

NATIONAL GEOGRAPHIC

*"I want to go out and
be a face in the crowd
that no one looks at."*

KATIE STUBBLEFIELD
FACE TRANSPLANT
RECIPIENT

THE STORY OF A FACE

Inside the
groundbreaking
face transplant
that has given
a young woman
a second chance
at life



The 2018

C A M R Y

JOY



Let's
Go
Places

toyota.com/camry

Prototype shown with options. Production model may vary. ©2017 Toyota Motor Sales, U.S.A., Inc.

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Before Katie Stubblefield had a face transplant, she posed for this portrait. It shows her severely injured face—but photographer Maggie Steber also wanted to capture “her inner beauty and her pride and determination.”

MAGGIE STEBER

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Identity. Experience. Emotion. The human face expresses all this and much more. As a result of one impulsive act, a teenager lost her face. Incredible medical advances and skilled surgeons made it possible for her to get a new one.

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BY YUDHIJIT
BHATTACHARJEE
PHOTOGRAPHS BY

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**YOU ONLY LIVE ONCE,
BUT IF YOU DO IT RIGHT
ONCE IS ENOUGH.**

—MAE WEST

**CLIMB
ON**

COVER STORY

An Extraordinary Assignment

BY SUSAN GOLDBERG EDITOR IN CHIEF

ADREA SCHNEIDER'S HEART went to a woman in her 60s. Her liver went to a 66-year-old man. Her right lung was given to a 51-year-old woman, the left to a woman age 62. Her kidneys and corneas were donated. Her uterus was used for medical research on infertility. Her face went to Katie Stubblefield.

This is a story about that face—a gift from a young woman who died, to a 21-year-old woman who would become the youngest face transplant recipient in American history.

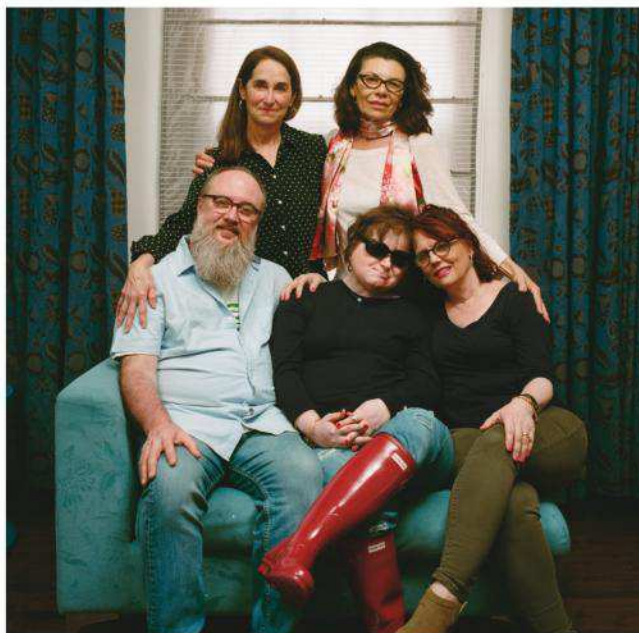
It is a story about breakthrough science and the doctors, nurses, and surgeons who created a medical miracle. It is a story about perhaps the most distinctive part of our body and the very nature of human identity. It is a story of second chances.

The story starts with two tragedies. The first was Katie's—an impulsive teenage moment that forever changed her life and that of her family. A suicide attempt with a rifle. A blast that took her nose, mouth, jaws, the front of her face, part of her forehead, and most of her eyesight.

The second tragedy, about three years later, was Sandra Bennington's: She lost her 31-year-old granddaughter, Adrea, to a drug overdose. Adrea had indicated she wanted to be an organ donor—but it was Sandra who took the extraordinary step of giving her granddaughter's face to Katie.

Adrea "couldn't use her face anyway anymore," Sandra said. "When we go to heaven, we have a new body... It was hard, you know, but I thought, my goodness, here's this young girl who needs a face. What a wonderful thing that would be. It just seemed like it was meant to be."

National Geographic spent more than two years documenting Katie's face transplant, detailing the procedure in a way that has never before been seen. We were given unprecedented access by the Cleveland Clinic



in Ohio, where the transplant was performed—and, more important—by Katie and her parents, Alesia and Robb Stubblefield, and Sandra Bennington. They trusted us to accurately and sensitively take tens of millions of readers on a journey that made Katie the 40th person in the world known to have received a face transplant.

Katie and her family allowed this intimate contact, including permission to interview her doctors in depth, because they're trying to make

Robb and Alesia Stubblefield flank daughter Katie. Behind them are two of the *National Geographic* colleagues who worked on Katie's story for more than two years: writer Joanna Connors (left) and photographer Maggie Steber.



Round Island Skink (*Leiolopisma telfairii*)

Size: Total body length, 22 - 27 cm (8.7 - 10.6 inches) **Weight:** 75 - 85 g (2.6 - 3 oz) **Habitat:** Prefers vegetated palm forest and weed-based habitat **Surviving number:** Fewer than 26,000



Photographed by Gabby Salazar

WILDLIFE AS CANON SEES IT

Sweet relief. When introduced rabbits and goats were removed from their home, Round Island skink populations rebounded. The two non-native species had upset the natural balance by clearing vegetation vital to the skink and its insect prey. One of eight endemic reptiles on the island, the skink hides between leaf litter and rocks during the hottest

hours, foraging in the cooler parts of the day and at night. Life is good, but living on an island with limited populations, the future is always in question.

As Canon sees it, images have the power to raise awareness of the threats facing endangered species and the natural environment, helping us make the world a better place.



EOS System

Canon

something positive out of a catastrophe. “I wanted people to know how amazing this procedure is and to know how beautiful life is,” Katie said. “Bottom line, I want to help people.”

Our writer, Joanna Connors, and photographers, Maggie Steber and Lynn Johnson, together spent hundreds of hours with Katie, her parents, and her doctors. They were there for the surgeries leading up to the face transplant. They witnessed Katie crying in pain and documented the ceaseless efforts of Alesia and Robb to bring her comfort. They went with her to medical appointments and hung out at the family’s temporary home at the Ronald McDonald House. They were in the operating rooms for Katie’s 31-hour transplant surgery. They were there when Katie’s family saw her new face for the first time.

“Ever since I first met Katie and her parents, I was so struck by the parents’ resolve that Katie would have a new face and that she would have a life,” Steber said. “I really began to regard them as warriors... warriors for their daughter.”

It would be incomplete for this note not to include a warning. This is a story that some of you may find very difficult to look at. The photographs of Katie before her surgery, especially, are hard to view. The photos of the operation itself may shock some readers. But we’re telling this story because it’s a story that matters.

Katie’s face transplant happened because it was paid for by the U.S. Department of Defense. Insurance companies don’t cover face transplants, which are considered experimental. The military funded this surgery, and funds other kinds of transplants, through the Armed Forces Institute of Regenerative Medicine because it wants to improve treatment for service members who are injured in battle.

Countless advances in medicine have come about in response to

THIS IS A STORY THAT SOME OF YOU MAY FIND VERY DIFFICULT TO LOOK AT. THE PHOTOGRAPHS OF KATIE BEFORE HER SURGERY, ESPECIALLY, ARE HARD TO VIEW. BUT WE’RE TELLING THIS STORY BECAUSE IT’S A STORY THAT MATTERS.

wartime injuries and illness. As Connors notes in her story: “At 21, with a face severely wounded by ballistic trauma, Katie was the closest the Pentagon might ever come to a stand-in for its wounded warriors.”

The story also is important because it highlights the scientific advances doctors have made. Much of the work that led to Katie’s ability now to breathe through her nose, eat, and speak began at the Cleveland Clinic in 1995, in surgeon and scientist Maria Siemionow’s laboratory. While many in medicine scoffed, Siemionow did the basic research, performed the first face transplants on rats, in 2003, and did the first human face transplant in the United States, in 2008.

As you’ll see in this story, Katie’s journey has been remarkable and arduous. It isn’t over yet: She has more surgeries to come. She’ll have a lifelong reliance on powerful drugs. But she’ll be able to go out in public and share an important, hard-learned message with young people who feel they cannot go on. “Anything going on in your life, you can get through it,” Katie says. “Life is a beautiful gift.”

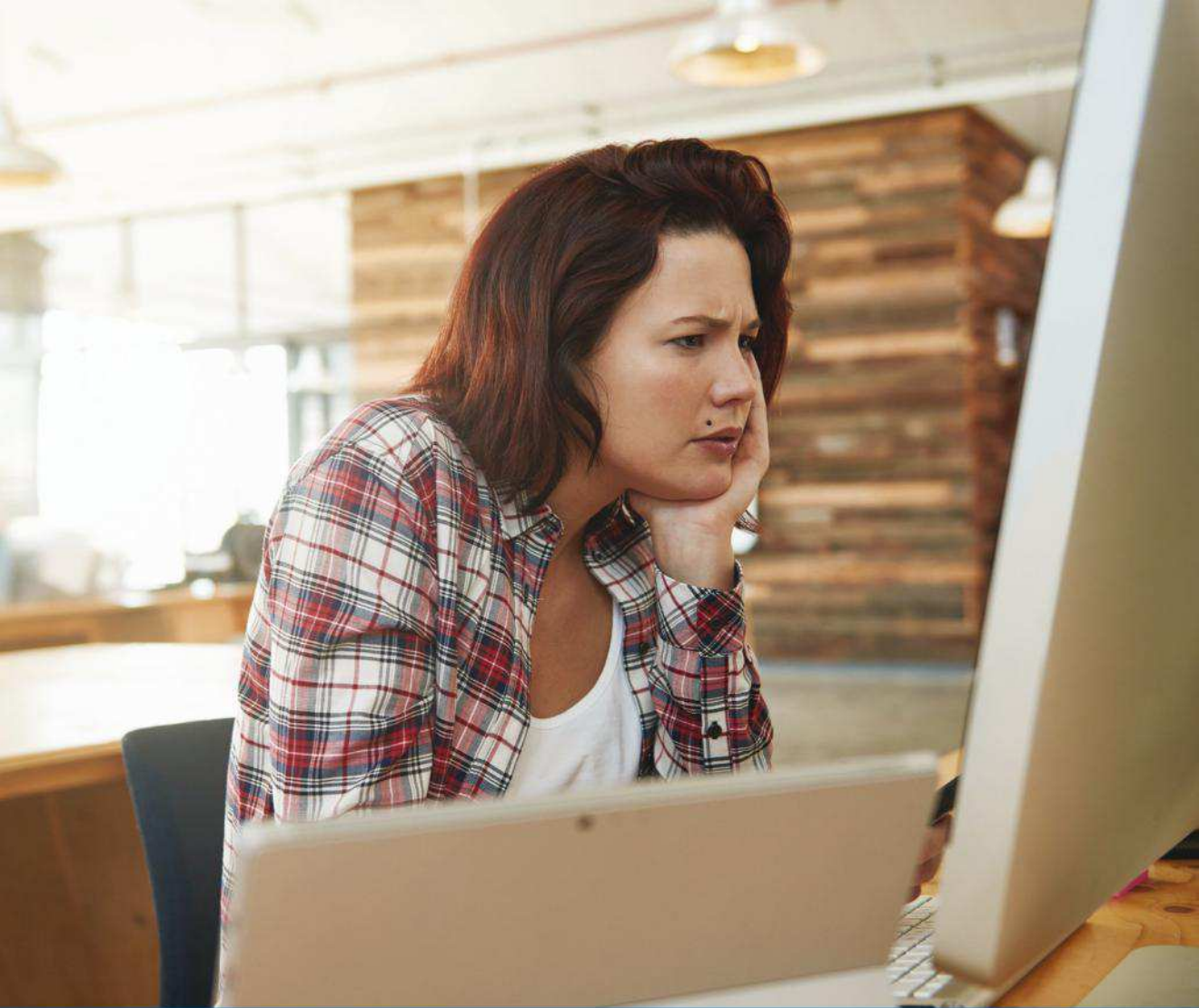
And for Sandra Bennington and Andrea Schneider, Katie has this poignant message: “Thank you for being so loving and giving and caring. You gave me back life. I will always love you and be thankful for this beautiful gift.”

Thank you for reading *National Geographic*.

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P R O O F

NATIONAL GEOGRAPHIC



PHOTOGRAPHS BY **ROBERT ORMEROD**
LOOKING AT THE EARTH FROM EVERY POSSIBLE ANGLE



Grant Thompson, who has a YouTube DIY science channel, struggles under the weight of a rocket at the

ROCKETS FOR REGULAR FOLKS

In the Nevada desert, hobbyists launch their homemade craft into the atmosphere.

VOL. 234 NO. 3



Tripoli Rocketry Association's major annual launch in the Black Rock Desert.



The Federal Aviation Administration allows attendees to send objects as high as 492,000 feet (93 miles).



Participants aim to build rockets that will reach their maximum altitude, producing a straight contrail.



Since 1991, hobbyists, scientists, and students like Jake Warshawsky, 13—holding the Green Machine—and



Leif Jurvetson, 16—with Nike Ska—have met in the Black Rock Desert to launch their homemade projectiles.

THE BACKSTORY

A PHOTOGRAPHER FINDS PEOPLE LIVING THEIR DREAMS
OF SPACEFLIGHT ON EARTH.

HEAT AND SWIRLS OF DUST above the cracked earth of northwestern Nevada make any sign of life look like a mirage. In the fall of 2016, photographer Robert Ormerod turned off the road and onto the dried lake bed of the Black Rock Desert in search of a rocket launch. On the horizon he could make out a hazy row of RVs—those of the attendees of a famed amateur-rocketry convention.

Since 1991 the Federal Aviation Administration has granted the Tripoli Rocketry Association permission to shoot rockets up to 492,000 feet (93 miles) in the air for the event. It's one of the few times when high-altitude rockets can be safely and legally launched, so 100 to 200 hobbyists gather annually to test their creations. Tripoli calls the event "a venue for projects that should NOT be flown publicly due to safety and legal restrictions." In other words, don't try this at home.

One engineer installed a GoPro camera on his rocket; he showed Ormerod

pictures it had captured high in the sky. Others get creative—one rocket is shaped like a bottle of Jägermeister. From the control center comes a count-down: 5, 4, 3, 2, 1. The rockets blast off, then gently float back to Earth under parachutes—if they don't malfunction.

Ormerod was into astronauts and science fiction as a kid but never imagined being able to travel beyond Earth. "When only a tiny percentage of people can go to space, what does everyone else who dreams of it do?" he wondered. Then, at a rocket launch in his native Scotland, he found the answer: They live their interstellar dreams on the ground. Soon he was following scientists to a Mars simulation in Utah and aurora hunters to the otherworldly coast of Iceland. Next he'll visit crop circle enthusiasts in Russia and astronomers in South Africa. "They're ordinary people," Ormerod says, "but they're blasting into outer space."

