogi Adityanath—the radical Hindu priest who had campaigned on the threat of "love jihad"—as the state's new chief minister. Adityanath had declared war on the buffalo meat export industry, which is largely run by Muslims and often accused of being involved in cow slaughter. Many slaughterhouses had since been shut down.

So instead, Premi's cadres in the Shamli unit of the Bajrang Dal were now focused mainly on the fight against love jihad. In practice, this amounted to a bizarre, Stasi-like effort to micromanage the dating scene in a town of 100,000—and to stamp out religious miscegenation at first flush. They ran an extensive surveillance operation, they said, using Facebook and a network of on-the-ground informants.

The social media arm of the dragnet was run by a lanky, bearded teenager named Himanshu Sharma,

who sat cross-legged, a cushion resting between his back and the wall. On Facebook, Sharma said, he and his team had infiltrated hundreds of groups and friended thousands of people, trawling for Muslim men who flirted with Hindu women in Shamli. "We monitor everything, including which user ID is making what kind of comments on Facebook," Sharma said. "They are not subtle in expressing their emotions, and that makes our job easier." Sometimes, he said, he and his team use fake accounts with female names to draw men out. While he spoke, his smartphone buzzed constantly with notifications.

As Sharma was talking, Premi too was preoccupied with his phone, which serves as his main conduit to the group's local network of spies. These informants, Premi said, alert the Bajrang Dal whenever they suspect that a Hindu woman is in the company of a Muslim man. Security guards, gatekeepers, waiters, café owners, housekeepers at hotels: "All of them are part of our team," Premi said. "The effectiveness of this system is that they remain anonymous among the common people, but they are our eyes."

Sitting next to Sharma was the oldest member of the group, Jitendar Rana, 42, a trader who considered himself Premi's mentor. Rana granted that, now that the BJP ran Uttar Pradesh, there were fewer interreligious displays of affection in public. But the Bajrang Dal's message to informants was that vigilance was key. "You show them to us if you see them," he said. "We will take care of them."

When I asked them for an example, the men told me the following story. Early one October morning in 2018, Sharma got a call from an informant reporting a love jihad emergency. The tip concerned a couple who had booked a room in a local hotel. The informant, a waiter, believed that the man was a Muslim and that he and his girlfriend visited regularly to have sex.

Within 20 minutes, according to Premi, Sharma, and Rana, a mob of Bajrang Dal workers had assembled outside the hotel. The couple had been required to hand over ID to book the room, and the mob demanded to see it. The militants gathered outside the couple's room and started banging on the door. When the couple refused to open it, the mob made a unanimous decision to break it down.

The couple were in their mid-twenties. The guy was tall, well built, with a few days of stubble. Before he could do anything, the Bajrang Dal workers overpowered him. "We did physiotherapy on the guy," said Rana, smiling at his use of coded language for violence. They pushed him against a closet and told him to strip so they could see whether he was circumcised, a sure sign that he wasn't Hindu. After that, the group handed the man over to police.

To the cadres' surprise, the woman claimed that



The street in Shamli where Vivek Premi publicly beat Mohammed Reyaz in 2015.

the man was her husband, and she produced an identification card to prove it. Members of the mob argued that the document was counterfeit. The woman stood her ground, so Premi called her family, who hadn't known about her relationship with the Muslim man. Later, Sharma said, the woman's family forced her to leave her job and stay at home.

I later sought to verify this account with the hotel. The man who ran the reception desk declined to confirm any specific details. But on the condition that I avoid using the hotel's name, he said, "There was some issue about a love jihad case. It is our business to host people. But we have to be vigilant about not promoting love jihad."

## ONE

sunny Saturday, I met up with Premi's deputy, Sharma, to visit the court in Shamli. Premi had been apprehensive about introducing me to one of his informers, but he had finally agreed to let me speak to a lawyer who he said was an integral part of his network, since all interreligious marriages are registered at the court. On the way over, Sharma praised the attorney effusively.

Past the pink walls of the entrance, we entered a narrow concrete labyrinth of lawyers' chambers. It was loud, with court clerks, police, and hundreds of clients competing for attention from the attorneys. Finally we found our man. He was tall, bearded, and dressed in a white formal shirt, black pants, a black sweater, and black formal shoes. His name was Sachin Pal. He smiled and politely asked us to wait while he finished some paperwork, then led us out to a tea shop in the far corner of the compound.

I asked him how many interreligious couples register their weddings in Shamli. "Sir, we try to ensure that no couples manage to register their weddings," he replied. "We don't let it happen at all."

He claimed that he was part of a larger network of lawyers. If any Muslim man approaches the courts to register his marriage to a Hindu woman, he said, other workers in his office tell him when the couple has

arranged to visit the court. Then all he has to do is call or send a quick WhatsApp text to Premi's entourage. "On the day the couple comes to the court, the workers of Bajrang Dal take care of them at the gate," the lawyer went on. When I asked what he meant, Sharma chimed in to clarify: "We treat them the way we treated the guy we caught at the hotel."

Even lawyers who weren't part of the network now avoided working on interreligious marriages. "Everyone is scared of taking up these cases," the attorney said. "Because a huge mob of Bajrang Dal workers shows up."

## WHILE

I was spending all this time in Shamli alongside Premi and his accomplices, I also wanted to meet with someone else—someone I had only seen in videos that replayed often in my mind.

Shirt torn, bare-chested, his face swollen from beating, Mohammed Reyaz stands listlessly in the crowded marketplace as blood flows from his right eye and trickles down through his beard. One man from the Bajrang Dal holds him by the collar of his torn gray shirt while Premi flogs him with a belt, displaying no hesitation. Premi pauses when he grows tired, and rolls his sleeves up to his elbows to do his job more efficiently.

Because Reyaz's hands are tied behind his back, he can only hunch down to deflect the flogging. Aware of the many smartphones pointed at him, Premi glances up to meet the cameras. When he stops to interrogate Reyaz, the laborer seems to be semiconscious and can barely talk. Reyaz tries to explain that he is not interested in slaughtering cows. Young men in the mob next to Premi smile and wait for their turn to flog Reyaz. One of them, impatient, rolls up his sleeves and starts in. The video ends.

On January 4, 2019, I met Reyaz in the dilapidated one-room house he rents several miles from Shamli. The room was spartan, with bare brick walls. A woman in her late thirties tended a woodstove. The only furniture was a pair of rough wooden cots. Piled together on one of them, three of their young children slept soundly.

Reyaz sat on the dirt floor in a brown sweater, with a woolen muffler hanging from his neck. He had a pensive expression under his short, unkempt beard. To revisit the day of his beating—the hellish pain, the fear, the shame—was excruciating.

"I assumed it was the last few moments of my life,"

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Reyaz explained. “I begged him to stop and let the police punish me if I did something wrong. But he wouldn’t stop flogging me. I went unconscious after some time.” Reyaz lit a bidi, a poor man’s cigarette of unprocessed tobacco wrapped in a coarse leaf. After taking several drags, he continued: “I was not doing anything illegal.” Then his voice took on a pleading tone.

“Please do not tell anyone where I live. They will hunt me down if they know I spoke against them,” he said. “They did this to me when they were not in power. Imagine what they will do now that they have the protection of the ruling party.”

Beads of sweat rolled down his forehead. Reyaz said he no longer showed his face in Shamli, where Hindu militants roam the streets with impunity. He said his entire family avoids the town.

## HINDUS

make up about 80 percent of India’s population, and Muslims—at about 14 percent—are a disadvantaged minority by almost every measure: They are poorer, less educated, more likely to be imprisoned, and far less socially mobile than Hindus. Decades of housing discrimination and successive rounds of communal violence have also pushed them into Muslim ghettos, which only reinforce their socioeconomic inertia and stereotypes of Muslim backwardness.

So why is it that so many Hindus are convinced that Muslims have a diabolical upper hand and are on the verge of eliminating India’s dominant religious group? This worldview has become disturbingly prevalent over the course of my lifetime. I wanted to know how Premi, in particular, had come to believe it so deeply.

One day, Premi invited me to meet him at another Bajrang Dal office, in yet another dharamshala in the heart of a Muslim neighborhood, this time on the outskirts of Delhi. It was to be our first long, one-on-one chat, and I had a few minutes to wait before he was ready for me. Hanging on the wall opposite me was a life-size portrait of Madhav Sadashiv Golwalkar, the second supreme leader of the RSS.

Established in 1925, the RSS grew up in parallel with the European fascist movements of the 1930s, and Golwalkar was one of its chief intellectual architects. A lawyer, ascetic, and sometime zoology lecturer, he argued that India was synonymous with Hinduism, and that Hinduism was a kind of race—not in the biological sense, but in the sense that its cultural and religious essence grew from Indian soil.

In Golwalkar’s mind, anyone who chose to practice another religion that was not native to the soil of India—whether it was Islam, Christianity, or a secular

faith like communism—was an alien who had forfeited any standing in the race and the nation. “The foreign races in Hindustan must either adopt the Hindu culture and language, must learn to respect and hold in reverence Hindu religion,” Golwalkar wrote, “or may stay in the country, wholly subordinated to the Hindu Nation, claiming nothing, deserving no privileges, far less any preferential treatment—not even *citizen’s rights*.”

Inspired by the example of Nazi Germany, Golwalkar knew it was unlikely that “foreigners” would peacefully accept terms like these; he regarded Muslims, Christians, and communists as “hostile elements within the country” who posed “a far greater menace to national security than aggressors from outside.” If they refused to convert or submit, he intimated, they would have to be purged—forced to “quit the country at the sweet will of the national race.”

The RSS was profoundly out of step with the Indian independence movement, which ultimately enshrined the ideas of secularism and religious freedom in the country’s constitution. The new government banned the RSS altogether in 1948, after one of its former members, Nathuram Godse, assassinated Mohandas Gandhi for his “constant and consistent pandering to Muslims.”

Still, the Hindu nationalist volunteer corps kept expanding. It had absorbed a million members by the 1970s and spawned dozens of front groups. Modi joined the RSS as an 8-year-old boy and went on to carry out its business in secret when it had to go underground again in the late ’70s. Amit Shah, Modi’s immensely powerful and outspoken home minister, likewise became involved with the RSS as a youth.

In 1980 the RSS spawned a new political arm called the Bharatiya Janata Party. The BJP spent its first 10 years on the margins of Indian politics, with barely any seats in Parliament. But in the late ’80s and early ’90s, the party and its RSS allies found a way to captivate Hindus across India: They focused their activism on a single 16th-century mosque called the Babri Masjid, in the Uttar Pradesh city of Ayodhya.

According to long-standing legend, this particular mosque had been built atop the spot where the Hindu god Ram was born, so the RSS launched a movement to build a temple in the mosque’s place. In 1990 one of the cofounders of the BJP, L. K. Advani, embarked on a months-long pilgrimage from the coast of Gujarat

to Ayodhya, a journey that doubled as a roving political rally—organized in large part by the 40-year-old Narendra Modi. Traveling in a car that had been decked out to look like a chariot, Advani criss-crossed a huge swath of India, inciting frequent Hindu-Muslim riots in his wake. To provide muscle and protection when violence inevitably broke out around its Ayodhya activism, the RSS had also recently spun off a youth militia called the Bajrang Dal.

Finally, on December 6, 1992, the Ayodhya movement reached its climax: That day, a rally of some 150,000 Hindus overwhelmed police and stormed the Babri Masjid, razing it with hand tools in a matter of hours. Mass Hindu-Muslim violence broke out across the country. But by then—largely on the strength of Hindu identification with the Ayodhya movement—the BJP was the second-largest party in Parliament and controlled several state legislatures.

While the BJP had suddenly become a mainstream political party, no one seemed to know how seriously to take the Bajrang Dal. In 1997 the political scientist Paul Richard Brass called the group “a somewhat pathetic, but nevertheless dangerous version” of the Nazi Sturmabteilung, or SA, the militia group that protected Hitler’s first rallies. The same horrified but dismissive tone followed the Bajrang Dal for years. In January 1999, in the state of Odisha, a mob chanting the words “Jai Bajrang Dal” set fire to a station wagon where an Australian Christian missionary named Graham Stuart Staines was sleeping with his sons, Philip, 10, and Timothy, 6. All three Australians died in the blaze. Under the headline “Loonies at Large,” an article in *India Today* described the perpetrators as “ruffians with Hindutva leanings” who constituted a “lunatic fringe.” The idea that the Bajrang Dal, too, might one day become mainstream was unthinkable.

When Premi was ready to meet, he called me up to the roof. He was dressed in a crisp pair of military green trousers, a navy blue jacket zippered up to his neck, and black leather sandals. He sat and beckoned me to join him.

From the earliest moments of his childhood, I learned, Premi had been defined and surrounded by Hindu nationalism. He was strongly influenced by his grandparents, both of whom were Hindutva activists. His grandfather ran a Hindu martial arts training center, called an *akhara*, while his grandmother was the local head of the women’s wing of Arya Samaj, a

Hindu revivalist movement that started in 1875 and has converted thousands of Christians and Muslims to Hinduism.

Premi grew up attending schools run by the educational arm of the RSS—one of the largest chains of private schools in India—which instill Hindutva ideology and present Muslims and Christians as alien to Indian culture. Beginning in 2006, when he was 12 years old, Premi also began receiving formal weapons and self-defense training in the local Bajrang Dal *akhara*. He developed a lifelong fascination with firearms. “Since childhood I was fond of having pistols in my hand,” he told me. He eventually became accomplished enough to train instructors who run camps that prepare Hindu youth for self-defense with rifles, swords, and sticks. Though the camps that teach such skills are illegal, the Bajrang Dal trains thousands of youngsters in them each year across India.

In school and at the *akhara*, Premi was taught that India started out as a strictly Hindu nation, one that was victimized and terrorized during centuries of Muslim rule, when Hindus were forcibly converted to Islam. And he learned that the Muslim oppression of Hindus continues to this day. “We may have gotten freedom from the British, but we did not get freedom from the ideology of secularism, the ideology of communists. What is secularism? It is only about hurting the Hindu religion,” he said. And he came to believe that Indian Muslims are animated by “jihad ideology.”

Premi became a Bajrang Dal district leader when he was 18, which gave him numerous responsibilities: “Going to election booths to ensure that Muslims do not dominate any area in casting votes, and mobilizing youths if that was happening. Checking if police were not listening to Hindus, and if Hindus were being oppressed by the police. Taking action when someone abused or insulted Hindu symbols and culture. Keeping an eye out to make sure that no one outraged the honor of any Hindu girl.” But his purview was entirely local—until everything changed in 2015.

Looking back, Premi still regarded his beating of Reyaz, and the attention and status it brought him, as something of a fluke. After all, he said, it was not the first time he had thrashed a Muslim over cow slaughter.

Now, as a state-level leader, Premi claimed to be a member of over 500 WhatsApp groups. They included numerous district-level groups that he ran and monitored, as well as national and international groups run by other radical Hindutva leaders. From his phone, he was constantly surveying the battle against Islam on all its active fronts. The fight against love jihad was only one of them. The Bajrang Dal and its allies were also fighting against “land jihad,” a supposed conspiracy among Muslims to take over land and property in Hindu areas, make Hindus leave, and gradually take over whole neighborhoods. In practice, this amounted





Vivek Premi sings Hindu hymns with a crowd of young men in Shamli.

to a campaign to keep Muslims in their ghettos, at times by forcibly revoking undesirable real estate sales through intimidation.

The high fertility rate of India's Muslim population was an even more towering obsession: Hindutva activists called it "population jihad." In the memes and fantasies of the Hindu right, Indian Muslims are doing their utmost to outnumber Hindus, and they have already succeeded in many parts of India. "In West Bengal, the population of Hindus is less than Muslims," Premi told me. "Every day, Muslim youths gather in some part of the state and attack Hindus. I get information about that on social media."

But that information was more a collective hallucination than a set of facts. According to the most recent census figures, Muslims constitute 27 percent of the population of West Bengal; Hindus, about 71 percent. And across India, the Muslim birth rate—while indeed higher than Hindus'—has fallen faster than that of any other group in India over the past three decades. It is now the lowest it has ever been. Demographers predict that India's Muslim population will stabilize at about 19 percent of the population by around 2100.

As the sun set, Premi had his assistant bring us *balushahi*, a local sweet. After I had my fill, I offered some of my portion to the assistant, who hesitated. "Have the sweet," Premi told the man. "Don't worry. He is not the kind of Muslim who will kill you."

## THROUGHOUT

my reporting, my own status as a Muslim was the elephant in whatever Bajrang Dal office I happened to be in. I often felt provoked, needled, and scrutinized in my reactions, and occasionally vaguely threatened. At one point, one of Premi's deputies leaned over to whisper to another—loud enough for me to hear—to ask if my *ghar vapasi* might be possible.