—NINA STROCHLIC



Peter Thoeny carries a rocket built by his son, Alexis, an aerospace-engineering student in California.

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Bacteria Strike Back

LIFE-THREATENING ANTIBIOTIC RESISTANCE IS SPREADING FAR AND FAST—THANKS TO A LITTLE-KNOWN EVOLUTIONARY TRICK.

BY DAVID QUAMMEN

I

IT'S A RISKY WORLD, as we know, but all the more risky because some of the risks keep evolving. Ebola virus and the influenzas can adapt. ISIS can change tactics; Kim Jong Un can do turnarounds. And now experts warn that we have entered the “post-antibiotic era,” during which increasing numbers of people—in the hundreds of thousands—will suffer and die each year from infection by forms of bacteria that were once easily controlled with antibiotics.

The World Health Organization considers antibiotic resistance one of the biggest threats of the 21st century. The World Economic Forum calls it a “potential disaster” for human health and the global economy. Just one such microbial threat, multidrug-resistant *Staphylococcus aureus*, caused more than 11,000 deaths in the United States in 2011 alone, and that one plus other resistant microbes kill hundreds of thousands of people annually around the world.

How has this happened? By a combination of Darwinian natural selection (hit a population of bacteria with an antibiotic, and the fittest will survive) and an evolutionary mechanism discovered much more recently, a phenomenon so counterintuitive that Charles Darwin didn't imagine it: horizontal gene transfer. What that means is genes moving sideways across boundaries—between individuals, between species, even between kingdoms of creatures. One researcher in the 1950s dubbed it “infective heredity.” Genome sequencing reveals that such horizontal transfer of DNA has been profoundly important in the history of life, and among bacteria it's especially common, with particular implications for the spread of antibiotic-resistance genes.

AT THE START OF THE 1960S, a Japanese scientist named Tsutomu Watanabe saw this coming. After years of collaboration with Japanese colleagues, in 1963 he published a paper in English and, adopting the earlier phrase, called the phenomenon of antibiotic resistance “an example of ‘infective heredity.’”

The Japanese work began after World War II in response to increased cases of bacillary dysentery. Postwar deprivation, dislocation, and disruption of sanitary and health services probably exacerbated the problem, but its proximate cause was infection by bacteria of the *Shigella* genus. The preferred treatment first was sulfa drugs; when *Shigella* strains showed resistance to them, medical people turned to newer antibiotics, such as streptomycin and tetracycline.

By 1953 strains of *Shigella* showed resistance to both of those also. Each bacterial strain, though, was resistant to only one drug. It could still be stopped by the others. Then in 1955 a Japanese woman returned from a stay in Hong Kong sick with dysentery, and *Shigella* from her feces tested resistant to multiple antibiotics. From that point, resistance spread fast, and during the late 1950s Japan suffered a wave of dysentery outbreaks caused by *Shigella* superbugs resistant to four kinds of antibiotics: sulfas, streptomycin, tetracycline, and chloramphenicol.

The alarm bell rang louder when researchers discovered that this phenomenon wasn't confined to *Shigella*. Some cultures of *Escherichia coli*, taken from patients with resistant *Shigella*, showed resistance to the same drugs. So it seemed *E. coli* had shared. A whole packet of resistance genes had evidently moved sideways, probably in the depths of patients' guts, from one kind of bacterium to another. And the exchange wasn't limited to *Shigella* and *E. coli*. Further research showed that the packet could cross boundaries between other species, even from genus to genus, among almost every group of enteric bacteria, a large family of bugs that live within human intestines.

What exactly was this packet of genes that traveled so easily across boundaries? Watanabe and a colleague, Toshio Fukasawa, offered a hypothesis: It was an episome, a sort of autonomous genetic element that floats free within a bacterial cell, unattached to

Bugs vs. Anti-Bugs: An Arms Race

Penicillin was discovered in 1928 and developed for medical use in the early 1940s as a potent weapon against *Staphylococcus* of various sorts. But by 1955, penicillin-resistant strains of staph were turning up, especially in hospitals, from Sydney to Seattle.

Methicillin, introduced in 1959, was especially useful against the penicillin-resistant *Staphylococcus aureus*. But by 1972 methicillin-resistant *Staphylococcus aureus* had appeared in England, the United States, Poland, Ethiopia, India, and Vietnam.

Vancomycin, introduced in 1972, was named for its capacity to vanquish even bugs that resisted earlier drugs. But by the late 1980s vancomycin resistance had shown up in *Enterococcus* bacteria in the form of a gene called *vanA*, and within another decade *vanA* had jumped sideways across genus boundaries from *Enterococcus* into staph, including *Staphylococcus aureus*. By 1996 there were vancomycin-resistant staph infections in Japan, and during the early 2000s such resistance started showing up in the United States. And that was just the beginning.

—DQ

Artist **Victo Ngai** aimed to illustrate a “chilling irony”: Antibiotics that once killed bacteria have helped make the bugs drug resistant. Here antibiotics pouring into a stomach give rise to a “super-spirochete much bigger than his counterparts,” she says. “He’s made up of an aggregation of many pills, showing how each excessive intake of antibiotics is making the bacteria stronger.”





the cell's single chromosome. An episome is a short stretch of DNA, sometimes circular like a small bracelet, that exists and replicates in a cell independently of the cell's chromosome. It codes for traits that might be unnecessary for normal life but useful in emergencies, such as drought tolerance or immunity to a poison.

Watanabe declared to the scientific world, in his 1963 paper, what Fukasawa and he had already said in Japanese: Multiple resistance, to streptomycin and those three other antibiotics, was coded on an episome. That episome explained how harmless bacteria such as ordinary *E. coli* could convey genes for multiple antibiotic resistance across species boundaries, into dangerous bacteria such as *Shigella dysenteriae*, in a blink. The word "episome" would later be replaced by a synonym, "plasmid." Scientists now recognize plasmids as a major mechanism for transfer of antibiotic-resistance genes—sometimes whole packets of genes for multiple resistance—from one species of bacterium to another.

Among the most sobering recent developments was the announcement by a Chinese team of scientists two years ago that they had found a gene for resistance to colistin—a last-ditch antibiotic that has been called "critically important for human medicine"—in a strain of *E. coli* isolated from a pig. They named the gene *mcr-1*. What made their discovery especially chilling was that *mcr-1* rode on a plasmid, meaning that it could pass easily, quickly, from one species of bacterium to another by horizontal transfer.

Soon after the Chinese announcement came a flurry of publications from other groups of scientists declaring that they too had found the *mcr-1* gene on bacterial plasmids—in the urine of an 83-year-old Swiss man, in Danish chicken meat, in piglets from Flanders, in the feces of a hospitalized child in Cambodia, and elsewhere. This means that colistin too may soon be ineffective against many kinds of multidrug-resistant bacteria.

IN THE MEANTIME, THE INFLUENCE of Tsutomu Watanabe had reached far. A young American named Stuart B. Levy, on leave from medical school for a research fellowship, heard about him and arranged to work for a few months of 1962 in Watanabe's lab, at Keio University in Tokyo. It was a formative experience.

Stuart Levy, M.D., is nowadays a professor at Tufts University School of Medicine and an internationally renowned authority on antibiotic use, overuse, and

ANTIBIOTICS, WHICH MADE HUMAN LIVES BETTER AND LONGER, HAVE ALSO BEEN MAKING OUR BACTERIAL ENEMIES MORE FORMIDABLE.

resistance. He reminisced about Watanabe when I visited him in his office, on the eighth floor of a drab building just outside Boston's Chinatown.

"We worked in the lab without air-conditioning," Levy said. "It was very, very hot. Hot and humid." Levy's lab bench was on an upper level, with a sort of overlook from which, glancing down, he could see Professor Watanabe doing experiments in short sleeves "because it was so hot." Periodically someone would bring forth a hose and spray the professor with water to cool him off. A small man, an inch or two shorter than Levy, Watanabe spoke impeccable English and had a straightforward manner toward students and postdocs. He would bicycle around campus with his junior colleagues and sometimes take a few out to a bar for an evening of karaoke. On a visit to Philadelphia for a scientific meeting, Watanabe stayed with Levy's parents, who lived nearby. "I was delighted," Levy said, "because I worshipped him, in a weird way." A lively mentor, a focused and dignified Japanese scientist. What became of Watanabe? I wondered.

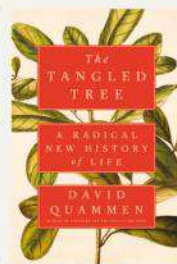
"He passed away of stomach cancer," said Levy. "He probably was in his 40s, early 50s."

After finishing his medical studies, Levy pursued a lifelong mission of trying to protect the world against bacterial superbugs. In 1992 he published a book titled *The Antibiotic Paradox*—the paradox being that these drugs, which made human lives so much better and longer during the 20th century, have also been making our bacterial enemies far more formidable by forcing them to adapt to the evolutionary challenge. Levy wrote that the spread of plasmid-transferable resistance genes, back in Watanabe's time, had "opened the eyes of microbiologists and medical scientists to a breadth of gene spread never before imagined."

The implications weren't broadly comprehended then—but nowadays they are, sweeping around the planet as fast as a gene can jump sideways.

'Tangled' research

National Geographic contributing writer David Quammen first reported on infectious disease in "Deadly Contact," a story in the magazine's October 2007 issue. This essay is adapted from *The Tangled Tree*, © 2018 by David Quammen, published by Simon & Schuster on August 14, 2018.



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DISPATCHES
FROM THE FRONT LINES
OF SCIENCE
AND INNOVATION



A Cool Corn-Country Theory

As scientists explore how industrialized agriculture is affecting U.S. weather and climate, an MIT study offers one notion. It says corn belt climes are changed by the corn itself—millions of acres of plants that take in carbon dioxide, then expel water, causing lower temperatures and more rain.



ANIMALS

WHERE ANCIENT WHALES ROAMED

BARNACLES
CONTAIN CLUES TO
MIGRATORY PATHS

Tagging and monitoring whales can reveal their extensive migration routes, but not how far—or whether—their ancestors roamed five million years ago. UC Berkeley researcher Larry Taylor knew that present-day barnacle shells take up differently weighted oxygen atoms from bodies of water. That creates a record of the oceans they've been in as passengers on whales. To see if barnacles had the same properties long ago, Taylor hunted down fossils that lived on early humpback whales, and bingo: They did. He hopes to shed light on prehistoric whales' movements, as well as on the evolution of the oceans. —LORI CUTHBERT

ENVIRONMENT

Netting a Win for the Oceans

The Great Pacific Garbage Patch contains at least 88,000 tons of plastic—and almost half of it is fishing nets. A company called Bureo is trying to solve the ocean's plastic problem by recycling nets into skateboards, surfboard fins, and sunglasses. At facilities in California and Chile, Bureo processes nets into pellets, then applies pressure and heat as the pellets are injected into molds—one win in the war on plastic pollution. —LC



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SILENT SPRING ON THE FARM

BY DAISY CHUNG AND MICHAEL GRESHKO

AS INDUSTRIAL-SCALE FARMS flourish in the European Union, its fields have grown quiet—robbed of the birds that once filled them with song. Since 1980 the number of birds that typically inhabit Europe’s farmlands has shrunk by 55 percent. And in the last 17 years alone, French farmland-bird counts dropped by a third—a “level approaching an ecological catastrophe,” according to a recent survey.

Intensified agriculture is driving the losses. Habitats where birds once bred, nested, and wintered now bear crops, and pesticides have killed off birds’ prey. In the past 27 years Germany has lost 75 percent of its flying insects by mass. Even avian species that typically adapt to humans have dwindled on farms, suggesting that the land is less able to sustain all kinds of birds.

To curb the losses of farmland birds, researchers contend that agriculture must be remade in nature’s image: less dependent on the addition of chemicals, more diverse in its flora, and more hospitable to local fauna.

Beyond France, beyond farms

In France, farmland birds have had the steepest decline, a trend also observed in North America and Asia. Birds preferring other habitats are also disappearing. Generalist birds increased in number as they moved into the emptied habitats, but recently they too are stable or declining.

DECLINE IN POPULATION (2001-2017) ← → INCREASE



French farmland birds are disappearing due to single-crop fields and the overuse of pesticides. Populations of insect-feeders like **meadow pipits** and **whinchats** are in free fall.

A recent study showed that **red-legged partridges** are poisoned by seeds treated with the insecticide fipronil.

The switch to taller and denser cereal crops is forcing **Eurasian skylarks** to look for other nesting sites.

Wetland drainage and the removal of grasslands for crops drive the decline of the **western yellow wagtail**.

The European range of the **Eurasian hoopoe** is most likely expanding northward due to a warming climate.



(2001-2017, FRANCE)

- Farmland-specialist birds*
- Woodland-specialist birds
- Urban-specialist birds
- Generalist birds

*SPECIALIST BIRDS PREFER ONE TYPE OF HABITAT, WHILE GENERALIST BIRDS DO NOT. BIRDS ARE DRAWN TO SCALE. RYAN T. WILLIAMS, NGM STAFF SOURCES: BENOÎT FONTAINE, NATIONAL MUSEUM OF NATURAL HISTORY, FRANCE; ANA LOPEZ-ANTIA, UNIVERSITY OF ANTWERP; BIRDLIFE INTERNATIONAL



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ILLUMINATING THE MYSTERIES—AND WONDERS—ALL AROUND US EVERY DAY

NATIONAL GEOGRAPHIC

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Geotrichum candidum
(fungus)



COUPOLE

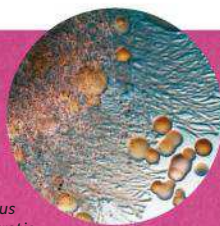
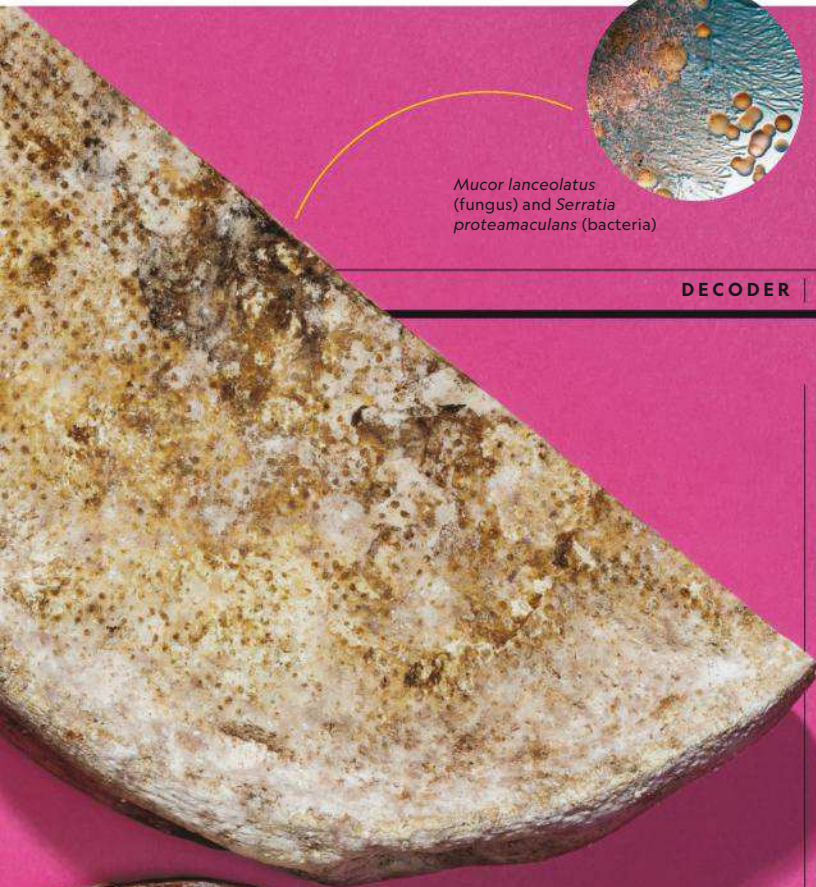
The rind of this creamy Vermont cheese is dominated by a fungus. The mold gives the rind a wrinkled appearance. While the inside is mild and lemony, the rind is potent and intense, “like sweet buttery flatulence,” says microbiologist Benjamin Wolfe.

Staphylococcus succinus,
S. xylosus (bacteria), and *Penicillium commune* (fungus)



BAYLEY HAZEN BLUE

This variety of blue cheese brims with unique microbial behavior. Fungi wage open battle for territory by producing antibacterial compounds. Researchers also have documented that some microbes change with each new generation, similar to the way animals evolve.



Mucor lanceolatus (fungus) and *Serratia proteamaculans* (bacteria)

TOMME DE SAVOIE

Bacteria on this French and Swiss cheese use molds as low-friction highways to spread across the cheese surface—an example of fungi and bacteria working together. The cheese is lower in fat, which the microbes feed on; that reduces the extent and pace of microbial activity.

DECODER | BY DANIEL STONE

LIFE ON CHEESE

Cheese is full of bacteria and fungi. How they interact could solve some big scientific questions.

CHEESEMAKING IS AN ART, but it's also science. Like other fermented foods such as sourdough, kombucha, and kimchi, cheese is the product of bacteria and yeast, plus mold. Cheese is mostly coagulated milk, but adding a unique culture of microbes determines its texture and flavor. In the cheese's thick exterior rind, microbes teem, jockey, and help create a covering to keep in moisture.

Microbiologist Benjamin Wolfe's lab at Tufts University studies how bacteria and fungi interact in the small ecosystems of cheese (compared with the wild worlds inside the human gut or a scoop of soil). "There's a war and peace happening on these cheese rinds," says Wolfe. Understanding what influences the microbes' behavior will illuminate how to manipulate and engineer them. That could lead to more effective pharmaceuticals, new ways of inoculating crops from disease, even a future of microbes colonizing other planets. Not to mention better cheese.



Vibrio casei, *Psychrobacter* sp., and *Halomonas* sp. (bacteria)

WINNIMERE

This Vermont cheese contains a mix of yeast and bacteria. As with some other washed-rind cheeses, Winnimere hosts marine bacteria, likely from the brines and sea salts used to produce it. The moist and salty cheese offers prime conditions for these microbes to flourish.

BY THE NUMBERS

9,744

ELEVATION OF SCHILTHORN IN FEET

1

WIDTH OF ROPE IN INCHES

65

FEET FROM PEAK TO PEAK



The Bernese Alps are in southwestern Switzerland.

With only a rope to stand on, a daring

'SOMETIMES YOU FALL DOWN
AND HAVE TO GET UP AGAIN.
BUT ONCE YOU WALK ACROSS,
YOU CAN DO IT THREE OR
FOUR TIMES.'

—Stephan Siegrist

T MINUS ONE WEEK
SETTING THE
SIGHT LINE

After years of climbing up a pair of parallel limestone pillars in the mountains of Switzerland, photographer Thomas Ulrich and alpinist Stephan Siegrist wanted to walk between them.

Three factors affect a high-line walk: focus, balance, and altitude. Since the line crossed at the towers' peaks, Siegrist would have no point of reference to focus on to keep his balance. "If you look straight, you see nothing—just air," Siegrist says. To fix this, they placed a brightly colored backpack on top of the tower.

T MINUS ONE DAY
ESSENTIAL
PREPARATION

A cable car took Siegrist and Ulrich halfway up the Schilthorn mountain to the towers. They climbed both spires and bolted in anchors to run a line between them. The anchors must be extremely secure to create the high tension that makes the line walkable. They also needed:

- One harness for climbing up and another for walking across
- Chalk to keep hands dry
- Sunglasses and sunscreen
- No shoes—bare feet are best for feeling the line

T MINUS ZERO HOURS
READY FOR
LAUNCH

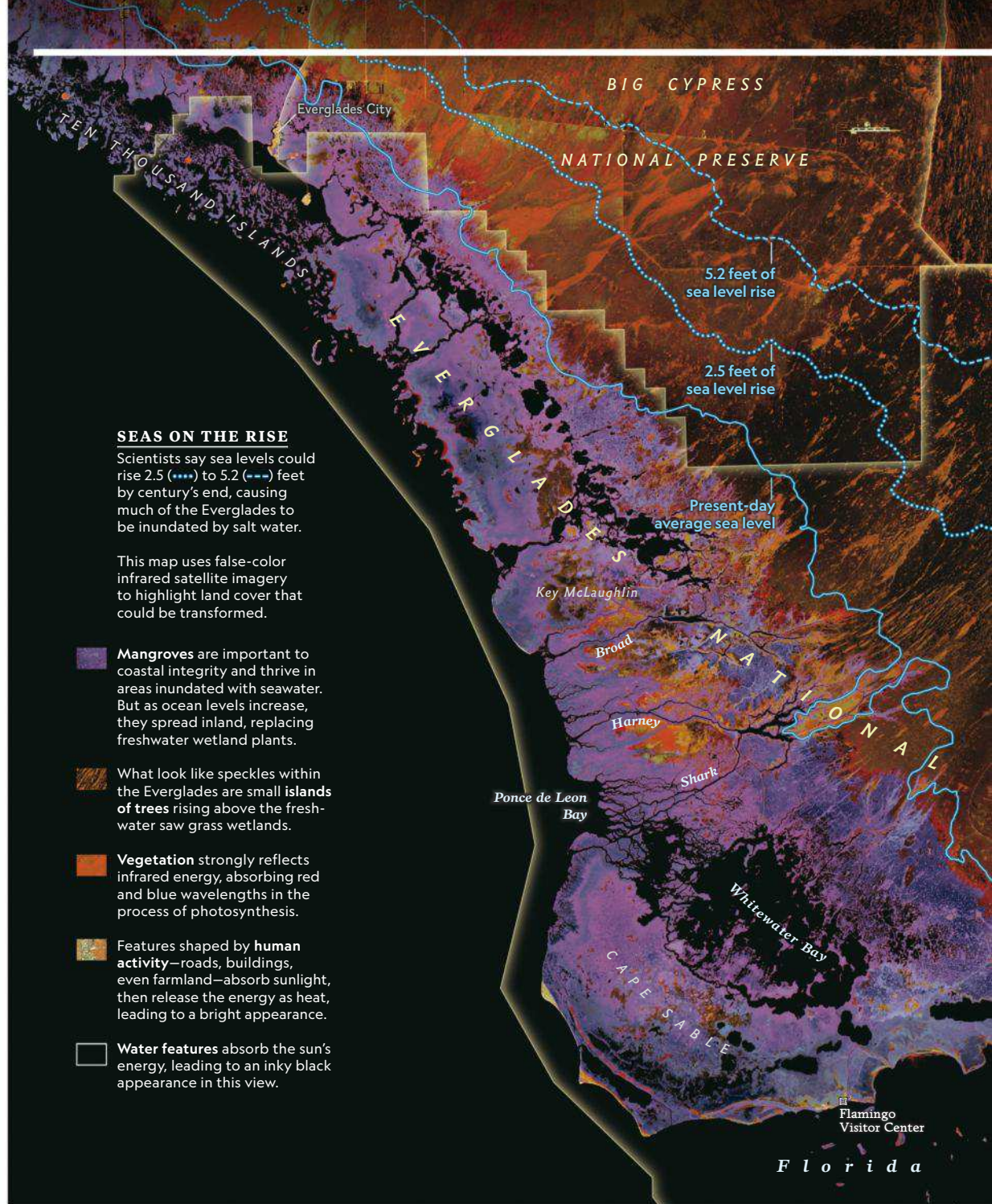
Rain would make the synthetic-fiber line slippery, but on this September morning there was only a light fog. Ulrich climbed a nearby ridge to get the shot, and Siegrist took a few practice steps to warm up and get a feel for the line's tension. The first step is the riskiest: Falling too early puts you dangerously close to the rock face. "After three steps you need to relax or your nerves [transfer to] the rope," Siegrist says. "If it works once, then it's quite easy."

WALKING THE LINE

mountain climber walks between peaks in the Swiss Alps.

BY NINA STROCHLIC PHOTOGRAPH BY THOMAS ULRICH

EBBING WETLANDS



SEAS ON THE RISE

Scientists say sea levels could rise 2.5 (---) to 5.2 (---) feet by century's end, causing much of the Everglades to be inundated by salt water.

This map uses false-color infrared satellite imagery to highlight land cover that could be transformed.

- Mangroves** are important to coastal integrity and thrive in areas inundated with seawater. But as ocean levels increase, they spread inland, replacing freshwater wetland plants.
- What look like speckles within the Everglades are small **islands of trees** rising above the freshwater saw grass wetlands.
- Vegetation** strongly reflects infrared energy, absorbing red and blue wavelengths in the process of photosynthesis.
- Features shaped by **human activity**—roads, buildings, even farmland—absorb sunlight, then release the energy as heat, leading to a bright appearance.
- Water features** absorb the sun's energy, leading to an inky black appearance in this view.

Florida



Florida's famed wetlands, the Everglades, are pinched between a burgeoning Miami to the east and encroaching saltwater to the west. With sea levels rising, the immense freshwater marsh hangs in the balance. By 2100 most of this unique national treasure could be dramatically altered.

BY MATTHEW W. CHWASTYK



UP TO THE EDGE

Urban and agricultural areas of Greater Miami press directly against the protected Everglades. Agricultural pollution from as far as 50 miles north harms the wetlands.

THEY'RE PRIMED FOR SEX FOR 24 HOURS—ONCE A YEAR

PHOTOGRAPH BY JOEL SARTORE

SUNDAR IS HIS NAME; Khushi is hers. Matchmakers in New Zealand introduced them—in the red panda habitat of the Wellington Zoo. Objective: reproduction.

Global networks of captive-breeding programs share and pair animals, hoping to replenish at-risk species and foster genetic diversity. When Sundar and Khushi came from other zoos to Wellington in 2015, they “got on very well together,” says Maxine Jenkins, the zoo’s carnivore team leader. Even so, starting a red panda family can take time because females are in heat only once a year—for just 24 hours.

On a July day in 2017, zookeepers noticed courting behaviors: loud vocalizations, Sundar forcing Khushi from a tree to the ground, trailing her for hours, and then...consummation(s). A few months later, more telltale signs: Khushi looked a little heavier and was gathering sticks and leaves for a nest.

On December 17 Khushi gave birth to a cub. His name is Ngima, a Nepali word meaning “sun in the sky.” Someday, Jenkins says, Ngima may “be part of the breeding program too.” —PATRICIA EDMONDS

HABITAT/RANGE

Ailurus fulgens—known by the names red panda, lesser panda, and fire fox—lives in parts of China, Bhutan, India, Myanmar, and Nepal. Its preferred habitat: gently sloping foothills, temperate forests, and an understory of bamboo (its chief food source).

CONSERVATION STATUS

The International Union for Conservation of Nature assesses the red panda as endangered. Estimates of its numbers in the wild range from 2,500 to 10,000. Its habitat has been degraded and fragmented by human activity; it is hunted for the pet trade and is vulnerable to disease spread by herders’ animals.

OTHER FACTS

In Bhutan some locals believe red pandas are reincarnations of Buddhist monks, and seeing one is a good omen.

NATIONAL
GEOGRAPHIC

PHOTOARK
JOEL SARTORE

This red panda was photographed at the Virginia Zoo.



For people with unresectable Stage III non-small cell lung cancer (NSCLC) whose disease has not progressed following concurrent chemoradiation therapy

THE OPPORTUNITY TO LIVE LONGER WITHOUT STAGE 3 LUNG CANCER SPREADING IS A POWERFUL THING

IMFINZI

IMFINZI may not work for everyone. When attacking cancer cells, IMFINZI may also affect healthy cells.

IMFINZI was proven to give people 3x more time without their cancer growing or spreading compared with placebo.* Until IMFINZI, there have been limited advancements to the current standard of care for unresectable Stage 3 NSCLC in the last 10 years.

*In a clinical trial, the median time that people lived without their tumors growing or spreading was 16.8 months for the 476 patients receiving IMFINZI compared with 5.6 months for the 237 patients receiving placebo (no medication). Median is the middle number in a group of numbers arranged from lowest to highest. Overall survival comparison is not yet available. The trial is still ongoing.

Ask your doctor about IMFINZI today.

VISIT IMFINZI.COM

WHO IS IMFINZI FOR?

IMFINZI® (durvalumab) is a prescription medicine used to treat a type of lung cancer called non-small cell lung cancer (NSCLC). IMFINZI may be used when your NSCLC has not spread outside your chest, cannot be removed by surgery, and has responded or stabilized with initial treatment with chemotherapy that contains platinum, given at the same time as radiation therapy. It is not known if IMFINZI is safe and effective in children.

IMPORTANT SAFETY INFORMATION

What is the most important information I should know about IMFINZI?

IMFINZI is a medicine that may treat a type of lung cancer by working with your immune system. IMFINZI can cause your immune system to attack normal organs and tissues and can affect the way they work. These problems can sometimes become serious or life-threatening and can lead to death.

Call or see your healthcare provider right away if you develop any symptoms of the following problems or if these symptoms get worse:

Lung problems (pneumonitis). Signs and symptoms may include new or worsening cough, shortness of breath, and chest pain.

Liver problems (hepatitis). Signs and symptoms may include yellowing of your skin or the whites of your eyes, severe nausea or vomiting, pain on the right side of your stomach area (abdomen), drowsiness, dark urine (tea colored), bleeding or bruising more easily than normal, and feeling less hungry than usual.

Intestinal problems (colitis). Signs and symptoms may include diarrhea or more bowel movements than usual; stools that are black, tarry, sticky, or have blood or mucus; and severe stomach-area (abdomen) pain or tenderness.