*Ghar vapasi*, which means "homecoming," is the name of the RSS's initiative to convert all Muslims and Christians to Hinduism. One Hindutva intellectual has called this kind of mass conversion "the Final Solution for the Muslim problem."

On the evening when we sat on the roof together, Premi tried to explain the concept as if it were entirely reasonable. "See, everyone accepts that they used to be Hindus at some point in time. It was under duress that they were converted by Muslim kings, forcibly," he said. "What is the problem now? There is no one to force them now. They should come back to the fold of Hinduism."

Not knowing how else to reply, I responded with: "Hmmm." There was a long and awkward silence



between us, but I kept my head down, glued to my notepad, pretending to write something very important. Eventually, Premi shifted to talk about a ghar vapasi he had personally carried out.

In April 2018, a dalit Hindu welder named Pawan Kumar chose to convert to Islam. Word of his new faith got back to the Bajrang Dal, and 20 days later, Premi's deputies appeared at Kumar's door. Surrounding him in his room, they flicked the skullcap off Kumar's head and began slapping and punching him, asking him if he had really converted to Islam and if he wanted to remain a Muslim. Cowed, Kumar said no. So they called in a barber to shave his beard, and someone in the crowd applied a red tilak to his forehead.

A couple of Bajrang Dal activists recorded what happened next, raising their smartphones high overhead for the best view, and the video went viral. It shows Premi performing an elaborate purification ceremony on the man. "Now say, 'I have no relation with any Muslim, nor will I ever go to a mosque,'" Premi tells him. Visibly fear-struck, Kumar's voice is barely audible as he repeats the words.

"The moment he said he had converted to Islam, we pushed him right then and demolished him. How dare he become a Muslim! I turned him a Hindu again," Premi told me, breaking into a laugh. There is a very small triangular gap between his two front teeth, which I noticed every time he smiled.

Then Premi turned serious. "Our purpose is to convert everyone living here to Hinduism. It will happen," he said. "You may not see this today, but it is bound to happen one day." The awkward silence between us grew longer. Once again I tried to pretend that I did not hear anything. "Look," he said, "I may not be alive, but this will happen." Later that January, I left India again, feeling more like a stranger in my own country than ever before.

## THINGS

only got worse from there. In May 2019, Narendra Modi was elected to a second term as prime minister, in one of the most overwhelming landslides in Indian history. Three months later, his government withdrew statehood from Jammu and Kashmir, essentially removing any capacity for self-governance from the state's Muslim majority. As he brought the territory under federal control, he sent in troops, locked up the state's elected leaders, and shut down internet and cell service, this time for nearly six months.

When Modi's government released the country's annual crime report in October 2019, it simply did not release the number of hate crimes committed against religious minorities or journalists. By then, two private

databases that tracked hate crimes against Muslims had also disappeared from the internet.

In all sorts of ways, the pace of the BJP's Hindu nationalist endgame was picking up. But in Uttar Pradesh, Premi was brooding and cooling his heels. In August 2019 his superiors in the Bajrang Dal had assigned him to the small town of Bulandshahr, about three hours southeast of Shamli—not to raise hell but to do damage control.

The previous winter, a mob led by the local Bajrang Dal district chief—a young Premi-in-training named Yogesh Raj—seemed to have finally crossed a line that caused public uproar: They allegedly attacked and killed a police inspector. The victim, Subodh Kumar Singh, had led the investigation into the lynching of Mohammed Akhlaq back in 2015. Singh had arrested several of the people allegedly involved, including the son of a local BJP politician. And now the inspector's family believed that he had been targeted in reprisal.

Police in Bulandshahr locked up two of the young leaders of the mob, including the district Bajrang Dal chief, and bad press about the militia flooded in. Premi's mission was to stabilize the situation, impose some discipline, and keep the local Bajrang Dal youth from doing anything to compound the damage. As he put it to me, "I was asked to come here to make sure that our cadres don't exhibit unnecessary displays of enthusiasm." Within three weeks of his arrival in town, the two young suspects had been released on bail.

I had come back to India for a few weeks and decided to pay a visit to Premi in Bulandshahr. He seemed bored and talked about how he missed beating up cow slaughterers.

While we were talking, sitting on plastic chairs in a small and dingy room in the local Bajrang Dal office, a man in his early sixties came in asking for Premi. He was a retired clerk, and he wanted to report that a few Christian missionaries had been visiting his settlement once a month. Some of the man's relatives had left Hinduism, and he was visibly upset about it. He asked Premi to take care of the missionaries. The moment he left the room, Premi took out his phone to get the word out. "Complaint of conversion by Christians in dalit area," he blasted out to the district Bajrang Dal cadres on WhatsApp. "Need to be alert."

Sensing an opportunity, I made a request that I'd been anxiously contemplating for some time: I asked Premi if I could look at his phone.

In recent months, the BJP had become more brazen in talking about its own vast apparatus for generating memes. In September 2018, Amit Shah had given a speech to the party's social media volunteers and talked about a WhatsApp group that the BJP ran for 3.2 million supporters in Uttar Pradesh. "We are capable of delivering any message we want to the public," he said, "whether sweet or sour, truth or a lie."

I had been watching Premi busy himself with his device for months, and for years I had been hearing about how central WhatsApp has become to the rise of the Hindu right. But WhatsApp is a black box: an end-to-end encrypted, private service. The closest I could come to experiencing how Premi and his allies saw the world, I realized, would be to see what was coursing through his account, if just for a few minutes.

Premi seemed deeply uncomfortable with the idea, but he eventually handed his phone to me, on condition that I only forward to myself messages that he approved. I looked at only a couple of the several hundred groups he belongs to: One was the local Bulandshahr Bajrang Dal list, where I could see Premi coordinating with all of his cadres and informants, trading tips and alerts. Another was a national list full of memes and propaganda, and I scrolled through dozens of items. One long message in Hindi went like this:

*Hindus formed half of the population in the Kashmir Valley just 20 years ago. Today not even a single Hindu is left in Kashmir. Ten years ago, Hindus constituted 60% of the total population of Kerala, but today they form only 10% of the State's population. In northeastern states of India like Sikkim, Nagaland, Assam, etc., Hindus are being killed or thrown out every day or religiously converted ... There are no more Hindus in Afghanistan, Hindus are on the verge of becoming a rare species in Pakistan and Bangladesh, and even in India, the number of Hindus is continuously reducing. What are the reasons for this???? If you don't reply to this question right now? In the future you won't be in a position to respond.*

Another message:

*Data of childbirth at a government hospital at Kasaragod in Kerala. Hindus-37, Christians-12, and Muslims-138. Muslims make babies and Hindus create wealth. But the same wealth comes in handy for the use of these Mallas. This is the black history of Hindus in this country ... Jai Hindutva.*

Yet another post presented a kind of infographic: a family tree of all the many supposed varieties of jihad. It broke them down into two main branches: hard jihad and soft jihad. Hard jihad encompassed several terms that were now familiar to me—population jihad, love jihad, and land jihad—but also several varieties that Premi hadn't told me about. I marveled at how systematic it was.

Of course, the posts were a fever dream. The figures about births in Kasaragod had no source that I could trace. And the idea that the Kashmir Valley was recently majority Hindu, or that it is now completely

empty of Hindus, is preposterous. In 1901, according to a census conducted by the British Empire, Hindus constituted 5.2 percent of the valley's population. In 2011 they made up 1.8 percent.

But what seemed very real was that even if social media platforms hadn't created the mass delusions of Hindu extremism, they had provided a shockingly efficient infrastructure for their spread. India has 400 million WhatsApp users and 260 million users of Facebook, and it is the largest global market for both platforms. Facebook has come under heavy fire in India for uneven enforcement of its community standards against hate speech and misinformation. A 2019 report by the NGO Equality Labs found that Islamophobic posts often stayed up on the platform. In a particularly chilling example, Equality Labs found a huge number of Indian Facebook posts targeting Muslim Rohingya refugees from Myanmar, who had already been the victims of one social-media-fueled ethnic cleansing in their home country. The Indian pages called the Rohingya "cockroaches" and posted fake videos that purported to show them cannibalizing Hindus—clear violations of Facebook's standards.

Facebook, which owns both platforms, tells WIRED that it has expanded its content review team in India, and has made progress in pulling down content that violates its standards on its eponymous blue app. But WhatsApp, the far more popular platform, essentially *has* no community standards. Because all of its communication is encrypted, the content that flows through it is entirely in the hands of its users.

After about 10 minutes, I handed Premi's phone back to him. His mood seemed worse.

I asked what he and the Bajrang Dal were focusing on these days. "Illegal immigrants," he said. Millions of Bangladeshis, he told me, had infiltrated India and spread out across the country, and the Bajrang Dal was on high alert about it. "Have you noticed the illegal settlements of Muslims on the outskirts of every city in the last five to 10 years? This is new. They didn't live here before," he said. "We have to beware of such people who don't look Indian." It sounded like he might just be describing poor settlements of Indian Muslims.

"We have to keep vigil, identify these intruders," he said. "They are the termites of this country, surviving on our resources. They need to be thrown out like termites." His language closely mirrored a speech that Amit Shah had given during a BJP election rally in April in West Bengal. "Infiltrators are like termites in the soil," the home minister had said. "A BJP government will pick up infiltrators one by one and throw them in the Bay of Bengal."

To identify all of these Bangladeshi infiltrators across the country, Premi told me, the government should roll out a nationwide register of citizens: a program to suss out who really belonged in India.

A version of what Premi was suggesting was already underway in Assam, a far northeastern Indian state that borders Bangladesh. Over the previous few years, all 33 million people in the state had been required to supply evidence that they or their ancestors were Indian citizens before 1971, the year Bangladesh was established. But it proved hard for many Indians to dig up the right moldering documents. Ultimately, in August 2019, some 1.9 million people were essentially deemed foreigners and were given 120 days to appeal their status, as the government raced to build mass detention centers. Even from the BJP's perspective, the program was a fiasco: The 1.9 million people in limbo included a huge number of Hindus, which led the state-level party leadership to disavow the whole effort.

But Premi, who told me he was contemplating a future in politics, still wanted to see a national version of the program—because he understood that a fix for its biggest flaw was already in the works.

## JUST

a few weeks later, in late November, Amit Shah announced that a National Citizens Register would indeed be rolled out across all of India in 2020. Then, on December 9, Shah introduced a bill before India's Parliament called the Citizenship Amendment Bill, which would establish a fast track to citizenship for anyone found to be an illegal immigrant from Bangladesh, Pakistan, or Afghanistan—provided they were Hindu, Sikh, Buddhist, Jain, Parsi, or Christian. In other words: Only Muslims needed to worry. The bill passed in a mere two days.

It didn't take long for people to realize that the new law, combined with a national citizens register, could easily provide a mechanism for stripping Indian Muslims of their citizenship. Protests erupted across the country. In the first mass demonstrations under Modi's rule, liberal Hindus and secular Indians finally woke up to the scope of the danger posed by the BJP government. One headline called the citizenship law "Golwalkar's Dream Come True." Shashi Tharoor, a prominent Congress Party leader, called it "an all-out assault on the very idea of India for which our forefathers gave their lives" and a violation of India's constitution. Momentarily fazed, the BJP denied that there was any connection between the new citizenship law and the National Register of Citizens—an argument strained by Shah's numerous public statements making clear that they were tailored for each other, a matching set. Meanwhile, the government's effort to build mass detention centers spread to other parts of the country.

This February, as peaceful protests against the Citizenship Amendment Act continued, Donald Trump

paid a visit to the Indian capital. As Trump was about to arrive, a local BJP leader demanded that a Muslim sit-in be removed from northeast Delhi. Hindu nationalists promptly staged a pogrom in the city—one that was nauseatingly reminiscent of the violence that wracked Gujarat in 2002, during Modi's first term as chief minister there. Roving Hindu mobs attacked Muslim homes, firebombed their shops, and assaulted Muslims on the street. Videos surfaced of Delhi police—who serve under Amit Shah's Home Ministry—destroying CCTV cameras and standing over a heap of badly injured Muslim men, forcing them to sing India's national anthem. Fifty-three people were killed, most of them Muslims; hundreds were injured. Meanwhile, at a state banquet less than a dozen miles away, Trump was heaping praise on Modi and listening to the Indian Navy Band play Elton John's "Can You Feel the Love Tonight."

As I watched events unfold from New York, something shifted inside me. I had spent much of my career reporting on sectarian violence in India, yet I had always thought of communal bloodshed as something that happened outside of Delhi—at least an hour or two away, in a dusty place like Muzaffarnagar or Shamli or Bishahra. Now the feeling of safety I had always identified with the capital was gone. As I watched a video of a Hindu mob dragging a young man by his legs while chanting "Jai Shri Ram," it was like seeing Mohammad Akhlaq's lynching transposed to my own familiar neighborhoods.

Since then, I have become terrified for my family, and haunted by the image of my parents in a detention camp. I worry that they won't be able to find the documents to prove that their parents were born in India. I feel a sense of betrayal more strange and personal than anything I've felt before toward my country: India is breaking its constitutional promise to protect everyone irrespective of religion, and we Muslims are coming to terms with the likelihood that nothing will save us. Even liberal Hindus, who cherish the idea of a secular India, have been far too slow to realize how extreme the Hindu mainstream has become, and how close a "ruffian with Hindutva leanings" like Vivek Premi can now stand at the center of Indian political life. Earlier this year, Premi quit his full-time work for the Bajrang Dal and became a district secretary for the BJP.

A few days after the violence in Delhi, the anchor of a national, prime-time Hindi-language news show devoted an hour to discussing the dangers of all the various kinds of jihad. He flashed onscreen the very same infographic that I'd seen on Premi's WhatsApp network, the one that showed the family tree of hard and soft jihad. The anchor invited readers to post their own photos of buildings taken over by Muslims under the hashtag #LandJihad.

On April 1 this year, India was scheduled to begin carrying out a national population registry—a first step toward completing its National Citizens Register. But as it happened, one nightmare has postponed another. On March 24, the entire country went into lockdown to hold back the spread of Covid-19. ■



# What Happened to Lee?

**He coded the internet security firm Cloudflare into existence, transforming it from a sketch on a napkin into a tech powerhouse.**

**Then Lee Holloway's behavior began to change. He became apathetic, distant, unpredictable. For a long time, his friends and family couldn't make sense of why he wasn't himself anymore.**

*by SANDRA UPSON / artwork by AMY FRIEND / photographs by JACK BOOL*

# On Friday, September 13, 2019,

Matthew Prince and Michelle Zatlyn, cofounders of the San Francisco internet security firm Cloudflare, stood on a slim marble balcony overlooking the floor of the New York Stock Exchange. A cluster of the company's executives stood near Prince, ready to shout out a countdown. "Louder! Louder!" Prince urged them. "Five! Four! Three! ..." At 9:30 am sharp, the founders reached down to ring the exchange's famous bell, kicking off the day's trading and offering their 10-year-old company on the public market. It was a rite of passage and also their payday, a moment that unlocked many millions of dollars in newfound wealth.

More than 100 employees and investors cheered from the trading floor below, their phones held high to capture the scene. Kristin Holloway, employee number 11, looked up at the balcony and snapped photos, then popped them into a text to her husband, Lee Holloway, the company's third cofounder. He was home in California. Every so often, a familiar face pushed through the throng to say to her, "Lee should be here."

In Cloudflare's early years, Lee Holloway had been the resident genius, the guy who could focus for hours, code pouring from his fingertips while death metal blasted in his headphones. He was the master architect whose vision had guided what began as a literal sketch on a napkin into a tech giant with some 1,200 employees and 83,000 paying customers. He laid the

**Lee Holloway spends time with his youngest son at home on California's Central Coast.**

groundwork for a system that now handles more than 10 percent of all internet requests and blocks billions of cyberthreats per day. Much of the architecture he dreamed up is still in place.

But some years before the IPO, his behavior began to change. He lost interest in his projects and coworkers. He stopped paying attention in meetings. His colleagues noticed he was growing increasingly rigid and belligerent, resisting others' ideas, and ignoring their feedback.

Lee's rudeness perplexed his old friends. He had built his life around Cloudflare, once vowing to not cut his hair until the startup's web traffic surpassed that of Yahoo. (It took a few short months, or about 4 inches of hair.) He had always been easygoing, happy to mentor his colleagues or hang out over lunch. At a birthday party for Zatlyn, he enchanted some children, regaling them with stories about the joys of coding. The idea of Lee picking fights simply didn't compute.