Hormone gland problems (especially the thyroid, adrenals, pituitary, and pancreas). Signs and symptoms that your hormone glands are not working properly may include headaches that will not go away or unusual headaches; extreme tiredness; weight gain or weight loss; dizziness or fainting; feeling more hungry or thirsty than usual; hair loss; feeling cold; constipation; your voice gets deeper; urinating more often than usual; nausea or vomiting; stomach-area (abdomen) pain; and changes in mood or behavior, such as decreased sex drive, irritability, or forgetfulness.

Kidney problems, including nephritis and kidney failure. Signs of kidney problems may include decrease in the amount of urine, blood in your urine, swelling of your ankles, and loss of appetite.

Skin problems. Signs may include rash, itching, and skin blistering.

Problems in other organs. Signs and symptoms may include neck stiffness; headache; confusion; fever; chest pain, shortness of breath, or irregular heartbeat (myocarditis); changes in mood or behavior; low red blood cells (anemia); excessive bleeding or bruising; muscle weakness or muscle pain; blurry vision, double vision, or other vision problems; and eye pain or redness.

Severe infections. Signs and symptoms may include fever, cough, frequent urination, pain when urinating, and flu-like symptoms.

Severe infusion reactions. Signs and symptoms may include chills or shaking, itching or rash, flushing, shortness of breath or wheezing, dizziness, fever, feeling like passing out, back or neck pain, and facial swelling.

Getting medical treatment right away may help keep these problems from becoming more serious. Your healthcare provider will check you for these problems during your treatment with IMFINZI. Your healthcare provider may treat you with corticosteroid or hormone replacement medicines. Your healthcare provider may delay or completely stop treatment with IMFINZI if you have severe side effects.

Before you receive IMFINZI, tell your healthcare provider about all of your medical conditions, including if you have immune system problems such as Crohn's disease, ulcerative colitis, or lupus; have had an organ transplant; have lung or breathing problems; have liver problems; or are being treated for an infection.

If you are pregnant or plan to become pregnant, tell your healthcare provider. IMFINZI can harm your unborn baby. If you are able to become pregnant, you should use an effective method of birth control during your treatment and for at least 3 months after the last dose of IMFINZI. Talk to your healthcare provider about which birth control methods to use. Tell your healthcare provider right away if you become pregnant during treatment with IMFINZI.

If you are breastfeeding or plan to breastfeed, tell your healthcare provider. It is not known if IMFINZI passes into breast milk. Do not breastfeed during treatment with IMFINZI and for at least 3 months after the last dose of IMFINZI.

Tell your healthcare provider about all the medicines you take. This includes prescription and over-the-counter medicines, vitamins, and herbal supplements.

What are the possible side effects of IMFINZI?

IMFINZI can cause serious side effects (see earlier).

The most common side effects in people with non-small cell lung cancer (NSCLC) include cough, feeling tired, inflammation in the lungs (pneumonitis), upper respiratory tract infections, shortness of breath, and rash.

Tell your healthcare provider if you have any side effect that bothers you or that does not go away. These are not all the possible side effects of IMFINZI. Ask your healthcare provider or pharmacist for more information.

Call your healthcare provider for medical advice about side effects. You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.FDA.gov/MedWatch or call 1-800-FDA-1088.

Please see Brief Summary of complete Prescribing Information on adjacent page.

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durvalumab
injection for intravenous use 50 mg/mL



IMPORTANT INFORMATION ABOUT IMFINZI® (im-FIN-zee) (durvalumab) INJECTION



WHAT IS THE MOST IMPORTANT INFORMATION I SHOULD KNOW ABOUT IMFINZI?

IMFINZI is a medicine that may treat a type of lung cancer by working with your immune system.

IMFINZI can cause your immune system to attack normal organs and tissues and can affect the way they work. These problems can sometimes become serious or life-threatening and can lead to death.

Call or see your healthcare provider right away if you develop any symptoms of the following problems or these symptoms get worse:

Lung problems (pneumonitis). Signs and symptoms of pneumonitis may include:

- new or worsening cough
- shortness of breath
- chest pain

Liver problems (hepatitis). Signs and symptoms of hepatitis may include:

- yellowing of your skin or the whites of your eyes
- severe nausea or vomiting
- pain on the right side of your stomach area (abdomen)
- drowsiness
- dark urine (tea colored)
- bleeding or bruising more easily than normal
- feeling less hungry than usual

Intestinal problems (colitis). Signs and symptoms of colitis may include:

- diarrhea or more bowel movements than usual
- stools that are black, tarry, sticky, or have blood or mucus
- severe stomach area (abdomen) pain or tenderness

Hormone gland problems (especially the thyroid, adrenals, pituitary and pancreas).

Signs and symptoms that your hormone glands are not working properly may include:

- headaches that will not go away or unusual headaches
- extreme tiredness
- weight gain or weight loss
- dizziness or fainting
- feeling more hungry or thirsty than usual
- hair loss
- changes in mood or behavior, such as decreased sex drive, irritability, or forgetfulness
- feeling cold
- constipation
- your voice gets deeper
- urinating more often than usual
- nausea or vomiting
- stomach area (abdomen) pain

Kidney problems, including nephritis and kidney failure. Signs of kidney problems may include:

- decrease in the amount of urine
- blood in your urine
- swelling of your ankles
- loss of appetite

Skin problems. Signs of these problems may include:

- rash
- itching
- skin blistering

(continued)

Problems in other organs. Signs and symptoms may include:

- neck stiffness
- headache
- confusion
- fever
- chest pain, shortness of breath, or irregular heartbeat (myocarditis)
- changes in mood or behavior
- low red blood cells (anemia)
- excessive bleeding or bruising
- muscle weakness or muscle pain
- blurry vision, double vision, or other vision problems
- eye pain or redness

Severe infections. Signs and symptoms may include:

- fever
- cough
- frequent urination
- pain when urinating
- flu-like symptoms

Severe infusion reactions. Signs and symptoms of severe infusion reactions may include:

- chills or shaking
- itching or rash
- flushing
- shortness of breath or wheezing
- dizziness
- fever
- feel like passing out
- back or neck pain
- facial swelling

Getting medical treatment right away may help keep these problems from becoming more serious.

Your healthcare provider will check you for these problems during your treatment with IMFINZI. Your healthcare provider may treat you with corticosteroid or hormone replacement medicines. Your healthcare provider may delay or completely stop treatment with IMFINZI, if you have severe side effects.

WHAT IS IMFINZI?

IMFINZI is a prescription medicine used to treat:

- a type of lung cancer called non-small cell lung cancer (NSCLC). IMFINZI may be used when your NSCLC:
 - has not spread outside your chest
 - cannot be removed by surgery, **and**
 - has responded or stabilized with initial treatment with chemotherapy that contains platinum, given at the same time as radiation therapy.

It is not known if IMFINZI is safe and effective in children.

Before you receive IMFINZI, tell your healthcare provider about all of your medical conditions, including if you:

- have immune system problems such as Crohn's disease, ulcerative colitis, or lupus
- have had an organ transplant
- have lung or breathing problems
- have liver problems
- are being treated for an infection
- are pregnant or plan to become pregnant. IMFINZI can harm your unborn baby. If you are able to become pregnant, you should use an

(continued)

effective method of birth control during your treatment and for at least 3 months after the last dose of IMFINZI. Talk to your healthcare provider about birth control methods that you can use during this time. Tell your healthcare provider right away if you become pregnant during treatment with IMFINZI.

- are breastfeeding or plan to breastfeed. It is not known if IMFINZI passes into your breast milk. Do not breastfeed during treatment and for at least 3 months after the last dose of IMFINZI.

Tell your healthcare provider about all the medicines you take, including prescription and over-the-counter medicines, vitamins, and herbal supplements.

HOW WILL I RECEIVE IMFINZI?

- Your healthcare provider will give you IMFINZI into your vein through an intravenous (IV) line over 60 minutes.
- IMFINZI is usually given every 2 weeks.
- Your healthcare provider will decide how many treatments you need.
- Your healthcare provider will test your blood to check you for certain side effects.
- If you miss any appointments, call your healthcare provider as soon as possible to reschedule your appointment.

WHAT ARE THE POSSIBLE SIDE EFFECTS OF IMFINZI?

IMFINZI CAN CAUSE SERIOUS SIDE EFFECTS, INCLUDING:

SEE "WHAT IS THE MOST IMPORTANT INFORMATION I SHOULD KNOW ABOUT IMFINZI?"

The most common side effects of IMFINZI in people with NSCLC include:

- cough
- feeling tired
- inflammation in the lungs (pneumonitis)
- upper respiratory tract infections
- shortness of breath
- rash

Tell your healthcare provider if you have any side effect that bothers you or that does not go away.

These are not all the possible side effects of IMFINZI. Ask your healthcare provider or pharmacist for more information. Call your healthcare provider for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

GENERAL INFORMATION ABOUT THE SAFE AND EFFECTIVE USE OF IMFINZI.

Medicines are sometimes prescribed for purposes other than those listed in a Medication Guide. If you would like more information about IMFINZI, talk with your healthcare provider. You can ask your healthcare provider for information about IMFINZI that is written for health professionals.



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This Look Could Have Killed

STORY AND PHOTOGRAPH BY JOEL SARTORE

S

ON ASSIGNMENT IN A CAVE TEEMING WITH BATS AND SNAKES, A PHOTOGRAPHER THOUGHT HE KNEW THE DANGERS. BUT THE REAL THREAT TO HIS LIFE CAME WHEN HE STEPPED OUTSIDE.

SEVERAL YEARS AGO, on assignment for *National Geographic*, I ventured inside a cave in Uganda to photograph a roost of roughly 100,000 Egyptian fruit bats. The bats are common throughout Africa, but this cave was special—shaped like an arch with light shining in at both ends. The rock ceiling was low, which meant the bats would be close and the shooting relatively easy.

I wore a respirator as a precaution. The only real danger, I thought, would come from the pythons and forest cobras slinking across the cave floor as they hunted for downed bats. I would be fine if I just watched my step. Or so I thought.

After working for a few hours, I exited the cave at dusk, packed up my gear, and began the long hike back to the road with my guide. I was filthy and tired but excited about the images I'd just taken and the fact that the bats didn't seem to mind my being there.

A hundred steps away from the cave, I'd just taken off my respirator and glasses when I heard a tremendous mechanical clamor above my head, the sound of a thousand windup toys all going off at once. Then came an ammonia-laced gust of wind as the bats in the cave poured up and out into the gloaming to begin their nightly foraging.

I looked up, just for a second, and caught a juicy dollop of fresh guano directly in my left eye. It was hot, and it burned. I knew right away this was a "wet contact," potentially as dangerous as a bite.

I've photographed animals for decades, and I know the drill: It's not the bears or lions that get you; it's the little stuff. I've had botfly larvae bury themselves in my hands and lower back. Then there was mucocutaneous leishmaniasis, a disease caused by a flesh-eating parasite. That one required a month







For a story on the wildlife of Africa's Albertine Rift, Joel Sartore photographed Egyptian fruit bats roosting inside a Ugandan cave. When he left the cave at the end of the day and removed his protective gear, he risked his life with one glance to the sky.

of chemotherapy. My parents, of course, lived in absolute fear every time I went to the tropics.

Back at camp I immediately called the Ugandan arm of the U.S. Centers for Disease Control and Prevention to see if the agency knew what, if anything, these bats might be carrying. There was a long pause on the other end of the line. "You shouldn't have gone in there," said the man. "Marburg circulates in that cave."

The Marburg virus is a terrible, messy death. It causes a hemorrhagic fever (translation: you bleed, everywhere) that's similar to that from Ebola (only it kills you a little faster sometimes).

There's no easy way to test for Marburg. If I was infected, the symptoms would arrive in three days to three weeks: severe headache, organ failure, and a raging fever so bad I wouldn't remember much—if I lived. In some outbreaks the death toll has been as high as 90 percent. My odds of survival would likely improve in the United States. "Go home now," the man said, "before you have any chance of becoming contagious."

Once back in Nebraska, I went into quarantine inside my own house, in a small attic bedroom that overlooks the street. For the first time I thought relentlessly about death. I remember it being sunny outside, the birds singing, the garbage truck roaring through the neighborhood. Every day like clockwork my dog barked at the mailman. Indeed the whole world acted as if nothing at all was wrong. I thought, Don't they know what's going on in here? Of course not. If they did, it would make national news.

For three weeks I stayed away from my family. I watched my daughter's birthday party from across the hall. I found my meals on a tray outside my door. I didn't eat much though. I just sat and thought, Do I feel hot? Does my head hurt? Yes? Maybe? Maybe not? I took my temperature 50 times a day. At the slightest hint of a fever, I was to drive myself immediately to the nearest hospital, just two miles away, where they had a negative-air-pressure room (to keep the virus from getting loose) all set up with my name on it. Inside that room, I imagined, there would be a negative-air-pressure tent surrounding my bed to seal me in even further.

Up until now this assignment on the wildlife of Africa's Albertine Rift had been a thrilling ride. We'd put camera traps on water holes and carcasses, capturing images of hippos, hyenas, and leopards from just inches away. I'd watched vervet monkeys steal the food right off my dinner plate. I'd been charged by an elephant, a lion, and a mountain gorilla—my fault, of course, for trying to get just a little closer.

But that was then, and a world away. Here in Lincoln, Nebraska, the time crawled by in my little room. I remember removing a clock because it ticked too loudly, another heartbeat I didn't need. I wondered if my photos were good enough. I wondered what photos I'd missed by not staying in Uganda until the end of my assignment time. But more than that, I wondered if, once I was out of the woods, I would appreciate all that I'd been given: my family, my life, and the absolute privilege to try to save the last wild places using photographs—something I still can't believe I've been able to do for a living.

On Day 22, with the quarantine over and no sign of sickness, I could finally emerge. I sat down at my own dinner table for the first time since leaving for Africa. My wife, Kathy, and all three of our kids were there, preparing a special meal to celebrate the end of my quarantine. Then someone turned on a blender.

Just for a moment, the room was filled with the sound of a thousand bats taking flight. I closed my eyes tight, just in case.

Photographer **Joel Sartore** is the founder of Photo Ark, a multi-year, joint project with National Geographic to create a photo archive of every animal species in captivity.



8,362

Number of species and subspecies whose portraits Sartore has made to date



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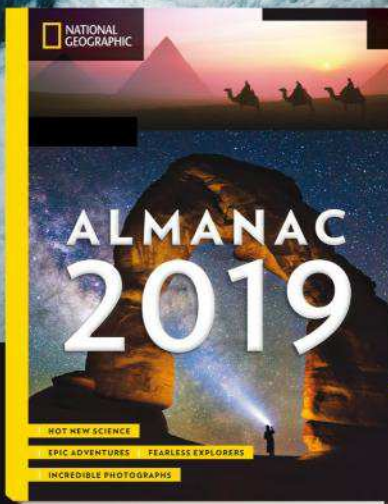


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You may be entitled to replacement solar panels and/or a new inverter from a BP Solar Settlement

*Para una notificación en Español,
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website www.BPSolarSettlement.com*

On December 22, 2016, the Court approved a Settlement in a class action lawsuit against BP Solar and Home Depot involving solar panels manufactured between 1999 and 2007 with an S-type junction box (“Class Panels”). You may be entitled to benefits from a \$45.33 million common fund or a separate \$20 million claims-made settlement.

The lawsuit claims these panels are defective and prone to junction box failures, which could cause burn marks at the junction box, shattered glass, and be a potential fire hazard. BP and Home Depot deny these claims.

Who’s Included?

The Settlement includes anyone in the United States who: (1) purchased certain BP solar panels for installation on a property, or (2) currently owns a property on which these panels are installed and, in either case, who still owns some or all of the BP solar panels.

The panels were sold through various distributors and retailers, including but not limited to Solar Depot and Home Depot.

What does the Settlement provide?

The Court approved a \$45.33 million Common Fund to pay for the removal and replacement of a subset of Class Panels (Category 1), and to pay administration, attorneys’ fees and costs, and Class Representative awards. The Court also approved the separate \$20 million Claims Made Fund for the remaining Class Panels (Category 2), which have a lower failure rate. Category 2 claimants will be entitled to a free visual inspection to identify any failed panels, a replacement of failed panels, and a free inverter with arc fault detection; or if over 20% of panels have failed, replacement of all panels. Nonresidential class members with 400 or more Class Panels will be invited to commercial negotiations.

How can I receive benefits?

You must file a claim to receive benefits. You can file a claim online at www.BPSolarSettlement.com or call 1-844-360-2767. Category 1 claims will be paid until the Fund is spent. The deadline to submit Category 2 claims is February 6, 2020 or until the \$20 million fund is spent.

This is only a summary, so please visit the website for complete information.

www.BPSolarSettlement.com
1-844-360-2767

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'THE WAKHAN CORRIDOR—
POOR, UTTERLY ISOLATED, AND
SHIELDED FROM VIOLENCE BY
THE HINDU KUSH—SEEMED AN
OASIS OF PEACE. IT WAS RURAL
AFGHANISTAN AS IT SHOULD BE.'

Sixteen hours into a transplant operation at the Cleveland Clinic in Ohio, surgeons finish the intricate task of removing the face from an organ donor.

Awed by the sight and by the gravity of their work, the team falls suddenly silent as staff members document the face in between its two lives.

The surgeons would spend 15 more hours attaching the face to Katie Stubblefield.

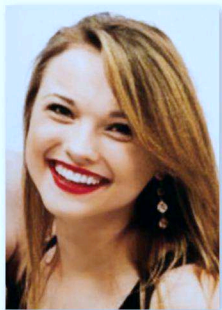
LYNN JOHNSON





This story is difficult to look at. Yet we are asking you to go on the remarkable journey of how a young woman received a face transplant because it reveals something profound about our humanity. Our face conveys who we are, telegraphing a kaleidoscope of emotions. It's our doorway to the sensory world, allowing us to see, smell, taste, hear, and feel the breeze. Are we our faces? Katie Stubblefield lost hers when she was 18. When she was 21, doctors gave Katie a new face. This is a story of trauma, identity, resilience, devotion, and amazing medical miracles.

KATIE'S NEW FACE



Katie Stubblefield in 2013
STUBBLEFIELD FAMILY

BY JOANNA CONNORS
PHOTOGRAPHS BY MAGGIE STEBER AND LYNN JOHNSON





The evening before surgery, Katie, whose damaged face was reconstructed, gestures to show that she's excited to be getting a new one. She shares the lighthearted moment with Diana Donnarumma, a friend she made at the Ronald McDonald House, and nursing assistant Karnyia Wade.

LYNN JOHNSON

With the donor's face almost completely attached, surgeons prepare to cut away Katie's forehead, following the line drawn on her skin. To transplant the face, they had started from her neck and worked up, connecting blood vessels, bones, and nerves. To stitch the blood vessels and nerves, microsurgions used sutures the size of a human hair.

LYNN JOHNSON





The face lies on a surgical tray, eyes empty and unseeing, mouth agape, as if exclaiming, ‘Oh!’

Sixteen hours ago surgeons in Operating Room 19 at the Cleveland Clinic began the delicate work of removing the face from a 31-year-old woman who was declared legally and medically dead three days earlier. Soon they will take it to a 21-year-old woman who has waited more than three years for a new face.

For a moment, the face rests in its astonished solitude.

Surgeons, residents, and nurses, suddenly silent, gaze at it in awe as clinic staff, like unusually polite paparazzi, move in with cameras to document it. The face, deprived of blood, grows pale. With each second of detachment, it looks more like a 19th-century death mask.

Frank Papay, a veteran plastic surgeon, picks up the tray, carrying it carefully in his gloved hands, and walks to Operating Room 20, where Katie Stubblefield waits.

Katie will be the youngest person to receive a face transplant in the United States. Her transplant, the clinic’s third and the 40th known in the world, will be one of the most extensive, making her a lifelong subject in the study of this still experimental surgery.

Looking down at the face he carries, Papay feels a kind of reverence. It’s an amazing thing, he thinks, what some people will do for others—to give them a heart or a liver, even a face. He says a silent prayer of thanks and takes the face to its next life.

A surgical resident carefully cradles Katie’s head to keep it still as she’s situated in the intensive care unit after the 31-hour procedure concluded. To protect her eyes, her eyelids were sutured shut. With the transplant complete, Katie would still require additional operations and many months of rehabilitation.

LYNN JOHNSON





WE ARE MEMBERS of an exclusive group: animals that recognize their own faces in a mirror. Besides us, great apes, Asian elephants, Eurasian magpies, and bottlenose dolphins are the only other animals known to recognize themselves. Dolphins as young as seven months will pose, twirl, and put their eye right up against the mirror to stare at their faces. Only humans are known to express dismay when looking at their reflections.

As we scrutinize our own faces for wrinkles and flaws, we can fail to notice what a marvelous organ the face is. Our faces are the most distinctive part of our visible body, a mysterious mosaic of the physical and the psychical. Faces are the body's workaholics: They confer and confirm identity, express emotion, communicate meaning, perform basic functions necessary for life, and enable us to experience the world through our senses.

We are born seeking faces. Newborns turn toward them during their first moments out of the womb. Babies observe, respond to, and mimic our expressions as though it's their job. And in a way, it is. This close study of faces is the way we all begin to understand the curious business of being human. Faces, in evolutionary terms, helped us become social animals.

Take a moment to look in a mirror. What do you see? Most of us would answer, "Myself."

My. Self. Our faces are the outer image we attach to our inner sense of self, to who we are and where we fit in the world. Faces root us in our culture, in the rituals and rules about how we present ourselves and how we see others. In some cultures, faces are veiled and hidden. Other cultures draw attention to faces with displays of tattoos, piercings, and scarification. In the contemporary world, faces are often a blank canvas to be manipulated with cosmetic surgery, injections, and intricate makeup techniques learned on YouTube. If we allow them to age, our faces will tell our life story. They connect us to the past in our ancestors and to the future in our children.

At the simplest level of identity, our faces function as our passport photo to the rest of the world. But they're also the way others seek to know us more deeply, to discover who we are behind that photo. "Appearance is the most public part of the self. It is our sacrament, the visible self that the world assumes to be a mirror of the invisible, inner self," wrote Harvard Medical

**1 year, 1 day before
Katie's transplant**

Taking advantage of a sunny spring day, Katie and her parents, Robb and Alesia Stubblefield, indulge in a nap in a park near the Cleveland Clinic. With Katie in a wheelchair, the three explored the park, wandering amid blossoming trees and singing birds. The outing came after Katie had spent a month in the hospital. To reposition her eyes, she had surgery to implant what's known as a distraction device. In the three years before her transplant, Katie was hospitalized more than a dozen times.

MAGGIE STEBER





School psychologist Nancy Etcoff in her book *Survival of the Prettiest*.

Whether the emotions we express with our faces are evolutionary adaptations or learned social behaviors is a topic hotly debated among social scientists. Charles Darwin argued in 1872 that facial expressions displaying some emotions are universal adaptations. In the late 1960s the psychologist Paul Ekman concluded that Darwin was correct. Human beings, across cultures, recognize specific facial displays associated with basic emotions: anger, disgust, fear, joy, sadness, and surprise.

Look in the mirror again. Think about what you can do with that face. You can kiss the ones you love, bite into an apple, sing, and sigh. You can smell freshly cut grass. You can gaze at your newborn and touch your cheek to his. Beyond showing (or not showing) our emotions, faces enhance our ability to communicate with language. We smile, we wrinkle our noses, we wink, we grimace, we perform countless expressions as we converse, often without even realizing it.

Now visualize what goes on beneath that astonishing face. We have 43 mimetic muscles to express emotion and articulate speech. We have four major muscles on each side of the face that move the jaws and complex lingual muscles that assist in swallowing and speech. The face is also made up of layers of blood vessels, sensory and motor nerves, cartilage, bone, and fat. Cranial nerves control the motor muscles and transmit sensory information to the brain, enabling us to see, smell, taste, hear, and feel sensation on the skin.

Go back to the mirror one more time. Look at your incredible face.

Imagine what it would mean to lose it.

KATIE WAS JUST 18 when she lost her face. That face now exists only in photographs. In a cruel reversal of the before-and-after makeovers of reality TV and Instagram, her “before” photos show a girl with a wide smile and flawless skin, a girl so young and beautiful she could have walked off the cover of *Seventeen* magazine.

This photographic evidence didn’t persuade Katie. “I never thought of myself as beautiful,” she told me one day, a few months after we met. Her mother, Alesia, wasn’t surprised to hear it. Katie was a perfectionist, she said: “Katie has a

big heart for other people, but she was always so hard on herself.” When I looked at the photos again, I saw a hint of fragility in her face, a glimmer of the cost of being perfect.

Katie was an irrepressible little girl, her older sister, Olivia McCay, told me. “She was fearless, very fearless, and a lot of fun.” She developed a quick, sarcastic sense of humor, a trait she shared with her brother, Robert. But as she grew older, Olivia noticed, Katie put enormous pressure on herself to achieve. “She wanted to be the best in all of these sports that she’d never even tried before,” Olivia said. “She wanted to be the best academically. She studied for hours, all the time.”

When Katie was in high school, the family made two major moves. Her sophomore year they moved from Lakeland, Florida, where she

The doctor wondered if Katie would make it. She was so tiny. Just 105 pounds. Even if she survived, would there be enough tissue to reconstruct her face?

grew up, to Owensboro, Kentucky. She’d just settled in when they moved again, a year later, to Oxford, Mississippi. Her father, Robb, who’d been a minister and educator, and Alesia took jobs teaching at a small Christian school. Katie enrolled as a junior and fell in love with a classmate. They started talking about marriage. “This one was just so serious for so young,” Olivia said. “She just grew up so fast that year.” After the moves, she said, “I think she was ready to have some stability and some consistency.”

She didn’t get them. In her senior year Katie’s world unraveled. She was already contending with chronic gastrointestinal troubles and surgery. She’d had her appendix taken out the year before, and complications led to the removal of her gallbladder in January of her senior year. Two months later, the Stubblefields told me, the school’s headmaster informed them that

he would not renew their contracts and then abruptly fired Alesia. Katie, who had trusted the headmaster, felt betrayed.

Then, on March 25, 2014, Katie picked up her boyfriend's phone and found texts to another girl. When she confronted him, her family told me, he broke up with her.

Hurt and angry, Katie went to Robert's place in Oxford, where she furiously texted and paced, back and forth. Robert called their mother. While the two were outside talking about how upset Katie was, she went into the bathroom, put the barrel of Robert's .308-caliber hunting rifle below her chin, and pulled the trigger. When Robert kicked in the locked door, he found his little sister covered in blood. "And her face is gone," he recalled, still shaken by the memory.

THE BULLET WAS A PERNICIOUS THIEF. To get a measure of what it stole from Katie, hold your hands up to your face, palms out, your thumbs touching beneath your chin and your index fingers touching between your eyebrows. Your hands are framing the part of Katie's face she lost. Gone were part of her forehead; her nose and sinuses; her mouth, except for the corners of her lips; and much of her mandible and maxilla, the bones that make up the jaws and front of the face. Her eyes remained, but they were askew and badly damaged.

This is how Katie arrived more than five weeks later at the clinic, which was founded in Cleveland, Ohio, in 1921 by four doctors, three of whom had served together during World War I and had come home inspired by the military model of teamwork among specialists. In Memphis, Tennessee, where Katie was first operated on, doctors had saved her life against all odds, but their attempt to cover the gaping wound with a tissue graft from her abdomen hadn't worked.

Brian Gastman, the first clinic doctor to see Katie, lifted her onto a gurney and wondered if she would make it. She was so tiny. Just 105 pounds. Even if she survived, he wasn't sure she would have enough tissue for all the reconstructive work he needed to do. "It was not great," he said. "Her brain was basically exposed, and I mean, we're talking seizures and infections and all kinds of problems. Forget the face transplant; we're talking about just being alive."

In his 27 years of training and practice,

Gastman said, this was one of the worst face traumas he'd ever encountered. Beyond the wound to her face, she had traumatic brain injury from the bullet's concussive force to her frontal lobe, optic nerve, and pituitary gland. The damage to her pituitary threw her hormones and sodium levels out of whack, which can be deadly. Taking charge of Katie's care, Gastman organized a multidisciplinary team of 15 specialists to address all her issues, from endocrinology to psychiatry.

Gastman, who is 48, gives the impression that he's always late, claiming that he has an attention deficit disorder personality. If he weren't joking, it would make sense, considering his many roles. He specializes in head, neck, skin, and high-risk soft-tissue cancers. As a plastic surgeon, he removes tumors and does follow-up reconstructions. He also co-directs the melanoma and high-risk skin cancer program and runs his own research lab.

Robb, Alesia, and Katie often say that Gastman loves Katie like a daughter. I asked him about that. The question made him uncomfortable, and he paused a moment before answering. "I'm not a touchy-feely-type person to begin with, whether it be my own family members or Katie," he said carefully. "But I feel very responsible to her. This is my life mission. With someone like her, who's so young, it's the pinnacle. This is what my training should be for."

"Katie loves Dr. Gastman," Alesia said, "but she has an old-man crush on Dr. Papay." Papay, who is 64, chairs the clinic's Dermatology and Plastic Surgery Institute. He acts as the suave counterpoint to Gastman, with his silvery gray hair and bon vivant manner. His years of work with face transplants also make him the voice of experience and wisdom on the clinic's face transplant team.

Papay studied biomedical engineering before going to medical school; his training taught him to "work from failure," anticipating potential problems and devising solutions. Papay told me he gravitated to plastic surgery because it's about function as much as form. "Everyone thinks that we're the cosmetic guys, the hairdressers of surgery, and we do face-lifts and breast augmentations," he said. "But in plastic surgery and now face transplants we're innovators—we're fix-it guys."