He was becoming erratic in other ways too. Some of his colleagues were surprised when Lee separated from his first wife and soon after paired up with a coworker. They figured his enormous success and wealth must have gone to his head. "All of us were just thinking he made a bunch of money, married his new girl," Prince says. "He kind of reassessed his life and had just become a jerk."

The people close to Lee felt tossed aside. They thought he'd chosen to shed his old life. In fact, it was anything but a choice. Over the next few years, Lee's personality would warp and twist even more, until he became almost unrecognizable to the people who knew him best. Rooting out the cause took years of detective work—and forced his family to confront the trickiest questions of selfhood.

On the floor of the stock exchange that September morning, Lee's younger brother Alaric weathered the morning in a state of low-grade panic. He snapped selfies with early employees and fired them off in texts to his brother. Alaric had never worked at Cloudflare, and he knew barely anyone there. But his dark hair flopped over his forehead with the same distinctive swoop as his brother's, and his long, tapering face had the same dark eyes and olive skin. "It was surreal," Alaric says. "People kept looking at me like they knew me."

At home with his parents in San Jose, Lee, 38, was restless. He paced the rooms and hallways of the 1,550-square-foot house, a loop he'd been tracing since he'd moved in with them two years earlier. He didn't speak. His parents had the TV on, and they called him over whenever Prince or Zatlyn appeared onscreen.

Later, he paused at the family's Roku to search YouTube for videos of Cloudflare. Then he resumed his circuit: walking the halls, buzzing his lips, snacking on cashews.

## What

**makes you you?** The question cuts to the core of who we are, the things that make us special in this universe. The converse of the question raises another kind of philosophical dilemma: If a person *isn't* himself, who is he?

Countless philosophers have taken a swing at this elusive piñata. In the 17th century, John Locke pinned selfhood on memory, using recollections as the thread connecting a person's past with their present. That holds some intuitive appeal: Memory, after all, is how most of us register our continued existence. But memory is unreliable. Writing in the 1970s, renowned philosopher Derek Parfit recast Locke's idea to argue that personhood emerges from a more complex view of psychological connectedness across time. He suggested that a host of



mental phenomena—memories, intentions, beliefs, and so on—forge chains that bind us to our past selves. A person today has many of the same psychological states as that person a day ago. Yesterday’s human enjoys similar overlap with an individual of two days prior. Each memory or belief is a chain that stretches back through time, holding a person together in the face of inevitable flux.

The gist, then, is that someone is “himself” because countless mental artifacts stay firm from one day to the next, anchoring that person’s character over time. It’s a less crisp definition than the old idea of a soul, offering no firm threshold where selfhood breaks down. It doesn’t pinpoint, for example, how many psychological chains you can lose before you stop being yourself. Neuroscience also offers only a partial answer to the question of what makes you *you*.

Neural networks encode our mental artifacts, which together form the foundation of behavior. A stimulus enters the brain, and electrochemical signals swoosh through your neurons, culminating in an action: Hug a friend. Sit and brood. Tilt your head up at the sun and smile. Losing some brain cells here or there is no big deal; the networks are resilient enough to keep a person’s behaviors and sense of self consistent.

But not always. Mess with the biological Jell-O in just the right ways and the structure of the self reveals its fragility.

Lee’s personality had been consistent for decades—until it wasn’t.

From an early age, he was a person who could visualize sprawling structures in his mind. Growing up in the 1990s in Cupertino, where his dad worked at Apple, Lee had early access to the latest computers, and he and his brother grew up binging on videogames. As a gamer, he was legendary among his friends for being able to read a complex situation, rapidly adjust strategies, and win match after match. And it wasn’t just videogames. His childhood friend Justin

Powell remembers Lee strolling into a middle school chess club tournament cold. He wasn’t a member of the club, but he won the tournament anyway. Lee avoided becoming insufferable by channeling his wit into snarky commentary. “Watching a movie with him was like a version of *Mystery Science Theater 3000*,” Powell says. “His very presence challenged you to keep up with him.”

Lee and his friends would cart their computers to each other’s houses to play games together. He became curious about the machines themselves and started learning computer science, first in high school, then at a local community college and UC Santa Cruz, where an unlikely set of circumstances connected him with Matthew Prince.

Then a young entrepreneur, Prince was pursuing an idea for an antispam software tool when he encountered Arthur Keller, a UC Santa Cruz computer science professor. Keller and his students had already worked out a very similar concept. Prince and Keller agreed to share a patent, along with Keller’s students. One of those students was Lee, and Prince hired him on the spot. “I had no idea this school project would turn into something much bigger,” Lee later said in a video interview with a group called Founderly.

Prince set up the company, Unspam Technologies, in Park City, Utah, about a mile from a cluster of slopes where he could indulge his passion for skiing. Lee moved into Prince’s basement, at first working for free in exchange for food and housing. But Lee and the other Unspam engineers grew restless, and they started spinning up side projects, including one called Project Honey Pot, which tracked spammers as they crawled the web. That’s all it did—it collected and published data on spammers, but it didn’t do anything to stop them. Still, the project quickly amassed a loyal following.

In 2007, Prince left Utah to start business school at Harvard, and Lee moved to California to live with his girlfriend, Alexandra Carey. They’d known each other as undergrads, when she was a teaching assistant in his computer architecture class. Lee had goofed off in that class, once pranking the professor by scrawling childish notes on the transparencies of an overhead projector. Alexandra had been amused, but it wasn’t until after college that a relationship bloomed. Living in different cities, they fell for each other while playing and chatting within a multiplayer videogame called *Savage*. Now, with Prince leaving Utah, it seemed a natural time for Lee to join Alexandra. They married in 2008.

Lee and Prince kept working at Unspam from their respective cities, but as Prince was wrapping up business school, Lee called to tell him he was considering other job offers. Prince countered with a new and rather audacious pitch: He and a classmate, Michelle Zatlyn, had hit on a startup idea they thought had potential. What if they expanded Project Honey Pot to not just recognize spammers and hackers but also fight back against them? The plan was to build out massive networks of servers around the world, convince website owners to route their traffic through those servers, and gather enough data to detect malicious requests amid the good ones. That might give them the tools they needed to stop even the world’s biggest denial of service attack. But Prince needed a technical cofounder, and his about-to-defect employee was his top choice.

Prince talked for an hour straight. At the end of this spiel, Lee’s side of the line was quiet. “I was like, ‘Are you still on the phone?’” Prince recalls. “Then he said, ‘Yeah, that’ll work, let’s do that.’” And that was it.

They whipped together a demo and in late 2009 raised a little over \$2 million from two venture capital firms. It was enough to rent a converted two-bedroom apartment above a nail salon in Palo Alto, where they could start building their idea in earnest. Lee would show up every day wearing the same Calvin Klein jeans, leather jacket, and beanie on his head, and lugging a giant ThinkPad laptop nicknamed the Beast. “We had this shared vision,” Zatlyn says. “And Lee was the architect behind it. He just obsessed over it.”

The following year, Prince talked his way into TechCrunch Disrupt, an onstage competition for startups that can lead to big funding rounds. As

Disrupt approached, Prince and Zatlyn grew nervous. Lee had missed a lot of days of work due to migraines. He didn't seem anywhere close to finishing a demo. When the day of the event arrived, Prince and Zatlyn walked onstage praying that the software they were presenting would actually work.

Prince started his pitch. "I'm Matthew Prince, this is Michelle Zatlyn, Lee Holloway is in the back of the room. We're the three cofounders of Cloudflare," he boomed, stabbing the air with his finger as he spoke. In fact, Lee was backstage furiously fixing a long list of bugs. Prince held his breath when he ran the software, and, perhaps miraculously, it worked. It really worked. In the hour after he walked onstage, Cloudflare got 1,000 new customers, doubling in size.

They earned second place at Disrupt. "In the next couple of weeks, all these somewhat mythical VCs that we'd heard of and read about all called us," Prince says. Under the onslaught of attention, Prince, Holloway, and one early hire, Sri Rao, rolled out constant fixes to hold the system together. "We launched in September, and in a month we had 10,000 websites on us," Lee said in the Founderly interview. "If I'd known, we would have had eight data centers instead of five."

With customers now multiplying, Ian Pye, another early engineer, hollowed out a toaster, tucked an Arduino board inside, and hooked it up to the network. Whenever a website signed up for Cloudflare services, the toaster sang a computerized tune Pye had composed. "It was horribly insecure," Pye says. "But what were they going to do, hack our toaster?" The toaster lasted two weeks before the singing became too frequent and annoying and they unplugged it.

Cloudflare was growing fast, and Lee worked long days, often from home in Santa Cruz. He and Alexandra now had an infant son. During the first few months of the baby's life, Lee and Alexandra still made time to play videogames together. Alexandra remembers cracking up when Lee co-opted a nursing pillow to support his neck while he sat at his computer. Several of his old friends came over once a week to play the board game version of *Game of Thrones* or the multiplayer videogame *Team Fortress 2*. Alexandra focused on childcare, but she made sure the players had food. "I was doing it for him," she says.

But around 2011 she started noticing that Lee was growing distant and forming some odd new habits. He spent a lot more time asleep, for one. After long workdays, she recalls, he'd walk in the door, take off his shoes, and immediately pass out on the floor. Their cat sometimes curled up and napped on his chest. His son, not yet 2, would clamber over him, trying and failing to rouse him to play.

When people invited them to parties, Lee refused to go. Alexandra started attending her friends' weddings by herself. It hurt her to see everyone else there as a couple, while the chair next to her sat empty. At home she'd cook dinner, and he'd look at it and say he was ordering pizza. On a weeklong family trip to France, he spent three days sleeping in the hotel room. "I'd say, 'What's going on, we're going to these places—are you coming?'" Alexandra says. He'd insist he was too tired. She was finishing up a master's degree and shouldering the bulk of childcare; she, too, was tired. Alexandra begged him to go to therapy and cajoled him to play with their son, but he didn't engage. "After a while you think, well, this is the person I'm with," she says.

In 2012, Alexandra told him she was taking an internship in Southern California, at NASA, and she was planning to take their son with her. She says his response was to calmly ask her to file for divorce before she left. "I was crushed. I said, 'Maybe it doesn't have to be that way,'" she recalls. "He said, 'No, no, it does.'"

When Lee told Prince and Zatlyn about his divorce, they both expressed their shock and gave their condolences, but Lee seemed to barely acknowledge the change. Prince and Zatlyn found his behavior tremendously odd. Still, they could rationalize it away. Relationships end for many reasons. Alexandra and Lee had married young, and both had worked long hours; perhaps they had grown apart. Besides, Lee was thriving at the company, so they didn't press.

## Some

**months after** Alexandra moved away, Lee was sitting at a table with a couple of coworkers, including Kristin Tarr, who ran communications at Cloudflare. She'd just published a blog post describing how customers could enable two-factor authentication on their accounts. He turned to her and said, "I read your blog post. It was really good." A friend saw the interaction and teased her: Lee's flirting with you!

Lee and Kristin started spending time together. On one of their first dates, Lee took her to see his favorite metal band, the Swedish group Opeth. He revved up

her interest in basketball, and they became Golden State Warriors junkies, watching every game. Kristin brought her own interests and energy into the relationship. She convinced him to trade in his old jeans-and-leather-jacket uniform for nicer shirts from Rag & Bone. He

**"HE IS TYPING, TYPING,  
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still wore beanies and hoodies, but now they came from Lululemon, where Kristin, a running freak, had a weekend gig as a brand ambassador. Sometimes he refused to get



Lee and his wife, Kristin Holloway (top), on vacation in Rome in 2014. He proposed to her hours after this photo was taken. Lee and his Cloudflare cofounders (below), Michelle Zatlyn and Matthew Prince, attend a holiday party in 2011.

out of bed or retreated with a migraine; Kristin responded by signing him up for 5K races and coaxing him into training for them. Their coworkers marveled that their lead engineer had become so athletic.

Within a few months they had moved in together. She whisked him off on adventures, pulling him away from his computer and his videogames. They went tubing on the Truckee River. They played endless rounds of Bang! and Settlers of Catan with board-game-loving coworkers. Both near-sighted, they pretended they were moles, snuggled up in their burrow of a home. As their fortunes grew, they upgraded their digs, moving from Mole Hole to Mole Tower to Mole Terrace. They gave their friends animal identities too; Prince was a mongoose, while another executive was a

Graham-Cumming, then an engineer and now Cloudflare's chief technology officer. "His hoodie is on, he's in the zone, he's doing brain surgery on this thing."

Then, late in the night, Lee stood up. He announced that he'd finished, and he wandered away. "It was like, bzhzhzh, type-type-type, 'I'm done!'" Graham-Cumming says.

The other engineers immediately started reviewing his code. By the morning, the debugging process began for real. The gambit worked, and all of their existing customers suddenly got encryption. It was a proud moment. Says Graham-Cumming: "The size of the encrypted web doubled overnight."

## As

**Lee and Kristin** planned their wedding, he decided to address a health problem he'd long ignored. Lee had been born with a heart issue, a leaky aortic valve, and some doctors thought it might be contributing to his migraines. "If you put your head on his chest, you could hear it," Kristin says. "We called it his squishy heart." Doctors were split on how serious his condition was, but in January 2015 a surgeon at Stanford insisted he get surgery right away. Lee went in for the six-hour procedure. As he lay on his hospital bed, he recorded a video to his son: "I love you! I'll see you soon with a brand-new heart." He signed off with a smile and a wave.

Kristin now sees the surgery as a grim turning point. Lee's heart came out of the procedure stronger than ever, but mentally he never seemed to recover. He slept all the time. He'd taken a leave from work to have the surgery, but he extended his leave by a month, and then another, until he finally returned to the office in the late spring.

swan. In May 2014, Kristin quit Cloudflare, and the next day they left for a vacation in Italy. They got engaged in Rome.

At work, Lee was still the star engineer. At the end of the summer of 2014, he took on a project that earned Cloudflare its first bout of internet fame: The company would help websites become encrypted for free. (It was not yet standard for company websites to be encrypted.)

Lee agreed to build the necessary software by the end of September. As the date approached, Prince asked for updates, but Lee blew him off. Then, on the day before the new system was supposed to go live, he pulled his hoodie down low on his head, put on his headphones, and sat down to bang out the code.

It was a Sunday, but the office was packed with people writing up the pending announcement or delivering coffee and food. Lee's coding, though, was the main event. "And he is typing, typing, and I don't think anyone dared to interrupt," says John

In June they got married, in Hawaii, in front of a crowd of friends and family. Kristin noticed that he seemed subdued. It was as if someone had washed the color out of his personality. Prince noticed too but chalked it up to a slow recovery from the surgery.

Not long after, Lee and Kristin took a trip to Europe, spending a few days in France, just as Lee and Alexandra had years earlier. Kristin had never been to Paris, and she was excited to explore the city. She ended up doing that on her own, while Lee again spent days asleep in their hotel room. "This is so weird," Kristin remembers thinking. On their trip to Italy, he'd been eager to jump out of bed and visit museums and cafés, and walk around. She was puzzled, but between his migraines and his heart issue, there was always an explanation at hand.

At the office, he was becoming impossible to work with. He would lash out at people, and then in meetings he would zone out, openly playing games on his phone. During one meeting, Prince texted him: "Are you playing a game? People are noticing." Then: "Not a great leadership signal."

Prince and Zatlyn confronted him about his behavior, and Lee promised to do better. But his responses seemed rote. "I was like, why is he so disengaged? Why doesn't he seem to care?" Zatlyn recalls. They figured he must be burned out. Still, it hurt; it felt as if Lee was breaking up with them. She'd paid attention to the stories of startup founders who split up, the mess of their breakups sometimes dragging their companies down with them. "So I'm thinking, well, I guess that's what that feels like."

They put their friend on an official performance-improvement plan. Over many weekly lunches, Zatlyn and Prince tried to get through to him. Nothing seemed to stick. "For several years," Prince says, "the thing that was causing me just incredible anxiety was that I had all this loyalty to this person, but they're becoming a jerk."

Eventually, in 2016, they decided Lee had to leave the company. "He kind of just said, yup, that sounds about right," Prince says. They threw him a going-away party that July. Prince thanked him in a speech with tears streaming down his cheeks. Lee stood beside him with a beer in hand, a thin smile on his face.

## Now

**that he wasn't** working, Lee napped constantly. Kristin was

seven months pregnant, and they agreed that after the baby's birth, Lee would be a stay-at-home dad, at least until he figured out what to do next. In the meantime, they would live off their savings and Kristin's salary from a new job at an ad tech firm.

Lee's actions, however, only grew more bizarre. He watched *Home Alone* several nights a week. He wore his beanie all day, every day, pulling it lower

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Lee (center) gathered with his family for Thanksgiving in 2016, including (from left) his brother Alaric; his wife, Kristin; his older son; his mother, Kathy; his younger son; and his father, Rendon.