Over the course of many surgeries, Gastman and a team of specialists stabilized Katie and

*1 year, 2 days before
Katie's transplant*

During one of Katie's hospital stays, Alesia cleans and comforts her following a meal. Katie drank from a sippy cup because without lips, she had a hard time keeping liquids from dribbling out. To move her eyes closer, a doctor would come each day to adjust the distraction device, which was attached to her maxilla, the bone in the center of the face.

MAGGIE STEBER





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TOP

**9 months, 21 days before
Katie's transplant**

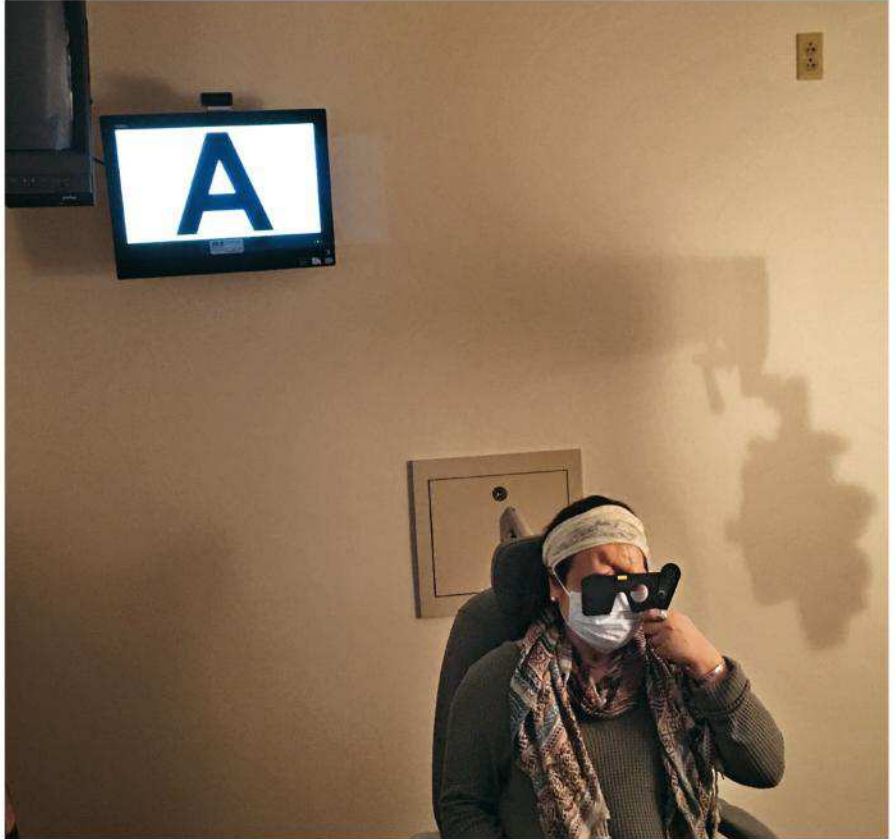
Katie is fed soup for lunch. With her limited vision, she had difficulty finding her mouth. On this day she wasn't allowed to eat solid food because of a recent operation. Doctors had taken off the distraction device, which had moved her eyes into a better position.

BOTTOM

**6 months, 4 days before
Katie's transplant**

In an examination room, Katie holds an instrument to measure the acuity of her eyesight. Robert Engel, an optometrist at the Cleveland Clinic, was evaluating her corneas.

He also replaced a dislodged contact lens for one eye; the lenses help protect her corneas from abrasions caused by inward-turning eyelashes.





TOP

6 months, 3 days before Katie's transplant

Katie meets with the clinic's first two face transplant recipients: Shaun Fiddler and Connie Culp. They offered her comfort—as well as humor. "It's OK to be scared," Fiddler said. "It's going to get better. It just takes a while." Culp quipped: "Don't worry. Just don't get wrinkles!"

BOTTOM

6 months, 1 day before Katie's transplant

Celebrating Katie's 21st birthday, her mother tells her to make a wish and blow out the candle. The family went to restaurants even though Katie sometimes heard people whisper about her face. It upset her, but she pretended she didn't hear. She wanted to tell them, "I got hurt, but I'm getting better."







patched her face. They removed and repaired shattered bones. To create a nasal passage and protect her brain, Gastman made a rudimentary nose and upper lip from her thigh tissue rolled up inside out. For a chin and lower lip, he used a piece of her Achilles tendon. The doctors fashioned a new lower jawbone from titanium and a piece of her fibula with flesh still attached, using as a guide a 3D model made from a scan of Olivia's jaw. To move Katie's eyes closer together, they attached to her skull a distraction device, adjusting it day by day. It was challenging work, and Gastman was proud of it.

Katie had never seen this face, but she had come to know it by touch—the crooked tube of flesh in the center, the bulbous chin. She knew her eyes looked as though someone had grabbed her by the cheeks and jerked up on one side and down on the other.

She called this face, the second of her young life, Shrek.

FOR KATIE, 2014 WAS A LOST YEAR. She remembers nothing of her suicide attempt or the surgeries that followed. Her parents had to tell her what happened. It shocked her. "I never thought of doing that ever before, and so on hearing about it, I just didn't know how to handle it," she told me. "I felt so guilty that I had put my family through such pain. I felt horrible."

The Stubblefields never returned to Oxford. Robb and Alesia moved to the Ronald McDonald House near the clinic, into a room about the size of a studio apartment with a makeshift kitchen. Katie qualified for Medicaid, and the clinic paid for much of her care with federal funding to study face transplants. For daily living, the Stubblefields subsisted on the kindness of others—family and friends gave them money, held fund-raisers, and started online campaigns. Robb picked up odd jobs, painting houses or working security.

Katie became their full-time job. Whenever she was in the hospital, one of them was nearly always with her, day and night. When she wasn't in the hospital, their days were filled with doctor's appointments, rehab sessions, and the search, always, for something new that could help her. Acupuncture. Massage. A chiropractor. A personal trainer. A nutritionist. Music therapy. Spiritual and healing services.

**9 months, 22 days
before Katie's transplant**

At Cleveland's Tudor Arms Hotel, Katie and her father sing "Have I Told You Lately That I Love You?" as they share a dance. "Before this, I never spent so much time with my parents," said Katie, who credits their love and devotion with helping to save her life. "Are we still broken over this whole thing? Oh my gosh, yes," Robb said. "Things happen in life that shatter us to pieces, but I think it's where we go from there."

MAGGIE STEBER





They googled for information, posted updates for friends on a Facebook page, and used a dry-erase calendar to track their schedule.

Two years after Katie arrived at the clinic, I met her and her parents in the waiting area of the plastic surgery department, a large, sunny room that marks one of the many odd crossroads of modern American medicine. Here, patients suffering significant facial disfigurement and scarring wait for their appointments alongside buffed and gleaming clients who come in for Botox injections and face-lift consultations.

Katie arrived in a wheelchair pushed by her father. She wore a surgical mask over the lower half of her face and a brightly colored head scarf. She looked small and vulnerable, though I soon learned she wasn't. She took my hand and said a cheerful hello, and as we chatted, I saw that in this space, at least, she seemed entirely comfortable. Maybe that's because she didn't stand out. In one way or another, everyone there was dissatisfied with his or her face.

When I visited the family at the Big Mac House, as Robb calls it, Katie was almost always in a recliner, tilted back and covered in fleece blankets. Alesia tended to her nonstop, dispensing medications, bringing her water in a child's sippy cup, rubbing her hands and feet with scented lotions, and heating slippers and eye masks in the microwave.

Katie usually listened passively to the conversation but sometimes interjected a comment or a joke, giving me a glimpse of the funny Katie her family frequently described.

One day we were talking about religion, which is central to their lives. What happened to Katie shook their faith a bit but didn't kill it. It also didn't kill their marriage—a common repercussion when a child dies or has overwhelming medical problems. Where Alesia is emotional, Robb tends toward intellectual discourse. He has a bushy beard that enhances his sagelike manner, and when Alesia is fired up, he gazes at her with a tender smile.

That day Alesia was telling me about her extremely conservative Christian upbringing. Her church didn't allow drinking, and in middle age Alesia discovered she loves wine and a good cocktail. "Can you believe it?" she said. "I didn't have my first drink until I was 43!"

Katie perked up. "I had my first drink when I was 14," she said.

This was news to Alesia and Robb, who



After Katie had waited more than a year on the transplant list, a donor was found: Adrea Schneider (above). Sandra Bennington weeps as she talks about Adrea, her granddaughter. Sandra agreed to donate Adrea's face after she failed to recover from a drug overdose. Adrea had a hard life, Sandra said. Her mother, Sandra's daughter, used drugs, and Adrea was born with drugs in her system. Before Adrea died, she was in drug rehab and had reconnected with Sandra. "She could come over and visit, and we would laugh and act silly and, you know, like sisters."

MAGGIE STEBER (LEFT); BENNINGTON FAMILY (ADREA SCHNEIDER IN 2017)

Katie's main doctors, Brian Gastman (rear) and Frank Papay (center) had planned to perform a partial transplant, keeping her cheeks, eyebrows, and forehead. But as the operation progressed, they realized she might look better with a full transplant because the donor's face was larger and darker in skin tone. To show Katie's parents how this would look, Gastman and Papay take photos with the new face in place.

LYNN JOHNSON





laughed in the way of parents who figure, What can you do? “Oh, Katie,” Alesia said fondly.

One evening Alesia told me their situation still felt unreal. She had never worried about Katie getting into trouble. Katie was sensitive and had a melancholy streak, yes, but she also had a snarky sense of humor. The night before she shot herself, she’d jokingly refused to clean up after dinner, picking up a lamb puppet and saying in a cartoonish voice, “This is ba-a-a-a-d.”

What clues had she missed? Alesia often descended into spirals of guilt and grief, feeling that she’d failed her daughter. She clung to one thing that Kathy Coffman, a clinic psychiatrist, had told her. The suicide attempt—Alesia almost always called it “the accident”—was an impulsive act. Five minutes later, or five minutes earlier, and Katie might not have grabbed the rifle.

“It was one moment,” Alesia told me. “One moment, 20 seconds, changed our lives.”

AS RECENTLY AS 2004, the face Katie called Shrek was the best that even the most skilled reconstructive plastic surgeons could do for a patient as severely injured as she was. Katie would have lived the rest of her life concealing what she could of her face with surgical masks and scarves, hearing the startled whispers of strangers when she went out in public, and struggling to speak and eat.

That grim fate changed in 2005, when French surgeons performed the world’s first partial face transplant. But it was a scientist at the Cleveland Clinic who pioneered the procedure by conducting years of research to demonstrate that faces, like hearts and hands, could be transplanted.

At the clinic there’s a saying: Face transplants have many fathers but only one mother. The clinic’s effort was led by Maria Siemionow, an elegant and reserved doctor who was born and trained in Poland. Siemionow, who came to the clinic in 1995, was the first in the world to win official institutional approval to do the groundbreaking surgery on human subjects in 2004. Four years later, a team of surgeons at the clinic, including Siemionow, completed the first face transplant in the United States.

Now at the University of Illinois at Chicago, Siemionow told me she first thought about transplanting a face in 1985, during a charity mission to Mexico. She’d operated on some



children there who were so badly burned that their fingers had fused.

“Subconsciously, I started thinking, if we can do something for their hands, what about their burned faces?” she told me.

Doctors had been transplanting internal organs since the first successful kidney transplant in 1954. The end of the 20th century brought vascularized composite allotransplantation—the term for transplantation of faces, hands, and other parts of the body that are not solid organs. But the notion that faces could be transplanted remained, for many, far-fetched.

Most in the medical world scoffed, Gastman told me, but Siemionow carried on, conducting hundreds of experiments. She tested surgical techniques and suture patterns in



Stepping away from the operating room, Papay, seated next to Alesia, and Gastman, next to Robb, show photos they just took of Katie and discuss the advantages and risks of using the donor's entire face. A full transplant would look better, helping Katie feel more comfortable in social situations. But transplanting that much skin could increase the risk of rejection. Robb and Alesia decided Katie would want to look as good as she possibly could.

LYNN JOHNSON

anastomosis—the joining of two vessels or nerves—and developed novel immunosuppressive strategies to prevent rejection of the complex variety of tissues that make up the face. She was the first to report successfully transplanting an animal face when she attached a new face to a rat. The rats were startling to look at, with patchwork faces of light and dark fur. Siemionow named one white rat Zorro, for its masklike appearance after she'd transplanted a brown face onto it.

“Even my friends were saying, ‘Maria, you’re wasting your time,’” Siemionow told me.

As Siemionow was doing her research, the idea of face transplants was beginning to gain acceptance. The British medical journal the *Lancet* published an article in 2002 titled “Face Transplantation—Fantasy or the Future?” “The

concept may be shocking,” the authors wrote. Nevertheless, face transplants were likely the future, they declared, and conceivably could also become a duty for surgeons treating severely disfigured patients.

Ethicists weighed in, many arguing that face transplants, like hand transplants, were not life-saving and would expose patients to too many severe risks just to make their lives easier.

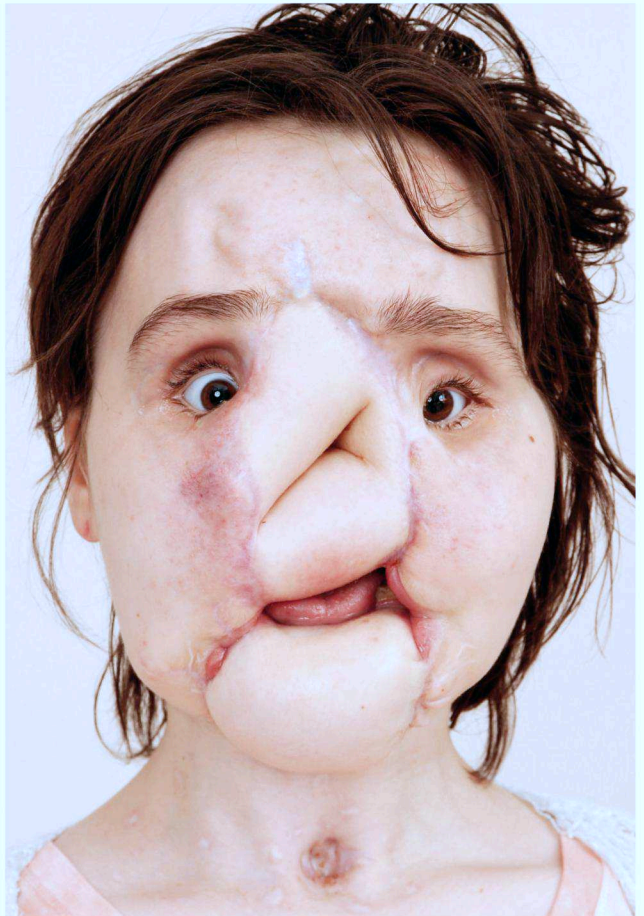
The proposition of transplanting visible parts of the body also carried with it a huge “yuck factor”—a term bioethicists actually use to describe a strong emotional response by the public to biotechnological innovations. After all, no one sees a transplanted heart, even the patient herself. A transplanted face carries with it echoes of the 1997 thriller *Face/Off*, which has





Shortly after the operation, Robb, Alesia, and Katie's brother, Robert, gaze at Katie's new face for the first time as she remains sedated in the ICU. Standing at her bedside, they whisper to each other about her appearance. Robb said later that he found it surreal to see his daughter with the third face of her life. Alesia thought she looked really good, not as swollen as she'd expected, but she also wondered, "Where's Katie?" Robert noted a new feature: a dimple on her chin.

LYNN JOHNSON



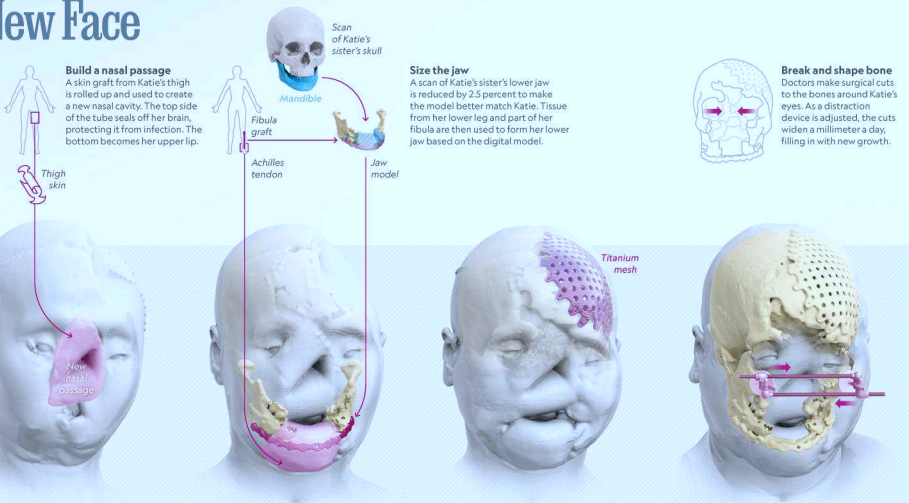
CLEVELAND CLINIC

Katie's family came to love her reconstructed face and see it as a testament to the extraordinary efforts her doctors made to save her life. To understand her story, the Stubblefields believe it's essential to see this face. But living with the face she called Shrek was a struggle for Katie. "I felt like other people would look at me and think I looked like a Cyclops or a freak," she said.

**1 year,
9 months,
18 days
before Katie's
transplant**

Building Katie's New Face

Katie Stubblefield lost most of her face when she shot herself in 2014. She was stabilized in a Memphis, Tennessee, hospital, but when her wound couldn't be closed, she was moved to Ohio's Cleveland Clinic. Once there, she began the journey to rebuild her face, which would include a 31-hour full-face transplant.



1

Keep her alive

When Katie is first admitted to the Cleveland Clinic, she has already undergone multiple procedures to stabilize her. The clinic continues this work, removing shattered bones in her jaw and skull, keeping her windpipe open for breathing, and covering her wounds for healing.

2

Rebuild her nose and skull

Doctors construct a nasal cavity, which will help protect Katie's brain from infection and make eating and breathing easier. Plates and screws from previous operations are taken out, and her open face wound is sealed. Infected bone from her skull is removed.

3

Refine the jaw

Katie's jaw needs hardware to stabilize her face. Her sister is scanned to provide the necessary dimensions to build an appropriately sized jaw made of titanium and grafted leg bone. Composite tissue of muscle, skin, and part of the Achilles tendon is used to form a lower lip.

4

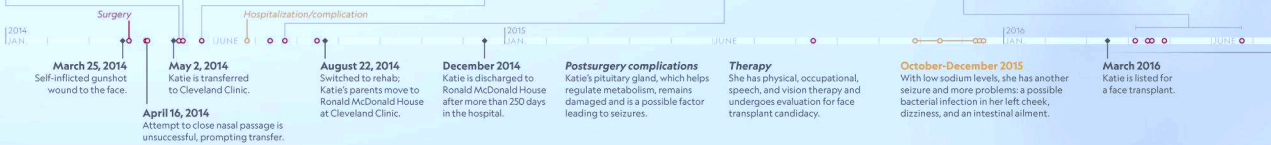
Fix her skull

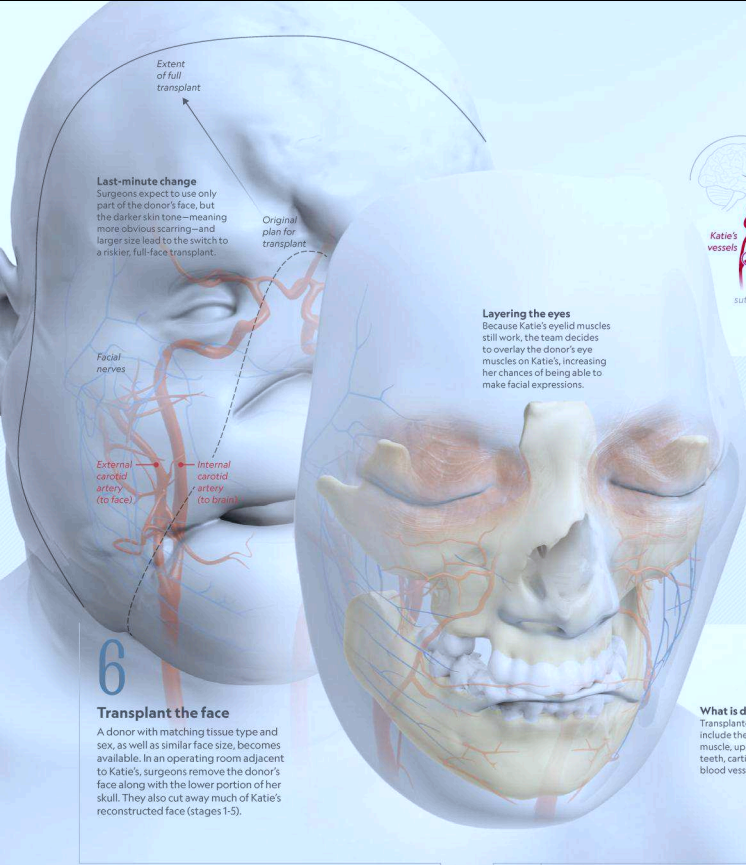
An earlier operation opened Katie's skull to remove damaged tissue and prevent swelling of the brain. This hole is now at risk for infection. A custom-made titanium mesh implant that closely fits Katie's anatomy is added to help prevent exposure and infection.

5

Reposition her eyes

Katie's eyes are misaligned and too far apart. To prepare her skull to fit a donor face, surgeons employ a method called distraction osteogenesis. Surgeons reshape bone by cutting through it with a saw and controlling for shape and length as it regrows.





6

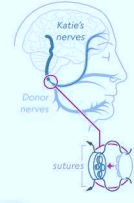
Transplant the face

A donor with matching tissue type and sex, as well as similar face size, becomes available. In an operating room adjacent to Katie's, surgeons remove the donor's face along with the lower portion of her skull. They also cut away much of Katie's reconstructed face (stages 1-5).

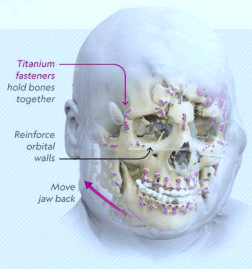
Layering the eyes
Because Katie's eyelid muscles still work, the team decides to overlay the donor's eye muscles on Katie's, increasing her chances of being able to make facial expressions.



Connecting blood vessels
In a critical step in the surgery, blood vessels are quickly attached to limit the time the donor face lacks access to oxygenated blood. Katie's new face then flushes pink.



Connecting nerves
Once the blood vessels are joined, Katie's facial nerve trunks are connected to the donor face, one on each side. Nerves to her eye muscles, which she can control, are preserved.



7

Fine-tune the transplant

Doctors closely monitor Katie for signs of rejection after the surgery. Her nerves need more than a year to recover. Post-transplant surgeries seek to bring her tongue closer to her teeth, better align her jaw, and reshape her eye sockets to keep her eyes properly placed in her skull.

What is donated
Transplanted parts of the face include the donor's skin, muscle, upper and lower jaws, teeth, cartilage, soft palate, blood vessels, and nerves.



Tongue and speech
After the transplant, Katie's tongue can't touch her teeth or the roof of her mouth, making it impossible to produce th, d, n, l, t, and s sounds. P and b are also difficult for her.

Transplant training
Surgeons practice regularly for 14 months on cadavers and 3D-printed models of faces.

More than 14 months until donor is found
May 4-5, 2017
Face transplant

August 1, 2017
Katie is discharged from Cleveland Clinic.

Postsurgery recovery
Her cognitive abilities intact, Katie continues her physical and occupational therapy. She also works with a speech therapist and takes Braille lessons.

Continuing treatment
Told by her surgeons she'd now be a "professional patient," Katie takes immunosuppressive drugs and her hormone levels are monitored. She's learning to use her new face as she regains the ability to eat and speak.

JASON TREAT AND RYAN T. WILLIAMS, NGM STAFF ART; BRYAN CHRISTIE, SOURCE: CLEVELAND CLINIC



MARTIN SCHOELLER

**1 year,
29 days
after
Katie's
transplant**

Katie can close her eyes, wrinkle her nose, pucker her lips, and, as Gastman says, "she has a smile going on." Surgeons have since adjusted her lower jaw and will likely slim her face, reduce scarring, and improve her eyelids. Over time her face will continue to regain function. "It's not like my normal face," Katie said, "but then part of me is like, 'This is my face. Now it's my face.'"

FBI agent John Travolta switching faces with terrorist Nicolas Cage.

Papay followed Siemionow's research and offered support. As soon as he became chairman of the plastic surgery institute, he told me, "I went to her and I said, 'Let's do it.'"

IT'S HAPPENING NOW!" Gastman said as he breezed into Katie's room the morning of May 4, 2017. He'd been up most of the night, drinking Diet Coke to stay awake as he made the last-minute arrangements. Entering the room filled with Katie's friends and family, he felt as if he were walking onto a sports field after going through a stadium tunnel.

The two tiny corners left of Katie's lips lifted in the suggestion of a smile. She was finally getting a new face. It had been more than three years since her injury, more than a year since her name had been added to the waiting list kept by the United Network for Organ Sharing, a contractor for the U.S. Department of Health and Human Services.

Gastman told Katie she was doing this not just for herself but also for others like her in the future. "You're helping make these reconstructions a reality, and they're only going to get better," he said. "Every case we learn so much. And with your case we're going to do a lot better than we did 39 face transplants ago, because we have learned so much."

Insurance companies, Medicare, and Medicaid don't pay for face transplants because they're still considered experimental. But the American Society for Reconstructive Transplantation has paved the way for insurance payments by proposing guidelines for determining medical necessity. The Department of Defense made Katie's transplant possible through the Armed Forces Institute of Regenerative Medicine (AFIRM), which has also supported hand transplants.

The consortium of military and private institutions, established in 2008, had a \$300 million budget, with \$125 million from the military and the rest from other sources. It put transplants and other innovative research into regenerating tissue and bone, as well as new immunosuppressive therapies, on a fast track. Joachim Kohn, one of the first directors of AFIRM's research projects, told me that the initiative was launched after the Second Battle of Fallujah, the bloodiest conflict of the Iraq War. "Hundreds

**19 days after
Katie's trans-**

Katie takes for herself if a rare occu the hospita and others stopped by on her prog new face, w tures still in quite swoll

MAGGIE STEBER



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of severely burned and crippled service members came back to America,” he said. A paper published in 2015 reported that 4,000 service members in the wars in Iraq and Afghanistan sustained injuries to their faces, about 50 considered catastrophic.

The Cleveland Clinic has received \$4.8 million, with \$2 million earmarked for face transplantation research. So far, no service members have had face transplants, though Siemionow said she’s interviewed candidates. She told me they decided not to go through with it. “They are very tough people,” she said. “They consider the wounds as an honor. They want to be deployed.” A face transplant, with its requirement of lifelong immunosuppression, would prohibit that.

At 21, with a face severely wounded by ballistic trauma, Katie was the closest the Pentagon might ever come to a stand-in for its wounded warriors. But before Katie could become a voluntary human research subject, Gastman, Papay, and others at the clinic spent many hours explaining to the Stubblefields what a new face would mean for Katie. The family hadn’t heard of face transplants until a doctor in Memphis told them about the clinic’s work.

Restoring function—the ability to eat, to speak, to breathe through the nose, to blink—is far more important than looks, Papay told me. That gave me an opening to bring up an awkward subject. Many face transplant patients don’t look all that good. Their faces look a bit frozen, masklike, and slightly off-kilter.

“Am I being mean or too critical?” I asked.

“No. I think you’re being honest. I think you’re right,” he said. “They will never look like they did, OK? And so they look presentable in public, but do they look like they did before? No. They look better than their disfigurement, but to what degree is so variable.”

Managing expectations about how they will look is one of the biggest challenges for the team, Papay said. “You have to be extremely honest, to a fault, and extremely realistic and extremely transparent. And if you’re not, you’re actually doing something that to me is terrible.”

Coffman, the psychiatrist, who has worked with all three of the face transplant patients at the clinic, helps screen candidates for the procedure, making sure they’re stable psychologically, they understand all the risks and unknowns, they can be trusted to stick to the medication

regimen, and they can truly give informed consent. Coffman has a tranquil therapeutic manner and is especially protective of Katie, visiting her daily whenever she’s in the hospital.

A suicide attempt complicates the matter, Coffman said, telling me about one of the earliest transplant patients, a man who’d shot himself in the face. The transplant, performed by a team in Paris headed by Laurent Lantieri, was successful. The man looked good. But about three years after the surgery, he killed himself. “It was quite devastating for the whole team,” Coffman said. “Dr. Lantieri has voiced the opinion in conferences that he would not do another face transplant on somebody that was suicidal as a cause.”

That brought us to Katie. “That puts a huge burden on you to discern whether Katie will try this again, doesn’t it?” I asked Coffman. “Yes,” she answered. But she pointed out that Katie acted on impulse and hadn’t given any indication she was thinking about suicide before that day. “I think that she has been very stable,” she told me. “She’s been on medication. She’s never voiced any suicidal thoughts since that time. She’s generally a very upbeat person.”

As part of the protocol for Katie’s informed consent, Coffman and others had outlined the risks. One of the biggest is the potential for rejection. Faces are riskier than solid-organ transplants since they involve many kinds of tissue, including muscles, nerves, blood vessels, bones, and skin. Katie would have to make a lifelong commitment to taking powerful immunosuppressive drugs, which would also add to the risks, making her far more vulnerable to infections and diseases, especially lymphomas, other cancers, and diabetes.