**Lee still takes part in some activities with his wife and children, including working on jigsaw puzzles.**

and lower. When Kristin went into labor, he slept through most of the two-day ordeal, first slumbering at home and then resuming his nap at the hospital. When he woke up, he insisted, against Kristin's wishes, that she not get an epidural, which provoked a heated argument with one of the doctors. After their son was born, Kristin's mom says the doctor pulled her aside and commented that she'd never seen an expectant dad react that way. Kristin confronted him about his behavior later, and he promised her, "I'll do better."

In those heady first months of parenthood, he failed. He took copious naps. Sometimes she'd cook him dinner, and he'd reject it and order a burrito. "I was like,

what is happening?" Kristin says. "Everything felt so strange and out of control."

Distraught at his lack of interest in their son, she decided to stage a moment of parenting normalcy. If she couldn't coax him into engaging with their child, she'd settle for its illusion. While Lee lay on the couch, she handed him the infant and grabbed her phone to record the scene. "You're standing, and you're so cute!" he coos as he props up the baby on his chest. "You're smiling and making a sound!" He dotes on his baby for less than a minute before handing him back to Kristin.

She kept trying to probe what was on his mind, and he kept replying, "I'll do better." The repetitiveness of his answers struck her as robotic. It seemed of a piece with the way he now touched every tree he passed on their walks. "I think deep down I knew something was wrong," Kristin says. She thought maybe he'd developed PTSD after the surgery or was struggling with a bout of depression. She'd been asking him to see a counselor with her. Finally, as she prepared to return to work, she threatened to leave him if he didn't. Lee agreed.

In the couples' therapy session, Kristin cried openly and talked about how her husband didn't seem to care about their new baby. "Lee was just blank," she recalls, and she wondered why he wasn't reaching out to comfort her. Suddenly he stood up, announced he'd forgotten to return the therapist's office bathroom key, and wandered out of the room to put it back, returning a few minutes later.

When her maternity leave came to an end, Kristin hired a nanny and went back to work, but her alarm was mounting. She started booking appointments with every specialist she could think of while Lee spent his days in bed. "So I'm cajoling him out of bed, getting him into the car, making sure my son is out with his nanny, covering my own work somehow," and then shuttling him from appointment to appointment. "It was like that for three months."

In mid-March of 2017, Kristin and Lee went to a neurologist to get the results of an MRI. To Kristin, it seemed that the neurologist had initially been skeptical of her concerns. Lee was young, healthy, and communicative.

The MRI told a different story: There was atrophy in the brain inconsistent with the age of the patient, the neurologist reported to them. When Kristin asked her what that meant, she said Lee had a neurodegenerative disease of some kind, but they'd need to do more tests to get a specific diagnosis. One of their doctors suggested they go to the Memory and Aging Center at UC San Francisco.

That evening, Kristin started Googling. She pulled up the website of the Memory and Aging Center and started reading the descriptions of brain atrophy diseases. She knew immediately the neurologist was right. And in that moment she glimpsed the future: This was going to kill her husband.

She remembers sitting with her son that night. "Until that point, I'd held out hope. We have the resources, the best doctors, I can fly him to get him the best care," she says. "But to be in this position where nothing can be done is just ... It's so awful." She quit her job the next day.

A few weeks later, Kristin and Lee, their parents, and Alaric all gathered in a conference room on the UCSF campus with a panel of experts. "Do you know why you're here?" the lead neurologist asked Lee. He replied, "My wife organized this."

"Do you know that you're sick?"

"I get migraines a lot," he said. "And I had heart surgery."

The neurologists delivered their verdict: He appeared to have a textbook case of frontotemporal dementia—known by the shorthand FTD—specifically, the behavioral variant of that disease. It targets a network of brain regions sometimes described as underpinning one's sense of self. As the pathological process advanced, it was carving a different person out of Lee's raw substance.

The term *frontotemporal dementia* refers to a cluster of neurodegenerative diseases that affect a person's behavior or speech while leaving memory largely intact, at least early on. Unlike Alzheimer's disease, FTD isn't well known. It is a rare disease, affecting roughly one in 5,000 people, though many of the neurologists who study it believe it is underdiagnosed. What is known is that for

people under the age of 60, it is the most common form of dementia. Still, as a man in his thirties, Lee was unusually young to be afflicted. For some patients, one of several genetic mutations turns out to be the likely cause, and a subset of patients have a family history of neurodegenerative diseases. But nothing in the neurologists' investigations turned up even a hint as to why Lee had been struck down.

Regardless of cause, the prognosis is grim. There's no treatment. Lee's doctors warned that his symptoms would grow worse, and that over time he would likely stop talking, become immobile, and struggle to swallow, until eventually an infection or injury would likely turn fatal. The best the doctors could recommend was eating a balanced diet and getting exercise.

The family sat stunned at the neurologist's words. The brain scans were undeniable. On a wall-mounted screen the doctors showed a cross-section of the four lobes of Lee's brain. In a healthy brain, the familiar, loopy folds of tissue appear white or gray and push up against the edges of the cranium, filling every available space. Lee's brain looked nothing like that.

Black voids pocked his frontal lobe, areas where brain tissue had gone dead. Seeing it, Kristin gasped. "There were huge dark spots in his brain," Alaric says. "That's what ... that made it concrete."

Lee received his death sentence with pure calm. While his family cried beside him, he complimented a doctor for having a nice wedding ring. At that, Alaric looked at him and realized for the first time the depths of his brother's transformation.

## Few

**disorders ravage** their victims' selfhood with the intensity of the behavioral variant of FTD. It takes all the things that define a person—hobbies and interests, the desire to connect with others,

everyday habits—and shreds them. Over time, the disease transforms its victims into someone unrecognizable, a person with all the same memories but an alarming new set of behaviors. Then it hollows them out and shaves away their mobility, language, and recollections.

Because it is relatively unknown and can resemble Alzheimer's or a psychiatric disorder, FTD is often hard to diagnose. As in Lee's case, the early stages can be misinterpreted as signs of nothing more serious than a midlife crisis. Patients can spend years shuttling to marriage counselors, human resources departments, therapists, and psychologists. By the time patients learn the name of their disorder, they are often unable to grasp the gravity of their situation.

Depending on where in the brain the disease first strikes, the symptoms can be jarring. Some sufferers become deeply religious, undergo wild shifts in political identity, or have a sharp change in interests or style of dress. One stockbroker, for example, started wearing all-lavender clothes and developed a sudden obsession with painting. As his disease progressed, he engaged in petty theft and swam nude in public pools.

The loss of embarrassment is common among some FTD patients, leading them to act in ways that might have horrified their former selves. Urinating in public, shoplifting, running red lights, making inappropriate sexual advances, digging through trash cans for food—all can be symptoms. Patients can lose the ability to evaluate social situations too, making them hard to interact with. In one extreme case, a patient's wife nearly severed her finger while using a pair of borrowed gardening shears. She shrieked to her husband, who had FTD, that she needed to

go to the hospital. He replied by saying they had to first return the shears to their neighbor.

These behaviors all arise because neurons are dying off in the frontal and temporal lobes, two large areas of the brain. Particularly vulnerable within these broad continents is a dispersed set of regions known as the salience network, which sifts through a barrage of sensations, memories, and emotions to focus a person's attention on what matters most in that moment. When this network breaks down, people may fail to grasp the emotional impact of their actions on others. "Emotions drive most choices in life, so if you don't have those systems, you're not the same person," says Virginia Sturm, a neuropsychologist and neuroscientist at UCSF. "There are no tight anchors to your sense of self anymore, and the boundaries of self become loose."

Eventually, many FTD patients end up as apathetic as Lee, the light of their personhood dimmed to a pale flicker. Apathy also leads to incontinence, as patients lose the desire to take even basic care of themselves.

In the months after Lee's diagnosis, Kristin spent as much time with her husband as she could. His decline had been steady so far, and she realized he would only slip further away. They spent the summer of 2017 going on long walks together. They took family trips. She found herself scrutinizing every interaction: Was that his last joke? His last laugh? His last hug? She never knew. He started leaving the apartment without saying anything, and she'd have to grab the baby and chase him down San Francisco's busy streets.

Lee was quickly becoming unmanageable. Once the baby learned to crawl, Kristin installed a gate at the

top of the stairs to keep him from falling down the steps. But whenever Lee walked past the gate, he'd reach down and unlatch it. He started blasting music videos in the living room at 11 o'clock at night, despite the small child asleep in an adjacent room. Sometimes he'd stay up all night, walking around in circles. Kristin struggled to take care of her son while making sure her husband didn't duck out the door unnoticed.

She and Lee's parents grew increasingly worried he could get lost or mugged or wander into traffic. His parents, who are in their sixties, volunteered to take over Lee's care, and in the fall of 2017, Kristin agreed it was time for him to move in with them in San Jose while they figured out a long-term plan. "It's too hard to keep him safe in San Francisco," his father, Rendon Holloway, says. "He has to have his walks." Kristin was working full-time in San Francisco; she and their son stayed behind. Lee would visit them a few days a month.

Kristin and their son spent many of their weekends in San Jose. In the first year, his mother, Kathy Holloway, recalls, when Lee saw the two of them arrive, "he always ran to his bedroom and grabbed his suitcase." He would say, "I want to go back to San Francisco."

Lee often tried to leave the house. His parents eventually added an alarm that chimed loudly whenever the front door opened. They hid his shoes. He'd hunt for them, and if he found them he'd lace up and bolt out the door.

When he wasn't trying to escape, Lee settled into a rhythm of scrolling through family photos on his phone, playing *Mario Kart*, or watching YouTube videos, all in roughly 30-second spurts. He'd search YouTube for "Cloudflare," "Kristin Holloway," or his favorite bands and watch snippets of their music videos. Then he'd pace heavily around the house, loud footfalls thudding at all

### **HOLLOWAY RECEIVED HIS DEATH SENTENCE WITH PURE CALM. WHILE HIS FAMILY CRIED BESIDE HIM, HE COMPLIMENTED A DOCTOR FOR HAVING A NICE WEDDING RING.**

hours of the day. Kathy lined the floors with rubber mats to deaden the sound.

As the months passed, he spoke less and less. In one video from July 2018, Lee has his arm wrapped around his son while he reads him a bedtime book. Lee mumbles the words unevenly, without inflection, and hurries through the paperboard pages.

From behind her phone's camera lens, Kristin saw that this might be the last bedtime story he read their son. Still, she kept recording, and she ended it with a "Good job!" to them both.

Conversations soon became impossible. Lee started chattering in repetitive, unceasing loops. He would tell Kristin: "We met at Cloudflare. We got engaged in Rome. We got married in Maui, Hawaii." He repeated it hundreds of times a day. Then the loops got shorter, more cryptic. He spoke fewer sentences, instead muttering sequences of numbers or letters.

In September 2018, Prince and Zatlyn went to visit him while he was on one of his trips to San Francisco. Seeing Lee for the first time in many months, they thought he looked like a zombie, trooping aimlessly from room to room with empty eyes. At intervals during their visit he'd sit down in the living room, turn on the TV, and flip through the channels, never watching any one thing for more than a minute. Then he'd wander off again, all the while whispering numbers: 1 2 3 4 5 6 7. 1 2 3 4 5 6 7.

He was both present and absent, a combination that kept his family on edge. When I visited his parents' house in April 2019, Kristin and Alaric were also there for the day. We were clustered in the front hallway while his mother slipped into the kitchen to make tea. Lee, dressed in a Henley shirt and sweatpants, emerged from the back of the house. He stood tall and silent, and his arms hung heavily at his sides. He looked at Kristin, expressionless, as she introduced me and explained I'd come to write a story about his life. He turned to wander into the living room and kitchen, where he leaned his elbows on the counter and reached a hand out to his mother, wordlessly requesting a snack. Then Kristin and Alaric went out with him for a walk, while I sat down with his parents.

As we sat in the family's living room, Kathy described caring for her son, even as he grew increasingly distant. She misses the warmth in their daily interactions. "He used to come give me a hug and say, 'I love you, Mom,'" she says. "No more."

Kathy is not the only one struggling to accept Lee for who he is—whatever he is. Managing his decline has strained the family, and his relatives sometimes clash over who should take care of him and how he should live. Kristin has spent many hours in therapy working through her grief and her feelings of guilt over deciding to live apart from Lee. She says she has felt alone in their relationship for years, and she's determined to give her son a relatively normal childhood. Alexandra, Lee's first wife, wonders whether her marriage fell apart because of the disease or their incompatibility. Was Lee simply someone who could sleep through European vacations and reject a homemade meal, or were those early incidents symptoms?

There's no way to know for sure. Who was he then? Who is he now? How tightly knit is any person's selfhood across time? The philosopher Derek Parfit might have approached the issue by asking how many psychological chains bind Lee today to Lee in the past. His links are more tenuous than most people's. But they persist.

In January 2019, Kristin was driving in a grocery store parking lot when her phone rang. She glimpsed the screen and froze. Lee was calling. There on the screen was his face, an old photo from when they had just started dating. She hadn't seen the photo in almost two years—it had been that long since he had called her.

She answered, and the words tumbled out of her. "Baby, I love you so much, I miss you," she cried. "Are you OK? Do you need anything?" He didn't say anything, but she could hear his breathing on the other end.

He hung up.

In that instant she realized how desperately she missed hearing his voice. "I'd been in this process of losing him, then to have this moment of him reaching

out from wherever he is," she says. "It blew my mind."

The Cloudflare IPO in September raised \$525 million. Lee, as one of the founders, suddenly became a whole lot richer. With his financial future now secure, Kristin set in motion the plan for his long-term care. She bought a 5,000-square-foot house on an acre of California's Central Coast, a spot they chose in the hope that his father, Rendon, could walk with him along the shore. She worked with a landscape architect to tailor the outdoor space to Lee's needs. There are zigzagging paths on which Lee can roam and a fence to keep him safely inside. Nontoxic plants only. No nut or fruit trees allowed; those could be choking hazards once he develops difficulty swallowing, as his doctors anticipate he will.

Lee and his parents have moved there, and he has full-time care assistance too. Kristin shipped some of the furniture they'd bought together to make the house feel more familiar to him, and she blanketed a wall in family photos. She, Alexandra, and their sons visit occasionally.

Kristin hopes she has designed the perfect environment. Most FTD patients aren't so fortunate, if you can call it that, to wind down their lives on a personalized estate with a staff dedicated to keeping them safe and calm. Their families don't always have a choice in how involved they want to be. Still, all the money in the world can't answer the question of who, really, is living in that house.

On rare occasions, Lee still surprises his parents with an affectionate pat on the back. He calls people from time to time, even if he never speaks a word. An old colleague recently saw that he'd liked a post on LinkedIn. However diminished, a person lingers in the shattered roadways of his mind.

Some months ago, Lee sent Kristin a series of text messages. In them were photos she'd shared with him earlier: she and their son on Halloween, a trip to the park, Christmastime. At the end, he'd typed the words: "the love." ■

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AFTER 20 YEARS  
OF MARATHON  
COMPETITION,  
AT AGE 44 I RAN BY  
FAR THE FASTEST  
OF MY LIFE.

ALL IT TOOK WAS  
TECHNOLOGY,  
NEW WAYS OF  
TRAINING, AND  
PLAYING  
HIDE-AND-SEEK  
WITH MY PAST.

BY  
**NICHOLAS THOMPSON**

PHOTOGRAPHS BY  
**IKE EDEANI**



**OUTRUNNING MYSELF**



## **Running is the simplest of sports: right foot, left foot, right foot.**

But the simplicity opens up complexity. There's no ball to focus on, no mat to land on, no one charging toward you with their shoulder down. And so your attention shifts inward. As you run, you're just you—right foot and left foot, nature and nurture, whatever goes on in your mind.

My relationship to the sport begins in Bacone, Oklahoma, in the mid-1940s. My father, Scott Thompson, grew up there as the shy, misfit son of a domineering Baptist minister. Frank Thompson, or Granddad, was an imposing oak of a man with eyebrows the size of muskrats. He was a Golden Gloves boxing champion and wanted his only son to obsess about sports, but my father was uncoordinated and athletically indifferent. He wanted to read books and listen to *The Marriage of Figaro*. Eventually, my dad escaped his unhappy home for boarding school in Andover, Massachusetts. He applied in secret, paying the application fees with money he earned on his paper route. He did well there and won a scholarship to Stanford and a Rhodes Scholarship to study at Oxford. His friends from that time remember him as a flurry of energy, wit, and charisma. After meeting my father on campus in 1960, John F. Kennedy was quoted in *The Saturday Evening Post* that Scotty Thompson might make it to the White House before he did.

After he completed his studies, my father married my mother and began an

adult life of constant motion, ambition, and enthusiasm. He barely slept; he began publishing books and became a tenured professor; he made plans to run for office. But he also started drinking too much, smoking too much, going out too much. By the time he was closing in on 40—an age, he would often say, when all men's lives fall apart—he needed some discipline in the fermented mayhem of his days. As he would later tell me, running was the rare sport where you mostly competed against yourself. You could learn without having to lose. It was also something he hadn't failed at in front of his father.

In 1980, when my dad started putting on his running shoes, I was 5, and naturally, I wanted to tag along. I remember him driving his car around the block where we lived just outside of Boston with his eye on the odometer. Start at the front door by the boxwoods, turn left and left again. Go two full loops around the block; on the third, stop at the gate in the fence just past the beech tree. That's 1 mile. I remember the triumph of running the whole thing by his side. He was obsessed with his physical appearance, and he would teach me to do push-ups in the backyard and sit-ups with a round metal weight he kept under the bed. He began to race too. On my bedroom wall I have a photo from around that time of him running a 5-mile road race in Maine. He's wearing a red Lacoste polo shirt and socks that could stretch to his knees but are squished down at his ankles.

Two years later I went to New York to watch him run a marathon. My parents had divorced by then, and my father had moved to Washington, DC. He had a good job—but he hadn't exactly followed the path of John Kennedy. He was an associate director at the United States Information Agency, which meant he promoted Ronald Reagan's Cold War policies to the world. He lived in Dupont Circle and alternated runs of 12 and 6 miles every morning. He had gotten good. I searched for him in the sea of sweaty people in short shorts coming down the Queensboro Bridge. He spotted me and hustled to the side. I handed him a cup of orange juice and gave him a new pair of shoes. He gulped, laced up, smiled, and hurried along. His goal was to finish in under three hours, and he came close: 3:01:19. I didn't have much sense of how the sport worked—or, for that matter, how physical pain or time

worked—and for years I would wonder why he just hadn't sprinted at the end.

After the race he pledged to go faster in the next one. But life wasn't going to work that way. My father soon came out as gay. Not long after that he tested positive for HIV. It was the start of the plague years for that disease. Running faster wasn't much of a priority anymore.

## II.

**I started running for real at age 15**, not long after being cut from the tryouts for the sophomore basketball team at Andover, my father's alma mater. My self-confidence was at a nadir. I was pimply, nerdy, and, for the first time, living away from the love and support of my mother, who had heroically raised my two sisters and me after my father moved away. I was overmatched and trapped in a place where I didn't yet feel at home. One memory sticks in my mind as a metaphor for that time: I was in the dining room of a house on campus one afternoon, quietly preparing for a biology test, when one of my dormmates—a star on the football team—started making out with someone against the other side of the main door out.

Sophomores were required to play sports, and indoor track was still accepting castaways. So I wandered over and told the coach I wanted to join. He sent me off with the boys running the 2-mile, and, for my first few races, I completed the 21 loops around the oval in just under 12 minutes, putting me right about average. My coach, though, saw potential and entered me in the New England Prep School championships. And then, on a magical day in February 1991, at a school called Moses Brown, I discovered a gear I didn't know I had.

The track was an unfamiliar size, so I didn't have context for the times they announced after each lap. I wondered if there had been an error when the time for the first mile was called—5:25, by far my fastest ever. I finished in fifth place in a class-record time of 10 minutes and 48 seconds. The football star read about it in the



school paper and congratulated me. I had practiced reasonably hard, but you don't set records because of two months of doing the same workouts as everyone else. Clearly, my genes had played a role.

My father, meanwhile, had been given the most valuable mulligan one can get. A year after his diagnosis, he'd entered into a study of HIV-positive men, only to be informed that his initial diagnosis had been incorrect; he was HIV-free. Years later, he would tell me that the initial death sentence was what had enabled him to live. Until he was forced to confront what dying would actually mean, his sexual choices had been reckless. His days of competitive running, though, were behind him. By the time I picked up the sport in high school, he was in his early fifties, and his back, his knees, and his constantly blackened toenails wouldn't let him go for more than a few miles. He was a man who liked to do things all in or not at all. He put his running shoes away.

Boys improve more or less linearly at running until they turn into men. If you train steadily, your hormones work in concert with your muscles. Add increasing self-confidence to the mix and you get a positive feedback loop: Speed leads to confidence leads to speed. By my senior year, I was a New England prep school



track champion and headed off to Stanford and the Pac-10. But the pattern of improvement only holds if you stay healthy. The summer before I started college, I increased my weekly running miles from about 35 to about 70. My legs got stronger, but then they frayed. I showed up on campus with a stress fracture in my shin expecting to run cross-country races. A few months later, just as I was gingerly trying to train again, a doctor told me I had mononucleosis. The next summer I swam in polluted water and came down with hepatitis. I knew something was wrong when, on a run in the woods of Northeast Harbor, Maine, I stopped by a bed of moss and saw my pee had turned black.

Quitting the team was hard, but not running was easy. I convinced myself that the focus required by Division I sports would have narrowed the aperture of my college imagination. With no track practice, I had time for a million other things, including playing acoustic guitar. And so the fall after graduation, I moved to a farm in New Hampshire to concentrate on music.

At some point that summer, though, sitting by a granite stone wall and feeling lonely, I decided to try racing again. I was reaching inside myself because there was less going on outside. The realization that I wasn't good enough at guitar to make it my life was hitting me. There was no distraction of friends and parties and classes. I needed something to do. What I came up with was taking my father's goal and making it my own: run a three-hour marathon. I even asked him to do it with me, but he demurred. My training consisted of running a few days a week and strolling through sugar maples on the others. I was clueless. I entered a marathon in Providence and ended up struggling fitfully across the line in 3:18.

For the next decade, I trained episodically and entered marathons now and then while beginning a journalism career that had me moving every few years—from New Hampshire to West Africa to Washington, DC, to New Haven. I dropped out of one marathon at mile 23 because my knee hurt. My father, who loved my new hobby, was left waiting at the finish. I missed another when, driving with my father down to southern Virginia, we got a flat tire the morning of the race. The fastest I ran was a 3:07 in Maryland the year of the sniper. As I hit my late twenties, the three-hour goal seemed impossible.

But then I bought a book called *Advanced Marathoning* and learned the fundamentals of the sport. It really does help to run more than 20 miles multiple times. It really does help to run at least six days a week, and on some of those days to run until you hurt. Finally, on a loop course in Delaware, at the age of 29, I ran a 2:57. My father ordered a blown-up picture of me crossing the finish line. That summer, I moved to New York City and joined the Central Park Track Club. Six months later, in the New York City Marathon, I ran a 2:43, finishing 146th

## I NEEDED SOMETHING TO DO. I CAME UP WITH TAKING MY FATHER'S GOAL AND MAKING IT MY OWN: RUN A THREE-HOUR MARATHON.

out of 37,000. I wasn't elite, but I was getting close to what runners call "sub-elite": that category of person who wins Dick's Sporting Goods gift certificates at local road races.

I felt fit and healthy. I was 30 and newly married to a woman I'd fallen in love with in college. She'd moved to New York after graduation to begin a dual career as a professional dancer and a professor of dance. We were finally living in the same place. I was starting a great job as an editor at WIRED and writing a book. My father, meanwhile, had begun to unravel. He had stalled professionally, and wherever he went he carried pages of the half-finished manuscripts he'd written—histories, novels, memoirs, erotica. He'd begun, too, to obsess about sex and spent many hours a day chatting on gay hookup sites. He would quote Carl Jung and say he was unburdening himself of a repressed youth. He had fallen four years behind on his taxes.

After the New York Marathon, I got a physical. The doctor went through the usual steps. My heart rate was low, my reflexes were fine. Then he put his hands on my neck and found a small lump. I'd have to come in for more tests. My father used to say, "He whom the gods wish to destroy, they first make promising," a variation on a quote



from antiquity that he thought explained the darker moments of his life. Bad news hits hardest when things are going well.

I'd put off the physical because my right knee had been aching, and I didn't want to hear orders not to race. That worry came to seem comical as the reports got ever worse. My doctor told me that they'd need to do a sonogram and then a tissue biopsy. Next came the news that I needed surgery: An aptly named Dr. Cutter would have to slice open my neck to figure out what this little lump really was. The first surgery revealed my diagnosis: thyroid cancer. A second surgery followed. I was then given a radioactive pill and sent into our apartment for a weeklong quarantine. My wife would drop soup off at the door.

My variant of thyroid cancer was eminently treatable, and in the months that followed I recovered slowly. At first, I would step out of my apartment and struggle to walk the one block uphill from my apartment, in Brooklyn, to Prospect Park. But in due course I could walk anywhere, and eventually run. One glorious day, I both ran 10 miles and talked optimistically with my wife about having children. Fitness came back faster than I expected. Nine months after the diagnosis, I ran 15 slow miles in the mountains of Aspen, Colorado, and burst into tears as I came down from the last peak. Six months after that, I ran three times around the circular drive in Prospect Park, finishing first in a 10-mile race, my first win since high school. Soon I was back to my old marathon training routine. In November 2007, I ran the New York City Marathon 13 seconds faster than I had in 2005, right before my diagnosis.

Over the next 10 years, I ran and ran and ran. I entered 10 marathons and finished almost all of them between 2:42 and 2:46. Most years, I ran in New York, but after the race was canceled because of Hurricane Sandy, I entered the flatter Philadelphia Marathon and crossed the line in 2:39. In all these races, the only consistency was the finish. In some I started much too fast, in others I started much too slow. I slept well before some races. One year I headed to the starting line after pulling a near all-nighter bouncing our then 3-month-old—the second of three sons who would form our family—on my knees.

In January 2017, I started a new job as the editor in chief of this magazine. My father sent a long email about how proud he was. By that time he had moved to Asia and slowly squandered his money. With each new financial calamity, he would decamp to ever-poorer regions so that he could still live as he had in his former life. Now he was in the Philippines, by a lake in Batangas Province, almost literally the farthest place from Bacone, Oklahoma. He said he was healthy. In an email, he wrote, "I hope to send good news of sound body (indeed the cardiologist usually bitches at his nurse for bringing x-rays of a 55-year-old man). Marathons were a good investment."

Two weeks later, he suffered a heart attack. He had no chance to get to a hospital and died at age 75. He was felled by the same cause and at about the same age as his own father. I traveled to the Philippines to bury him. In his bedroom, I found a poem I'd written in the second grade about watching him run down the Queensboro Bridge.



**I used to think of athletic ability as a mountain. You're born at the base, and you'll die there too. In between, you climb higher and higher until you begin to descend. But that analogy isn't quite right, because as you get older you acquire**

wisdom that can help you train. I've come to realize that a better analogy is of rolling peaks. You go up, you go down. At some point you reach your peak, but there are still vistas as you descend.

One year after my father's death, in the spring of 2018, when I was 42, I got a call from Nike. They were looking for people to train under elite coaches, a moon shot program ultimately aimed at testing and promoting their new products. (Yes, I do understand why the editor of a magazine that covers technology and gear might have been selected by a company that makes gear and technology.) Did I want to participate? My race times had been consistently slower for roughly five years. Of course I did.

As I wrote in a story in WIRED in 2018, I was soon equipped with a heart-rate monitor on my arm, a balance monitor on my waistband, and sensors on my shoes that measured pronation and force. I started doing hard, structured workouts of a type I had never done on my own, and I had the oxygen consumption rate of my blood tested at Nike's lab in Portland. I drank beet juice every morning because studies have shown that high-nitrate foods can boost cardiovascular endurance. I started to log every workout publicly in Strava. In October of that year, I crossed the finish line in Chicago in 2:38, my best time ever.

Very few people quit running after a personal best. You want to get faster, until you realize you can't. And so, after Chicago, I began a quest to understand how much of our limits are physical, how much are mental, and how much they exist in some region in between. I had improved at an age when humans were supposed to stop improving. Now I kept thinking about all those races over the years when I hadn't improved. Why had I only once managed a marathon in under 2:40? And if that wasn't my limit, how about 2:30? Perhaps 7-year-old Nick was correct. Maybe Dad could have sped up at the end.

And so, in the spirit of experimentation, I decided to see if I could run fast marathons back to back. One of the great mysteries of running is the level of effort that breaks you. To a point, going harder makes you stronger, like blowing air into a tire that gets ever firmer. But there's a limit, and when you cross it the tire pops. Your muscles collapse and your motivation falters. Each marathon made me feel like a rag doll. It could take

months before I was ready to run hard again. But maybe, I thought, this year would be different. Perhaps there was air left in the tire for running the New York City Marathon just three weeks after Chicago.

My two older boys had come to cheer me on in Chicago, but the youngest one, then 4, had stayed in New York. I had a feeling that I would never be this fast again, and I wanted him to see me running well too. Parents can never know for sure what will inspire their kids or scar them, and few people are better at seeing through our vanities and pretensions than our children. Still, at the very least, he would get a sense of this thing I do when I put on my running shoes.

On the first Sunday in November, I trekked to the world's most inconvenient major marathon: subway to ferry to bus to security queue. At the crammed starting line, I stood stretching my ankles and my neck—the only parts of the body you can loosen when packed hip-to-hip. The gun went off and everything proceeded smoothly. Eight miles in, right before Barclays Center, I swerved to the right to grab Gu gels from my kids. I felt in control and surprisingly calm as I passed through Williamsburg and then down the Queensboro Bridge at mile 16. At the 22-mile marker at Marcus Garvey Park in Harlem, I felt great. My last 4 miles were by far the fastest of my race. For the second time in a month, I crossed the finish in 2:38.

I'd passed some psychological barrier, and probably a physical one too. I'd also been aided by tech. I had worn Nike's new Vaporfly shoes since nearly the moment they'd come out: first for a 2:43 in New York, and then for both my 2:38s. But the biggest tech aid might have been the heart-rate monitor on my arm. (I've tried several wrist heart-rate monitors, but they always give me a data muddle; chest-heart monitors feel like a girdle.) The screen of my Garmin watch displayed two numbers: my heart rate and my pace. I tracked my data in every hard workout and got feedback via text message from my new coaches, who would scan the numbers I uploaded and track the workout reports I put in a Google doc. Marathons are all about energy conservation. It's important to stay calm, and in both marathons I'd followed a very specific rule: For the first 20 miles, if I started running faster than six minutes per mile, or if my heart rate jumped above 145, I needed to slow. After mile 20, I

could go as hard as I wanted. And in those last 4 miles of the New York race, it was the data that had given me the confidence to push it to a roughly 5:45 mile pace.

Now I was exhausted. Every muscle was sore, and my body felt like a Jenga tower with half the blocks removed. I rested for two months, and then I wrote to Stephen Finley, the head of the Brooklyn Track Club. He had trained me, through the summer, as part of the Nike moon shot program, and we'd become friends. I wanted to get faster still. Would he help? Of course, he said.

The first thing Finley said to do was keep up my regular routines, with a little more intensity. When I'm in New York, I wake up at the same time, eat the same breakfast (oatmeal and nuts), and run 4 miles to the office. At the end of the day, I run home.

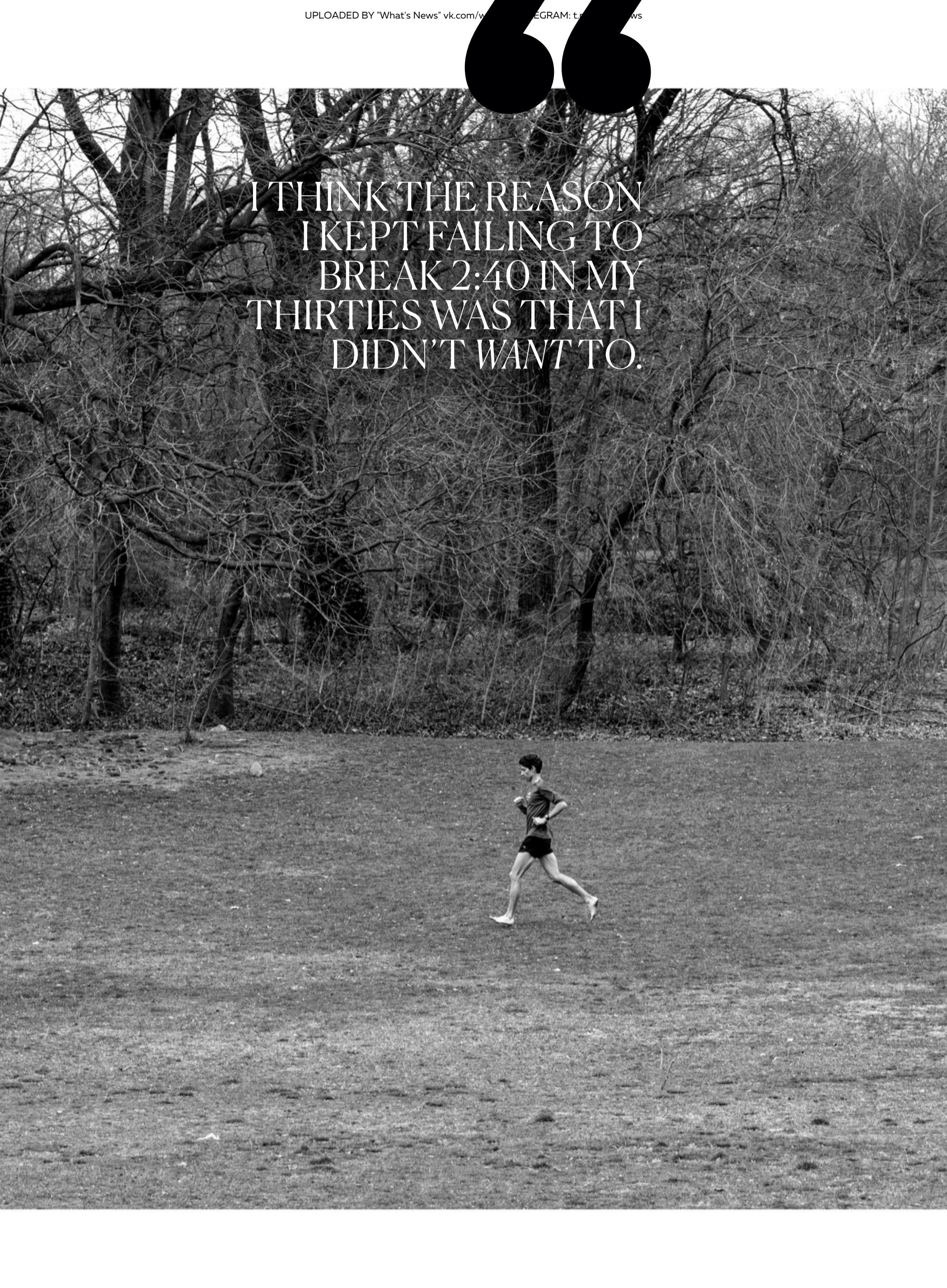
Finley created a plan in a Google doc to help me, and I began following the routine in earnest as the winter in New York started to bear down. Before Chicago, I had run an average of 55 to 60 miles a week, roughly half of what a professional marathoner does. By February 2019, I was up to 65 to 70 miles. Twice a week, I would do speed workouts. These might be short and fast (eight repeats of 1,000 meters hard, with rest in between) or longer and slower (three repeats of a 2-mile circuit, with rest in between). Occasionally I would run without shoes to strengthen my feet and to remind myself about posture. There was the occasional hitch. Traveling for work in Abu Dhabi, I was stymied by sand and wind. When I got back I tried to do a long run in Prospect Park at night, and somewhere on the far side of the park I pulled over by a water fountain and almost fell asleep on the ground next to a raccoon. Another day, I took my Vaporflys to the local track at the start of a snowstorm. The first-generation Vaporflys were good for many things, but they had the traction of a spoon wrapped in a banana peel. My marks in the snow were roughly left foot, right foot, left foot, butt print, arm print, left foot, right foot, butt print.

During the previous training cycle, I fell apart every time I ran a mile under five minutes and 35 seconds. Then, one day, I was racing down the drive in Prospect Park, drafting behind a guy riding a cargo bike. "Dude, how fast you going?" he asked. I looked down and was stunned to tell him I was running a 5:25 mile. He gave me a thumbs-up and let me keep drafting.

The real test came in April, at the Boston Marathon, a slow, hilly course. I set my goals cautiously. Just maybe, I could break 2:35. But a smart marathoner has a private goal and a public goal. I told everyone I was trying to break 2:37:12, a marathon run at exactly a six-minute pace, which my high school cross-country coach had once told me was the cutoff time for a real runner.

The gun went off, and everything flowed just fine. I ticked off the early downhill miles exactly on target. I felt nothing more than the normal marathoner's paranoia: At one point I became obsessed with the idea that my right shoe was tied too tightly. The hills passed much sooner than I expected. As the course turned right near the church I'd gone to as a kid, and about 2 miles from the boxwoods by my old home, my mother hollered words of encouragement. Soon I was racing downhill toward Kenmore Square. I ran mile 22 in 5:27 and finished the race in a new personal record of 2:34. Later, the Abbott World Marathon Majors emailed with the delightful news that my times in Boston and Chicago had made me the 29th-ranked marathoner over 40 in the world.

After I finished Boston, I found myself thinking of my father. He would have



I THINK THE REASON  
I KEPT FAILING TO  
BREAK 2:40 IN MY  
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DIDN'T WANT TO.



been proud. He always had a belief that I could do pretty much anything, even when it wasn't warranted. In high school, I was a mediocre but enthusiastic actor; I wanted the part of Rosencrantz in the school production of *Hamlet* and was disappointed not to be cast at all. My father said that if the drama director had any sense, he would have cast me as the lead. His confidence never waned. Shortly before his death, he sent a long email. "Reread the 24th book of the Iliad, where the gods throw ashes on some and gold on others," he wrote. His reading of the poem was a bit off, but his message came through: I had a wonderful wife and family and was doing OK. "Destiny, and you got all gold," he wrote. Perhaps his praise was an attempt to reverse the way his father had treated him. Still, what more can a child ask than that their parents have faith in them?

# IV.

**The math about how to get better at running,** at least at a first approximation, is fairly simple. There's the body's fitness: how efficiently you can uptake oxygen and move it to your muscles. Then there's your running economy: mainly how efficient you are at moving oxygen while at a given speed. And then there's how much you weigh. To improve the first two factors, you run harder and smarter and avoid getting hurt. To decrease your mass, you eat more spinach and less ice cream.

So why do runners have limits? And why do the limits differ from one person to the next? In part, it's because of physiological factors: blood oxygen levels, lactate, muscular strength, each of which has a genetic component. But there's another theory, put forward by a sports physiologist named Tim Noakes. As he puts it, in what he calls the central governor model, part of the reason we slow is because our brain is telling our body to stop because it's scared. It doesn't want you to overheat or develop a stress fracture in your shin, so it preemptively hits the brakes. If Noakes' theory is right, it implies a mind-body dilemma. We all can go faster. We just have to persuade our brains not to start the subconscious shutdown process right away. But the only thing we can use to trick our brain is our brain. Training becomes a game of hide-and-seek with oneself. When I think back to that day on the Moses Brown track, I wonder whether I could have run as fast had I known my early pace. If I'd realized how fast

I was going, my brain might have shut down.

This suggests a subtle sneaky brilliance to Finley's workouts. He constantly had me running 400-meter repeats, or even 200-meter repeats. Why? To make my legs stronger. But also to familiarize my body and mind with faster paces and to make me less scared of my watch. If you've run a 4:40 pace for any distance, you feel a bit less anxious seeing a 5:32 pace on your watch in a 10-mile race. He couldn't, though, tell me this. He needed to help one part of my brain hide while the other half was learning to seek.

After I'd recovered from Boston, I talked with Finley about a new goal: breaking 2 hours and 30 minutes in Chicago in the coming fall. He methodically planned workouts to slowly shift my physiology and my psychology too. I kept a Google doc in which Finley would plot everything out, like: "6x 1 mile w/ 90 sec rest start at 5:50, 5:45, 5:40, 5:30, 5:25, 5:20." Every Tuesday, I would run long, hard repeats. Every Thursday, I would run short, even harder ones. Every Sunday, I'd run long but not hard.

We slow down because we get older and our bodies break down. But I'm convinced we slow also because our days fill up. My job involves an endless series of crises and impossible dilemmas; parenting three kids is pretty much the same. There isn't remotely the time I had for hobbies in, say, my twenties. My best friend since nursery school—a professional trumpet player—has wryly pointed out that the years I've run fast are the years I haven't written any decent music.

Fortunately, running is a great hobby for busy people, because it doesn't take that much time. The sport is simple, so there are no plays or intricate moves to learn. And it's grueling, which means your body can only take so much. An elite tennis player might spend 40 hours a week on the court. An elite runner's schedule might take 12. During my most intense training weeks, I'm running for around eight hours total. That's a lot of time. But more than half of that time comes from commuting. I drop my kids at school and then run into Manhattan. I finish work, run home to Brooklyn, and arrive by 7 pm. My wife or our nanny has picked up the kids and started the evening routine. My Sunday morning long runs often start before the children wake up. My wife, having spent her life in dance, appreciates the value of my physical training—though she understandably prefers me to be back from these long runs at 7:30, not 8:00.

Sometimes I think that everything in life would be easier if I just put my shoes away. But more often I think the opposite. With a stressful job, it's helpful to have just a little bit of time where you force yourself to go outside and breathe. And I've come to believe that discipline in one part of my life makes it easier to have discipline in another part of life. Maybe my rather hard job would become even harder if I weren't running. Maybe my father could have held it all together if he'd just started running a little earlier.

In the days after my father died, I wrote a letter to my own children about him. It stretched to roughly the length of this essay. I'll give it to them when they're older. I want them to understand a man they knew only in his frail, harum-scarum last stages of life. I also wrote it for myself, of course. As the people I love the most know, I've spent my life both following my father and trying to avoid becoming him. I share his genes for running, and large parts of his personality. But genes that make one susceptible to alcoholism are inherited too. As for the *King Lear* madness at the end? It was nature, nurture, and circumstance. I'm approaching the age when it began for him.

I sent an early version of this essay to my older sister, who saw something clearly that I hadn't identified yet. "Running solved nothing for [Dad]. You've had a longer journey with it, and used it in ways that are much more productive. But I have this nagging sense that your story of needing to follow footsteps (the schools, the running) and needing so much *not* to follow footsteps (the overindulgence, the flameout, the irresponsibility and failure) are more complexly interwoven."

# V.

**The morning of the 2019 Chicago Marathon**, I drowned myself in beet juice and, lacking utensils, used the knife on a hotel corkscrew to spread peanut butter on a bagel. I hydrated with water, dehydrated with coffee, and hydrated again. Then I made my way to the start. Finley came, and he, my oldest son, and my younger sister and her kids positioned themselves on the course to strategically hand me water and energy gels. I spent some of the time before the race obsessing about the fact that I had brought two socks of slightly different sizes, but mostly I felt confident. If the day was perfect, 2:30 was possible.

Then the gun went off and everything went haywire. The skyscrapers of Chicago intoxicated my GPS, and my heart-rate monitor was in its cups too. Finley wanted me to run the first half at 5:45 per mile. I wanted my heart rate to be under 140. But about three-quarters of a mile in, my watch said I was running a 4:40 pace and my heart rate was 169. I passed the first mile, adrift without my technological crutches—a zoo animal dropped back into the wild. But then I saw the clock at the first mile marker: 5:45 on the nose. For the next 3 miles, my pace stayed the same. My watch was drunk, but I was holding steady. At times, as in all races, I felt exhausted, confused, and wanted to puke or drop out. But mostly I just tried to breathe, relax, and think about as little as possible.

I passed the half in 1:14:59 and then picked up the pace a touch. By mile 22, part of my brain was celebrating that I would

likely beat 2:30, and the other half was delineating all the things that could yet go wrong. Then, at mile 25, I tried to accelerate and suddenly felt as if I were running in boots made of concrete.

I felt momentary panic, the kind you get when your car first starts to skid on ice. But then I steadied myself and tried to concentrate on my breathing and a meditative pattern I sometimes use while running—counting out patterns of three as my feet hit the pavement. One, two, three. Right foot, left foot, right foot. One, two, three. Left, right, left. I thought about posture and trying to keep relaxed from the base of my skull to my heel, and from my cheekbones to my toes. I reminded myself that it didn't matter if I ended in a sprint, as long as I didn't end in a crawl.

Hitting my goal meant running a marathon in 9,000 seconds, and I crossed the line with just 47 to spare: 2:29:13. Only one person older than me went faster that day. My family sent texts full of emojis and love. Finley came running to congratulate me, to celebrate, and to reveal that, having seen me the week before, and toward the end of the race, he'd worried I'd pushed it too far. For the first time, he said, I had looked like I was truly exhausted. I'd made it. I'd done it. But now it was time to stop for a while.

# VI.

**At my father's funeral, one of his friends** told me a story from their college days. My amateur-boxer grandfather, Frank Thompson, had come to visit the campus. When my father introduced him to his friend, my grandfather said, “I wish I had a son as strong and handsome as you.” My father had spent his life trying to escape his taller, stronger father. Granddad’s desire that his son be good at sports had led his son to entirely reject sports. In fact, my father often said decades later that he was only able to run truly fast once Granddad died. And it was, indeed, two years after Frank Thompson’s death that Scott Thompson ran a marathon personal best, that day in New

York City when Nick Thompson handed him shoes and a cup of orange juice.

I've thought about my dad's comment a lot as I've considered why people get faster, or why I ran just under 2:44 at age 30, and just under 2:30 at age 44. We get faster because we train harder and improve the capacity of our mitochondria to manage oxygen. We get faster because we accumulate wisdom and stick to routines. And we get faster, too, because we break barriers in our minds that we don't know exist—and probably couldn't cross if we knew they did.

Part of the reason I got faster was technology—the shoes, the sensors, and even the Google doc that kept me on track. Part of it was focused coaching, which led to focused training and focused recovery. Maybe there are things that my sons, several decades from now, will understand that aren't apparent to me now. But today I think the reason I kept failing to break 2:40 in my thirties was that I didn't *want* to.

The cancer diagnosis I got the year I turned 30 made me feel mortal for the first time, and it was terrifying. I was convinced that, even if I survived—as I surely would—something else awful would be found the next time a doctor put his hands on my neck. I worked in WIRED's offices, which were then in Times Square, and I would run-commute home to Brooklyn down the Hudson River bike path. I'm not a person who usually stops during a run, but one evening, after the diagnosis but before the surgeries, I pulled over somewhere just south of Chelsea Piers and stared grimly out over the cold Hudson River. I hadn't had children yet, and I worried I never would. I was young, but felt as if I was slipping down the mountain. I stood there for maybe half an hour, before, slowly and stumbling, I began again to run back home. I've thought about that moment, and about what it meant to be sick, during probably every marathon I've run since.

Might that have been why I was stuck at 2:40 for so long? Maybe I didn't spend my thirties racing the clock; maybe I spent them racing myself as I'd been before I got sick. I was utterly content to stay even with that person for as long as I could. I was just happy to be free of cancer, to be able to do something that proved not only that I was still alive but also that the cancer hadn't slowed me down.

At some point I'll stop. Maybe, in fact, the fall of 2019 was the peak of my running life. I broke 2:30 and will forever, in the eyes of my children, have been momentarily fast. I even helped inspire one of them—the 3-month-old I once bounced on my knee through the night, now age 9—to do his own training. Two weeks after Chicago, he and I completed the 3.35-mile lap of Prospect Park together. I worry, of course, whether I might just be creating a burden for him. We give our children our genes and our love, and we don't have any idea of what, in the end, they'll do with them. My grandfather scarred my father by trying to push him into sports; my father inspired me by taking me running around the block. Maybe one of my sons will write a tell-all one day about the pressure his father put on him to be something he didn't want to be. Or maybe they'll find that they love the sport too, and I'll end up drinking beet juice with my grandkids.

I started talking to Finley again and made another Google doc, with its relentless schedule of Tuesday, Thursday, Sunday. Can I go faster in my next marathon? I don't know, but I'll certainly try. All three of my kids, though, are realistic about what it means to try to get faster as the body gets weaker every day. They are excited about what they'll feel like at 18 or 28. They're climbing up the mountain as I'm walking down.

In the taxi to the airport after Chicago, I asked my 11-year-old son what my next goal should be.

“2:35,” he said.

“2:35?” I asked in surprise, thinking perhaps he had meant 10 minutes faster.

“You think you’re going to run that fast again?” came the response, with wide eyes and a perfect grin. ▀



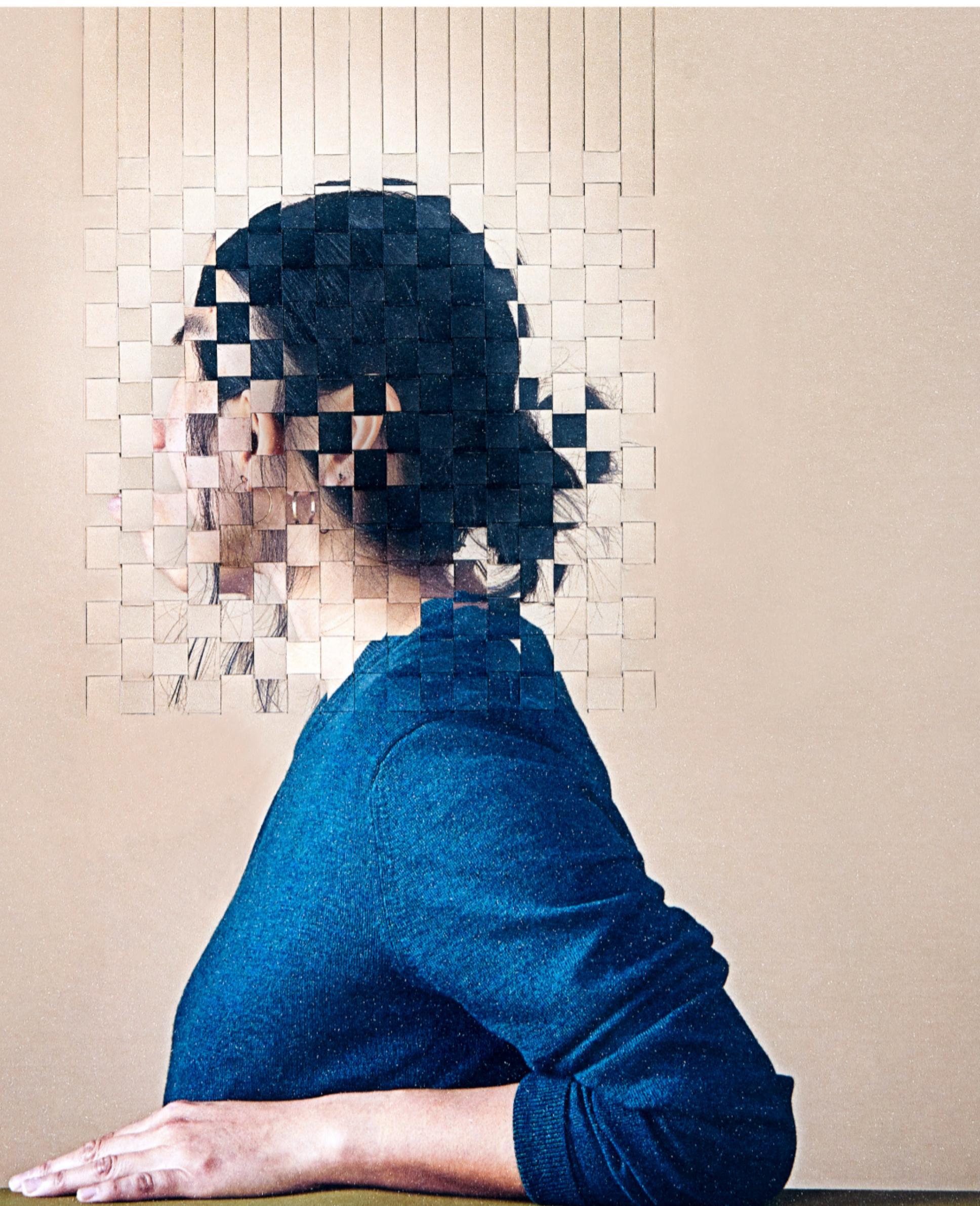
**At a Bay Area  
nonprofit, survivors of  
human trafficking shed  
old identities and  
level up their future.**

BY  
**LYDIA HORNE**

ART BY  
**ALMA HASER**

PHOTOGRAPHS BY  
**MARIA DEL RIO**

**Own**



T

**TODAY, AT A** family center in downtown Oakland, 11 students are training with two lecturers and two teaching assistants. Toys are strewn on the floor; the school, called AnnieCannons, offers childcare onsite. For the first six weeks, students spin up on basic digital literacy, then they spend up to six months learning programming languages—JavaScript, HTML, CSS—at times working on clients' projects. The coders are also encouraged to pitch products of their own, and they often come up with ones to help victims of abuse and exploitation. Coding is about identifying problems and finding solutions, says Jessica Hubley, one of the founders of AnnieCannons, a nonprofit that teaches coding to survivors of human trafficking and gender-based violence, and that is something these students have had a lot of experience doing.

Rev tells me she's worked on CSS animation, CLI GIFs, and a handful of other tech for clients: "DQaaS—data quality as a service—projects were quite regular last year." Those, she adds, were pretty valuable to stabilizing her income as she got more coding experience. Magical has been at AnnieCannons for a year. "My first web project was EasyTRO, an app that helps survivors of domestic abuse and human trafficking access the documentation needed to file a temporary restraining order." Voyager was a student in the nonprofit's third class; she now manages the bulk of the company's data project work.

In recent years, Catie Hart has spent her time both as a lecturer at AnnieCannons and as a human trafficking adviser to places like the San Francisco Police Department, Shasta County, and UC Davis. But when she was 18, Hart was coerced into sex work by a man she met just after she had arrived in San

Francisco. After more than seven years, she broke away, found her way to UC Berkeley, and got a degree in sociology.

To photograph Rev, Magical, Voyager, and Tia, photographer Maria del Rio shot images from a low angle; she—and collaborator Alma Haser—wanted to create a halo effect, reminiscent of Renaissance paintings. Del Rio then sent the files to Haser in East Sussex, UK, who printed the portraits in her studio and wove pieces of the images together to make a collage that would preserve the coders' anonymity. Most of the developers at AnnieCannons assume a pseudonym—as a safety precaution, as well as a symbol of a new identity.

These days Hart, who is now 40, is cutting back from speaking engagements and spending more time at AnnieCannons. "For the first time in my life," she tells me, "I have shed *survivor* or *victim* as my identity. I was having to survive on being a 'survivor,' because that's how I was making money, speaking about what happened to me. Now I want to talk about coding."

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LYDIA HORNE (@lyderature) is the editorial business manager at WIRED.

←  
Rev  
[previous page]

"The software I plan to develop will help people identify warning signs and symptoms of not-so-easy-to-spot abuse," says Rev. "If someone is being trafficked, I would like my software to prompt that person to start questioning the predatory behavior that is being normalized over time. It only takes one chink in the armor for a fresh and hopefully healthier perspective to start gaining ground."

→  
Voyager

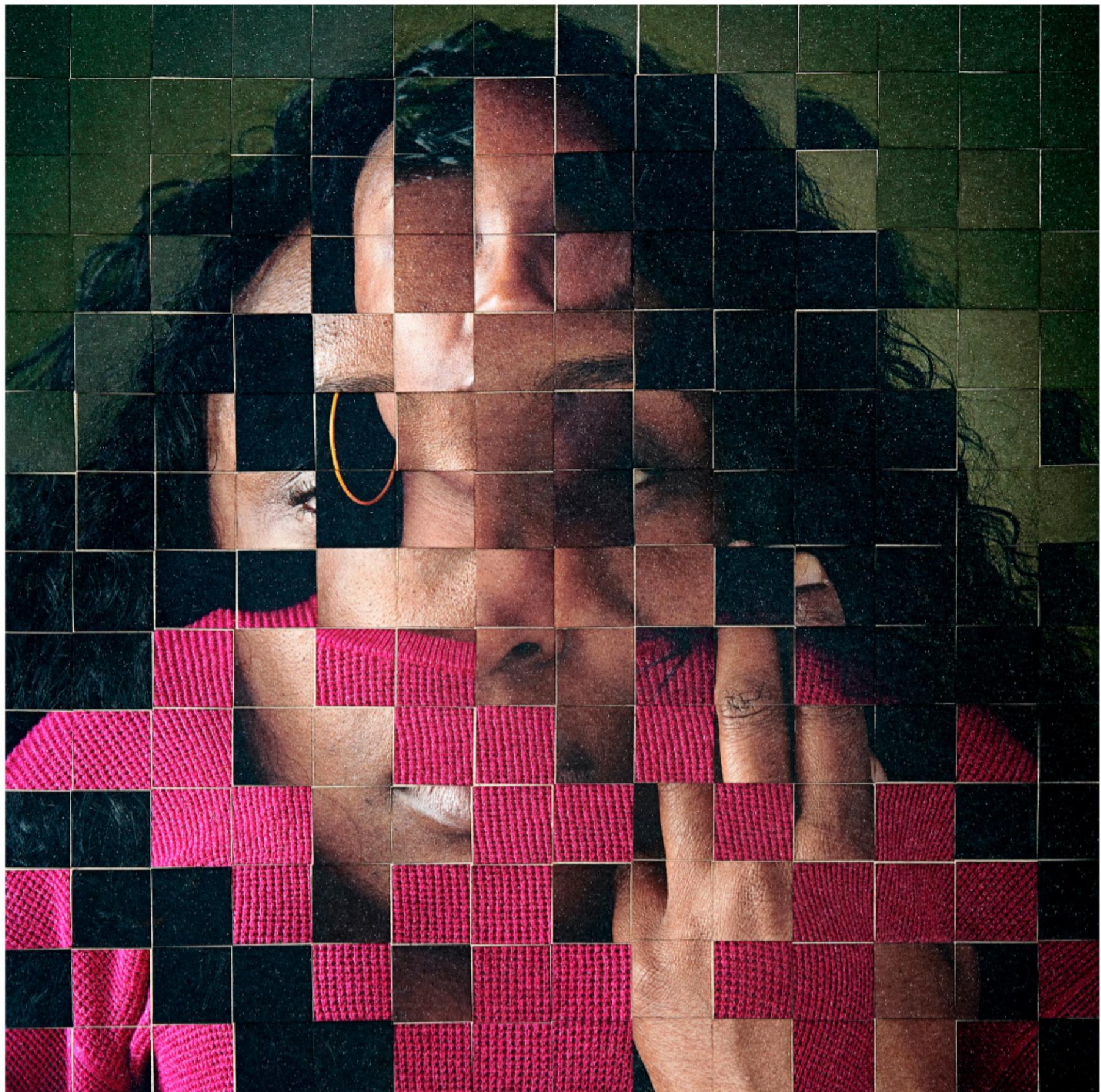
"I was part of cohort 3 in 2017," Voyager says. "I worked as a contractor in 2018. I became an employee in 2019."





Existem momentos de agir, e momen-

tos de esperar.  
Existem momentos de agir, e momen-



←  
Tia

Tia recently graduated from AnnieCannons and is now a teacher's assistant for the current class. She hopes to start working on clients' projects soon.

↑  
Magical

"I've completed over 200 data management projects, created the donation page for AnnieCannons' Easy-TRO, and cocreated a website for ARC facilities," says Magical.

•

# TOSSLED

FROM THE

# ARK

*by Adam Elder*



A wide-angle photograph of the Gulf of California. The horizon is visible in the distance, where the light blue water meets a sky filled with scattered, white and grey clouds. The overall scene is calm and expansive.

In the Gulf of California, a pudgy porpoise called the **vaquita** is on the verge of extinction.  
But its genetics could hold the key to saving other species.

# L

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Lorenzo Rojas-Bracho was in mourning. Beyond the windows of his hillside house in Ensenada, Mexico, the sun glinted brilliantly off the waters of the Pacific, but he'd drawn the curtains closed. In his living room, hanging above plush leather furniture, were whimsical paintings of the subject of his grief—a chubby, 4-foot-long porpoise called the *vaquita* (Spanish for “little cow”). Found only in the upper reaches of the Gulf of California, where the Colorado River meets the sea, the vaquita is the goth kid of the cetacean clan, with dark markings around its eyes and mouth and a reputation for extreme shyness. It is also the most threatened marine mammal on earth. Over the past 20 years, the species’ population has fallen by a staggering 98 percent. It’s officially listed as critically endangered, but even that term feels like a wild understatement; today there are perhaps a dozen vaquitas left.

Rojas-Bracho, a marine biologist, has been in love with aquatic mammals for most of his life. When he was 7 years old, he visited SeaWorld and offered his services as a killer whale trainer. (“They said no, of course, but they were very kind,” he recalled.) Now he is the head of the International Committee for the Recovery of the Vaquita and an idol among Mexican conservationists. A tall, wiry man with scholarly glasses, a salt-and-pepper goatee, and the disposition of a cool uncle, he takes a patriotic sort of pride in the porpoises. In the million years or so since their ancestors swam up into the Gulf, vaquitas have become exquisitely adapted to their special cul-de-sac: Their dorsal fins and flippers are proportionally bigger than other porpoises’, to dump heat when the water temperature breaks 90, and their echolocation is finer than a dolphin’s or a bat’s, allowing them to thrive in conditions so turbid that a diver just 15 feet down can’t see his own hands. What’s more, they’re cute. An old Gulf fisherman who was lucky enough to have seen one on a few occasions told me, “You almost want to cuddle it and pet it. It’s such a defenseless animal.”

Those who study the vaquita must handle disappointment well. But when I visited Rojas-Bracho in Ensenada, he wasn’t his usual stoic self. A few months earlier, in the fall of 2017, he and his longtime collaborator Barbara Taylor, a marine mammal geneticist at the Southwest Fisheries Science Center in La Jolla, California, had helped mount the first attempt to take vaquitas into captivity. With more than \$5 million in funding from the Mexican government and outside donors, they had assembled a fleet of 10 boats, a custom-built floating porpoise pen they called *el Nido* (“the Nest”), and a team of 90 people from nine countries—acoustics experts, spotters, animal handlers, veterinarians—along with four US Navy-trained bottlenose dolphins. The project had ended in tragedy. “I still cannot talk about it without crying,” Rojas-Bracho said.

The captivity expedition had capped off nearly a century of trouble for the vaquita. Like tigers, elephants, rhinoceroses, and pangolins, all of which teeter on the brink of extinction, the porpoise has been obliterated, indirectly, by China’s reckless appetite for exotic animal products. In the 1930s, Chinese fishermen started landing huge catches

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of a giant croaker fish called the bahaba. The species, which grows to 6 feet long and weighs up to 220 pounds, was prized for its swim bladder, or maw, an organ that helps ballast the animal. Although made up mostly of collagen, maws of all kinds are a popular medicinal supplement; they're sold dried and prepared in soup. Bigger is supposedly better, and the bahaba's is huge. By the middle of the 20th century, overfishing had decimated the species, so maw traders turned to the next best source, an equally giant Mexican croaker called the totoaba. Every win-

**Lorenzo Rojas-Bracho**, head of the International Committee for the Recovery of the Vaquita, at home in Ensenada, Mexico.

ter, it swam north to spawn off the coast of a small Gulf town called San Felipe, smack in the middle of the vaquita's only habitat.

The ensuing gold rush was catastrophic for fish and porpoise alike. At first, the totoabas were so plentiful that they could be harpooned from the beach, butchered for their maws—which, when dried, resemble colossal potato chips with unappetizing tendrils—and left to rot. But as the population dwindled, fisherman turned to new methods. Near the Colorado River estuary, they laid gill nets, aquatic weapons of mass destruction designed to hang in the water column and ensnare passing prey. Vaquitas have the fatal misfortune of being nearly the same size as totoabas, so the nets were disastrous for them.

The Mexican government banned totoaba fishing in the 1970s, but the killing never really stopped. By 2017, Rojas-Bracho and Taylor faced a difficult decision. With vaquitas stuck in critical decline, what else could be done? They'd talked about setting up a captive breeding program for years, but the expense and complexity had never seemed worth the risk. Now, though, it was time for a Hail Mary. That summer, Rojas-Bracho's boss, the Mexican environment minister, gave him the go-ahead to assemble his armada.

The team had four weeks to pull it all off. Early on in the effort, the vaquitas showed a knack for slipping past the researchers' nets, or just disappearing altogether. Then, with one week remaining, everything changed. "It was a gorgeous day," Rojas-Bracho recalled, sinking into his sofa. "I was far away from the action, but I could follow by radio. They were saying, 'We have the vaquita, it's behaving very nicely, it's coming to the net. We've got it on board, it's a female, it's a great animal, it's very calm.'" Rojas-Bracho motored over to take a look. It was the closest he'd ever been to a live vaquita. "I could see my eyes in her eyes," he said.

As the sun set and the sea darkened, the team introduced the vaquita to its temporary home, el Nido. At first, it swam erratically, taking the measure of its new surroundings. Then it started to adapt. Rojas-Bracho was seated on deck, taking it all in. He heard one of the vets say to the vaquita, "You're doing well, baby," so he stood up and walked away to call the environment minister. By the time he hung up, the situation had changed dramatically.

"The animal started behaving wildly, and then it stopped breathing and it started to kind of sink," he said. "Then there was a decision to take it out of the water and do CPR for three hours until it died, and that was painful. Jesus, it was painful. Seeing the best vets in the world trying to prevent the vaquita from dying, saying, 'Come on sweetie, you can do it, you can do it,' it was ..." He sighed quietly and lifted his glasses to wipe his eyes.

The scientists' terrible night wasn't over. They took the vaquita onshore and performed a necropsy. Rojas-Bracho didn't sleep. The next morning, everyone agreed to shelve the captivity project.

It should never have come to this, Taylor and Rojas-Bracho thought. People had known of the vaquita's plight for decades, and they'd also known precisely how to stop it. An animal that should have been a conservation success story—Mexico's answer to the bald eagle or the bison—had instead become a parable for the age of mass extinction.

Yet all was not lost. During the necropsy, the team had harvested a few tissue samples, consisting of millions of live vaquita cells. Stored in a lunch cooler, they were driven north, through the desert and across the border, and delivered to Phillip Morin, a population geneticist whose office is next door to Taylor's. Morin brought them to the San Diego Frozen Zoo, a sort of genetic safe-deposit box for threatened, endangered, and extinct animals.

## C

Conservation biologists have always played the role of the unheeded prophet. They may spend decades studying a particular plant or animal, and by the time they've amassed enough peer-reviewed data to make solid recommendations about how to save it, their expertise is often met with a shrug. Political or economic needs usually trump nonhuman ones, and so conservation never quite keeps pace with extinction. This is bad news for all species, but especially for those already trapped in what biologists call the extinction vortex, a spiral of mutually reinforcing threats that include predation, poaching, disease, pollution, natural disasters, habitat destruction, and genetic factors.

The questions that conservationists must ask themselves can be unpleasant: How to triage so many at-risk creatures? How to decide what lives and what dies?

That was the problem on Rojas-Bracho's mind the first time he walked into Taylor's office in La Jolla as a young PhD student in 1993. He'd just examined mitochondrial DNA from a couple dozen vaquita corpses and had found, to his astonishment, that each contained the same key sequence in the



**TOP:**  
Barbara Taylor at  
the Southwest  
Fisheries Science  
Center in La Jolla,  
California.

**BOTTOM:**  
One of the vaquita  
paintings she makes  
in her spare time.

control region—an area known for its high variability. This is very unusual, Taylor told me; it's as though every human in the world shared the last name Smith, without even a single Hernandez or Wang. Biologists typically treat this as a dire sign. In small populations, one of the biggest threats to long-term survival is a phenomenon called inbreeding depression. Left without many mates to choose from, animals end up reproducing with their relatives, with the result that harmful traits sometimes become concentrated in the population.

Strangely, though, the vaquitas showed no outward signs of inbreeding or poor health. Rojas-Bracho had dropped by Taylor's office to ask whether, when he published his study, journalists and lawmakers would assume vaquitas were doomed—too far down the extinction vortex to be worthy of conservation.

Intrigued by Rojas-Bracho's question, Taylor began delving more deeply into the vaquita's DNA, using computer simulations to peer back into its evolutionary history. How could an animal with so little genetic variation have so few bad mutations to show for it? Eventually, she came up with a hypothesis: The risks posed by inbreeding are generally greatest when a population goes from large to small in a very short period of time. Parts of the gene pool suddenly drain away, and you're left with a random assortment of traits. Dangerous or even fatal mutations can start showing up more often. The secret to the vaquita's fitness was that its population had been small for a long time. Natural selection had worked its slow magic, purging bad variants from the gene pool over millennia.

In the summer of 1997, Taylor and Rojas-Bracho undertook their first vaquita census in the Upper Gulf. It set the tone for the next two decades of research. The air-conditioning on their boat broke down in the 100 degree heat. One scientist cracked his spine in a fall. The Mexican navy boarded their ship regularly to check for drugs. Then a hurricane came roaring up the Gulf. "But we came up with a good abundance estimate!" Taylor said: 567 vaquitas. It was the first time either she or Rojas-Bracho had seen the animals alive.

The question now was why, in the absence of inbreeding, the vaquita population was dying off. Taylor and Rojas-Bracho eliminated the possible threats one by one. A

few scientists had blamed the damming of the Colorado River, which sometimes didn't even reach the Gulf anymore. Others had blamed pollution. Yet the vaquitas were eating well, and their blubber was free of contaminants. In a pair of papers published in 1999, Taylor and Rojas-Bracho concluded that gill netting was the main cause of the species' decline. Left in peace, the porpoise would recover. Rejecting what they called "the hypothesis of certain doom," they recommended changes to fishing regulations. "If the vaquita goes extinct, it will be the first species to have done so by gill net, and gill net alone," Taylor told me.

An eye-opening expedition to China seven years later foreshadowed a worst-case scenario for the vaquita. Taylor traveled to the Yangtze River to look for a dolphin called the baiji. Her team encountered heavy industrial pollution, dams, fishing, overdevelopment, and so much boat traffic that it reminded her of an LA freeway. What they did not encounter was a single baiji, and the animal was soon declared all but extinct. "A 30-million-year-old species disappeared when nobody was looking," Taylor said. She realized the need to keep a closer eye on the vaquita. Shrimping was the main fishery in the Upper Gulf at the time, and even those nets were killing the porpoises at a rate of 8 percent a year, the data showed. "It was a horrible rate of decline, but it still gave us time to fix things, and we really thought we *were* fixing things," Taylor said.

Then, thanks to China's 21st-century economic miracle, which increased demand for expensive maw, the totoaba gold rush in Mexico resumed. "It just seemed like it was overnight," Taylor told me. According to an undercover investigation by Earth League International, a black-market supply chain

sprang up: Illegal totoaba cartels, some of them loosely affiliated with Mexico's narco-traffickers, smuggled the maws to China, where large specimens might fetch \$80,000 per kilogram—more money, by weight, than gold or illegal drugs. They were a versatile status symbol; many people chose to mount them on their walls, give them as wedding gifts, purchase them as investment vehicles, or even pass them off as bribes to local officials. Fishermen who once made \$600 a month toiling for shrimp under the sun could now earn \$5,000 or more in a single evening. Meanwhile, vaquitas began dying off at a rate of roughly 35 percent a year.

In 2011, as though with the porpoise in mind, the journal *Trends in Ecology and Evolution* published a spirited exchange between two groups of researchers on the conundrum at the heart of conservation biology: When a species is swirling down the extinction vortex, how do you decide—quickly and accurately—what to do? The debate focused on the so-called 50/500 rule, first proposed in the 1980s, which says that in order for a species to survive, it must have at least 50 breeding-age individuals in the short term and 500 in the long term. Intended as a sort of back-of-the-envelope calculation, the rule had a couple of limitations: It took account only of genetics and inbreeding, excluding all the other threats a species might face, and it aimed to apply a universal standard to creatures as different as a gorilla and a condor.

One group of researchers, made up of Australians and Brits, had recently proposed that the long-term number be revised upward, to 5,000. It wasn't a perfect system, they wrote, but it was better than no rule of thumb at all. "Conservation biology is a crisis discipline akin to cancer biology, where one must act in a timely manner on

## Conservationists must ask unpleasant questions: How to triage so many at-risk creatures? How to decide what lives and what dies?





A child plays on the waterfront of San Felipe, Mexico, the epicenter of both the illegal totoaba trade and vaquita field research.

# “Oh my God, vaquita! Vaquita!” a spotter called out.

the best information available,” they wrote. As the climate crisis worsened, so would the need for quick decisions. A second group, consisting mostly of American researchers, was having none of it. Each species, they wrote, deserved its own case-by-case analysis. It was a sin to use scientific guesswork to decide whether an animal “should be tossed from the ark.”

In 2015, at Rojas-Bracho’s urging, former Mexican president Enrique Peña-Nieto banned most gill net fishing in the Upper Gulf, a cataclysmic prohibition in a region whose economy is at least 80 percent fishing-related. That stick came with a carrot in the form of a compensation plan to pay local fishermen not to fish. The problem was, all the money was given to the local fishing bosses, who owned the boats and held the permits, for them to distribute. You can probably guess what happened next: Many fishermen didn’t get any money at all, and because their profession was essentially illegal anyway, they kept hunting totoabas, sometimes encouraged—and equipped—by their bosses.

Sea Shepherd, a conservation nonprofit, dispatched several decommissioned US Coast Guard cutters to San Felipe to pull up nets, but the crews were periodically harassed, attacked, and even shot at by fishermen while the Mexican navy stood by. On San Felipe’s promenade, fishing leaders burned a skiff in effigy. They emblazoned the names of their opponents on the hull, narco-banner style.

The vaquita’s foes remain as entrenched as always. In late 2018, a few months before the United Nations announced that a million plants and animals face extinction this century, I went to San Felipe in search of the answer to a simple question: How many fishermen had been arrested for illegal gill-netting? A well-dressed junior officer at the local police station—a stark little building

on the outskirts of town—phoned his boss, then told me the local army base could help. A guard at the gate there told me to go to the navy base, where a media person told me to email the general-inquiries inbox in Mexico City. When I returned to the police station, the same officer kindly led me to the city administration building to talk to a municipal delegate—the man I should have asked all along, apparently. He told me to talk to the navy.

In my many conversations with Taylor, she had repeated a kind of mantra: “People are always looking for excuses not to do the hard thing.”

## A

A few weeks after Taylor returned from the failed captivity attempt, Phillip Morin came into her office at the Southwest Fisheries Science Center and sat down. A vaquita plush animal lay on her desk, and vaquita portraits dotted the walls. They matched the style of those in Rojas-Bracho’s house in Ensenada; Taylor had painted them all herself. Light streamed in from a large picture window overlooking the Pacific Ocean just across the street, but the mood in the room was heavy. “We waited too long with the vaquita,” Taylor said to Morin. “We should have started this process when there were 600 left.”

Morin announced that he had heard back from the San Diego Frozen Zoo with good news: The fresh vaquita samples were viable, and they were busy growing lots of cells. In the run-up to the captivity expedition, he and Taylor had arranged to have the vaquita genome mapped, using samples from corpses found rotting on the beach or

floating in the water. The genetic material was half decayed by the time it was catalogued, like a jumbled-up and incomplete pile of puzzle pieces. Still, they hoped it would help them maintain a healthy gene pool as they took more vaquitas into captivity. Now, using the fresh cells, they’d be able to assemble what is known as a reference genome—a complete, high-quality snapshot of all the porpoise’s chromosomes. They could finally put together the picture on the puzzle box. Yet with captivity no longer an option, they asked each other: What else could they do with it?

The answer may come from a burgeoning wing of ecology known as conservation genomics. By using the vaquita’s DNA data as a yardstick, scientists can gauge whether other animals whose populations are declining—animals they may know less about—are in danger of inbreeding. If the data suggests, as it does with the vaquita, that a species’ population has been stable over time and there is little variation within its genome, it’s probably at very low risk. If, on the other hand, the genetic variation is high, then the risk might be too.

By cross-referencing the genomes in this way, scientists can quickly assess the most urgent threats an animal faces: If inbreeding isn’t the biggest problem, then maybe poaching or habitat loss is. They can also determine whether the animal should be taken into captivity, and if so, how many individuals would be enough. Genomics can shortcut years of field research—which, with a million species on the line, we surely don’t have time for. It lacks the simplicity of the 50/500 rule, but according to Oliver Ryder, cofounder of the San Diego Frozen Zoo and keeper of what might someday be the only living remains of vaquitas on earth, it is already paying dividends.

Ryder is a bit like the godfather of vaquita genetics. Rojas-Bracho worked on mitochondrial DNA in his lab; Morin spent time there as a grad student. Ryder also helped resurrect the California condor, and he is steadily inching toward resurrecting the nearly extinct northern white rhino. He cited several instances in which scientists have used genomics to determine whether to intervene. Mountain gorillas, for instance, are something like the terrestrial counterparts to vaquitas. Their numbers are far below those of western lowlands gorillas, and their genome suggests they’re far more

inbred than their relatives, yet they have far fewer harmful mutations. This suggests that mountain gorillas' population can still recover if their other risk factors are solved. The same is true of Europe's Marsican brown bear. "What that means is that we're less likely to intervene precipitously—that we have more tools for making these judgments," Ryder explained. Whether or not the vaquita has a place aboard the ark, in other words, its frozen cells could secure spots for other species.

But having those cells on hand inevitably raises a far-out question: What about just de-extincting the vaquita? Can't we try to genetically engineer the porpoise back into existence? Taylor was quick to shoot down the idea. "It is complete science fiction, resurrecting the species," she said. For one thing, the only chromosomes she and her colleagues currently have are from a female, and to breed offspring they'd need a male. Then there's rearing the calf, which presents numerous Gordian knots: Without a mother, how do you teach it to communicate? To hunt? To evade sharks? It's hard enough reintroducing land animals like wolves or black-footed ferrets, which produce litters. Imagine doing it for an aquatic mammal that produces a single calf every year.

After the captivity attempt, Taylor had given up making porpoise portraits. "It's basically therapy, and painting vaquitas is not making me a happy person these days," she told me last summer. But she mentioned an upcoming survey that would include an attempt, via crossbow, to get a tiny biopsy from a male. Why, I asked? Her face broke into a mischievous smile. "Science fiction," she said.

## A

About 12 nautical miles off the coast of San Felipe, on a bright morning last October, the best animal finders in the world were looking out across the water through 2-foot-long military-grade binoculars, anxiously scanning for vaquitas. Taylor and Rojas-Bracho were aboard the *Narval*, a repurposed sightseeing boat, and in close radio contact with a nearby Sea Shepherd cutter. They hoped to spot a dorsal fin—a 12-inch-tall black trian-

gle among a billion zillion little blue triangles.

"Oh my God, vaquita! Vaquita!" a spotter called out. On the flying bridge a few feet away, Taylor, wearing a sun-flap hat and a headset like a football coach's over her short gray hair, calmly radioed Rojas-Bracho on the bridge. Both boats stopped. "They should be point-eight miles off your bow," Taylor told the Sea Shepherd crew.

The *Narval*'s diesel engine quit rumbling. No one said a word; if anyone had to move, they tiptoed. The aroma of Marlboro smoke wafted by. The boat rocked gently. Five minutes later, a voice on the radio: Spotters on the Sea Shepherd boat had identified two vaquitas—a mother and calf! Taylor dispatched a dinghy, and within two minutes it slowly motored off, with a photographer and a scientist armed with a crossbow. The dinghy stalked quietly into the area, but the hunt proved fruitless. Ten minutes went by, and gradually everyone acknowledged that the vaquitas had simply vanished once again.

By the end of the two-week survey, Taylor and Rojas-Bracho's team had spotted nine vaquitas, three of which were fat, healthy-looking calves. As always, though, the good news was tempered by bad: Fishermen were still working in the area, sometimes extremely close to the vaquita sightings. There were as many nets in the water as ever.

Late one afternoon, when the *Narval* was in dock and the sun was setting over the craggy desert mountains behind San Felipe, I joined Taylor on the flying bridge. She explained that her team identifies individual vaquitas by the nicks and scarring they get on their dorsal fins from gill nets. The female they'd captured had the markings. But another they'd pursued earlier had evaded their nets. They'd never caught it. "It was the first time I understood that the 1 percent left is not a random assortment," she said, leaning against a railing. "It gives you a little bit more hope that they can make it if they are the cautious type and they are teaching their calves to be cautious as well."

As rays of hope go, survival of the fittest seems like a faint one. By the time these geneticists unlock the story of the vaquita through its genome, the porpoise might live on only in a test tube, gone forever from the waters it settled long ago. Then again, when people won't do the hard thing, sometimes nature will. ▀

# COLOPHON

## Social distancing that helped get this issue out:

Stress-eating a stockpile of Veggie Crisps in one day; distancing from my phone—cuz Verizon's a carrier; forbidding all contact except for eye contact; a nerve-jangling two-day separation from my wife, who self-isolated in our (suddenly very unbooked) Airbnb unit when she became ambiguously symptomatic; #coronavirus-coverage channel on Slack; turning home office into home gym; #catchat; experiment: longitudinal study of the effects of unwashed hair on cohabiting households; using social media to convince friends and relatives that social distancing *really does matter*; learning the names of all the birds that visit the feeder outside my window; Chromebook middle school at the dining room table; livestreaming a clown variety show; getting asked, "Are you in line?" multiple times when trying to stay 6 feet away from the person in front of me; putting a lot more thought into home decor; text from Dad: "I think Mom is plotting various ways to kill me in the next two weeks"; videos of free-range penguins at Chicago's Shedd Aquarium; walking Boomer, who is delightfully oblivious; calling friends and family "just to chat"; 10 pounds of citrus for scurvy prevention; 40-window Zoom happy hour!

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