In 2016 at a conference in Paris, Coffman heard a member of a prominent face transplant team call for a moratorium. Patients were having more difficulty with antirejection medication than expected and were requiring more follow-up surgery. The mortality rate was worrisome as well: Out of 36 transplants at the time, six patients had died. When Coffman returned, she suggested that Katie might want to wait five years. “She was pretty adamant that she knows the risks, she understands the mortality,” Coffman said, but also noted her youth. “It’s that golden age when you don’t always think that mortality will affect you.”

Over and over again, Coffman and others

explained to Katie and her parents that the surgery was experimental and, because she didn't need the operation to live, it was elective surgery. But Katie didn't consider it elective.

AT 7:30 A.M., 11 SURGEONS gathered in OR-20. For the final time, Gastman went step by step through a typed checklist fastened to a whiteboard. Gastman and Papay repeatedly told me that the clinic's success with face transplants came from its team approach. "As a team, we have this collective genius," Papay said. Every two weeks for months, the surgeons had practiced in the clinic's cadaver lab, one team removing the face of a "donor" and the other team attaching it to the "recipient."

Alesia thought about what Katie had told her: 'I want to go out and be a face in the crowd that no one looks at.'

The donor was wheeled into OR-19 about 10 minutes later and transferred to an operating table. A ventilator delivered oxygen through a face mask to keep her organs viable. She had smooth, tawny skin, a cute nose, and dark hair. A staff member from the organ procurement organization for northeast Ohio, Lifebanc, told the group that after the donor's face was removed, surgeons from the clinic and other hospitals were waiting to recover her liver, kidneys, lungs, heart, and, for research, uterus.

The face surgeons go first. But since organs are precious and face transplants are not lifesaving, if the donor's condition started to decline, the team would have to abandon its work to allow other surgeons to collect the donated organs.

At 8:17 a.m., Gastman made the first cut, an incision in the donor's neck to insert a tracheostomy tube for oxygen. With the face mask removed, nurses prepped and cleaned the donor's face and shaved her hairline. Gastman drew lines down the sides of her face and from

ear to ear to guide the doctors' scalpels. For the next 16 hours, three to four surgeons, all wearing surgical loupes—glasses fitted with magnifying scopes—would bend over the donor like jewelers examining a precious gem. Around them, residents watched each move, transfixed, some standing on stools to get a better view.

First the surgeons removed her eyes for cornea recovery. Then they began the long work of isolating and delicately dissecting cranial nerve VII. The facial nerve emerges on each side of the face from the brain stem, travels to the front of the ear, and then divides into five branches, which lead to the scalp and forehead, eyelids, cheeks, lips, and neck. It has both motor fibers, controlling the muscles of facial expression, and sensory fibers, providing a sense of taste to the tongue and serving glands that allow us to salivate and cry.

Next they turned to what Papay called the bony cuts. He cut the entire upper jaw and part of the lower one to transfer to Katie, most of the cheekbones, part of the frontal bone that overlies the sinuses, and the orbital floors and lacrimal bones near the eye sockets. Where the bone was visible, he employed a variety of saws, including one that uses high-frequency ultrasound. Where the bone was not exposed, he used an osteotome, which resembles a chisel. "I call it the blunt work," Papay said. "It's manual labor, not as aesthetic."

Finally they turned to the blood vessels, which are done last to limit the time the face is without a blood supply. They dissected veins and arteries, tagging them with different lengths of suture to match them to Katie's vessels.

Nearly four hours after they'd started on the donor, when they were sure she was stable and they wouldn't have to abandon the surgery, they were ready to begin on Katie. At noon, doctors wheeled her into the adjoining OR-20. "Katie, we're going to take amazing care of you," Gastman told her. "And the goal is, you'll wake up and say, 'When are we going to start?'"

After the anesthesia put Katie to sleep, Gastman drew lines on her face to mark the cuts and then made the first incision, also a tracheostomy. Then he and two other surgeons began dismantling most of the reconstructive work Gastman had done on Katie in the previous two years. Residents crowded around this surgical table too. Hours went by. Monitors beeped steadily. The surgeons spoke quietly as they





worked. Nurses were in constant motion, handling instruments, checking monitors.

In OR-19, it was 12:11 a.m., the beginning of the next day, when Papay and the team severed the final blood vessel and removed the donor's face.

Papay, with the face on the tray, walked into OR-20, where doctors placed the face on Katie. Immediately they began to connect it to her blood vessels. When they finished the left side and unclamped Katie's vessels, her blood rushed in. The face blushed. When they finished the other side and unclamped, the whole face turned perfectly pink. "There was a very large internal sigh of relief by almost all of us surgeons," Gastman recalled.

They attached the face from the neck up, reversing the steps they'd taken to remove it. They started with the donor's bones, using osteo-integrated plates and screws to connect them to Katie's bones. Then they turned to connecting the nerves, a bundle of fibers surrounded by a sheath. The specially trained microsurgeons stitched the ends of the sheaths together with sutures the size of a strand of hair, trying not to damage the very, very fine fibers inside. "Then the nerves will connect, kind of kiss each other," Papay explained.

They sutured only the motor nerves, leaving the sensory nerves to connect on their own. During their first face transplant, they didn't connect the fifth cranial nerve, the main sensory nerve of the face and head. Yet the patient regained a great deal of her sensory function. It surprised and puzzled them. "We absolutely do not know how that happens," Papay told me. In the midst of such medical precision, there's still room for wonder.

NOT LONG AFTER DAWN, Papay and Gastman left OR-20 to talk with Robb and Alesia, who had been awake for 24 hours or more, waiting and worrying. Everything was going well, Gastman assured them, but there was a discrepancy in the size of the faces. A critical decision had to be made.

Through months of discussions and practice surgeries in the clinic's cadaver lab, the team had decided to do only a partial face transplant. They would fix just the cavernous, triangle-shaped wound, giving Katie a new

**20 days after
Katie's transplant**

On one of her daily walks in the hallways, Katie sings as she exercises with physical therapist Becky Vano (at left) and physical therapy student Nicole Bliss. Before the transplant, Katie had to learn to walk again to overcome spasticity in her limbs caused by the concussive injury to her brain. After the transplant, she had to start over with strengthening her legs.

MAGGIE STEBER

**7 months, 16 days
after Katie's transplant**

On her first long trip away from the Cleveland Clinic and the Ronald McDonald House, Katie visits her sister, Olivia McCay, in Peoria, Illinois. She holds her nephew, Luke. Olivia had Luke almost six months after Katie's face transplant. "I'm hoping I'll continue to heal," Katie said, "so he won't be scared when he sees me." Katie's eyes are often dry and painful, so she sometimes wears a protective plastic film over them to keep moisture in.

LYNN JOHNSON





nose, mouth, set of teeth, and chin, as well as the facial bone below her eye sockets and most of both jaws.

They had decided not to touch her cheeks, most of her forehead, her eyebrows and eyelids, or the sides of her face. They wanted to keep as much of Katie's face as possible, to preserve the features "that make her still look like Katie," as Gastman put it, and to reduce the risk of rejection, by limiting the amount of transplanted skin—the most antigenic part of the body.

But when they laid the donor's face on Katie, the surgeons saw that the triangle didn't fit well. Katie's head was smaller than the donor's, and her scar tissue took up space. There wasn't enough room for all of the donor's muscles and vessels. The donor's skin tone was also darker, and that mismatch would make the transplant stand out.

The surgeons conferred, some of them stopping to examine the 3D models that had been made from CT scans of the two heads. A majority thought they should give Katie the donor's full face. It was clear that it would look a lot better.

A few on the team argued that more tissue and skin might mean she would have to take higher doses of the strong antirejection drugs she'd be on for the rest of her life. Worse, in the case of a rejection so acute that her face had to be removed, she wouldn't have enough tissue on her body for reconstructive surgery.

Gastman and Papay explained the options to Robb and Alesia during that first visit and several more as morning turned into afternoon and the surgery continued. They showed the parents photos they'd taken with their own phones of the full face laid over Katie's face. They didn't tell them that Gastman wanted to do the full face because Katie was a young woman who cared about her appearance, while Papay wanted to use as little donor skin as possible to minimize the risks and maintain the function she had left.

At their fourth meeting, as the doctors went through the pros and cons of each choice, Alesia grew tense. She shifted in her seat constantly, twisting her arms and fingers, crossing and uncrossing her legs. She's a petite woman but feisty, and though her exhaustion and distress are etched on her face, you can see her natural beauty—one her two daughters had inherited.

"Every decision you're going to make now is going to be right," Gastman told Katie's parents.

**8 months, 22 days
after Katie's transplant**

Meeting Katie for the first time, Sandra studies her face, which had been her granddaughter's. "You look beautiful," Sandra says. Katie didn't look exactly like her granddaughter, Adrea, but Sandra could see Adrea in her nose and mouth. Before they met, Katie had cried because she was nervous. Afterward, she said, "I felt like she was my grandmother. I felt very loved." Sandra later said she wanted to tell Katie to call her Amma, the name Adrea had given her.

MAGGIE STEBER





“But you’re always going to have a what-if in your mind. So I think the best is just, ‘What does your heart really say?’ maybe is a better way of asking, ‘What do you think she wants? What would she be happier with?’”

After a long pause, Robb murmured, “I think she would want the full, the full-on.” Alesia looked surprised, then as if she might cry.

She twisted up even more. She wanted to blurt out, “No, no, no. This is your field. You should make the decision. Of course I don’t want Katie to die or be more likely to die. But she wants to fit in this world; she wants to be able to go out and be part of it.”

Gastman and Papay said they’d give them half an hour more. As they started to leave, Alesia pointed at Gastman and said, “What do you think, gut feeling?”

“Like I said, I think you could be right either way you go,” Gastman replied evenly.

“Could I be wrong either way I go?” she asked.

When the doctors left them alone, Robb and Alesia imagined what Katie would say if she woke up to the partial transplant, with its more visible scarring and mismatched skin tone. “She’d say, You mean I could have looked better than this, and you decided not to do it?” Robb said. Alesia thought about what Katie had told her: “I want to go out and be a face in the crowd that no one looks at.”

They had their answer.

At 3 p.m., 31 hours after surgery on the donor started, the surgeons finished suturing the top layer of skin, attaching the entire face. The nurses, residents, staff, and doctors applauded.

The face, now Katie’s, had lost its astonishment. It looked serene.

Gastman went to tell the family the surgery was a success. He told them he was going to go home, take a shower, kiss his daughters, and cry.

When Katie’s parents and brother came in to see her in the intensive care unit, they stood silently by the side of her bed, staring at her new face. Robb, having seen Gastman’s photos, was not shocked. Robert remarked that his little sister had a new feature, a slight dimple in her chin. “Like Kirk Douglas,” his dad said. Alesia stroked Katie’s arm and thought, “You had one face up to 18. You had another face from 18 to 21. Now you have this face.” She tried to see Katie in it, but she could not. She longed to see her daughter.

ONE MORNING, while Katie was still in the hospital, Alesia woke up feeling weird. She wasn’t sure what to make of the transplant. It was disconcerting: When she looked at Katie, she knew she was looking at someone else’s face. Was Katie still there?

“What if Katie comes out a different personality?” she asked Robb. “I don’t want that. I love who Katie is on the inside.” “Alesia,” Robb said, “we’re not watching some sci-fi movie.”

If it felt like a sci-fi movie at times, that was understandable. In her crowded room in the intensive care unit, hooked up to a ventilator, an IV tube, and an array of beeping monitors, Katie looked like the experimental subject that she, in fact, was. There was also something regal in her sedated repose, an impression highlighted by the tiara of jagged sutures etched across her bald head and the nurses, residents, and doctors who attended her like somber courtiers.

About two weeks after the doctors wheeled Katie out of the OR, a physical therapist had her out of bed and walking the hallways, their stately procession headed up by a pole festooned with bags of medications. Even though she was moving, Katie felt as if she were asleep for most of May, or in a movie, vaguely aware of people coming and going but never completely alert.

The first time she was aware of touching her new face, it felt very swollen and round. Papay had told her she’d gotten a cute nose and that it looked like her mom’s. She asked her mother if the new face was good enough that people would stop looking at her as if she were a freak.

The days in the hospital, as always, grew long. Katie had bad days and worse days, the pain sometimes unbearable. Hooked to a feeding tube, she moaned and sometimes cried that she was hungry. She couldn’t speak at all, so Alesia got her a whiteboard and marker. She scrawled: “mashed potatoes.” “Love you.” “It hurts.” Either Robb or Alesia, often both, stayed with her.

Chronic rejection will always be a risk for Katie, but she had no early, acute rejection episodes during her nearly three months in the hospital. She had three more major operations to undergo in the coming year and a half. First doctors would clean out her sinuses and insert titanium-mesh implants under her eyes to lift them up in the sockets and bring them forward. Second they would remove some of the extra

skin and tissue left in place in case of rejection, which Gastman likened to a face-lift. Finally a third surgery would shorten her lower jaw, move her tongue forward, and place an implant in the roof of her mouth, which doctors hope will help Katie speak more clearly.

“All those photos you’ve seen of people who’ve had face transplants and look so good, remember, those photos were taken after all of these revision surgeries,” Gastman explained on one of his frequent visits. “It takes time.”

“Dr. Gastman,” Katie said, “when you do the face-lift, I want a boob job too.”

Alesia, laughing, leaned in and whispered to Katie.

“Oh, I made you blush, Dr. Gastman!” Katie said.

He blushed deeper.

We tend to think of healing as a passive

Face transplant recipients undergo a metamorphosis. The new face becomes a matrix, not one or the other but a composite. Katie didn't look like Adrea.

activity, one that occurs while lying in bed binge-watching terrible television shows and waiting for your immune system to work its stealthy magic. With her discharge from the hospital on August 1, 2017, though, rest was over for Katie. “For the foreseeable future, you’re a professional patient,” Gastman told her the day before she left the hospital.

They all felt they were being set free when Katie returned to the Big Mac House. But they weren’t free. Alesia and Robb would now be Katie’s nursing staff, a round-the-clock job. They took home a 2½-page printed list of daily medications. The pharmacist who went over the list pointed two times to Prograf, the immunosuppressant. “The most important medication,” she said. The giant calendar on the wall filled with appointments. Physical therapy twice a week. Work with a personal trainer twice a

week. Occupational therapy once or twice a week. Braille lessons two or three times a week. Speech therapy four times a week.

Speech proved especially difficult. Katie’s mouth was mostly the donor’s mouth. Only Katie’s tongue and upper, soft palate remained, and they weren’t functioning properly. Her tongue didn’t touch her teeth. As hard as it was to understand Katie before the surgery, afterward it was almost impossible. Alesia and Robb interpreted for her, but even they sometimes guessed. The problem with her palate gave her voice a strong nasal timbre. When Katie heard a recording, she said, “I sound like a frog.”

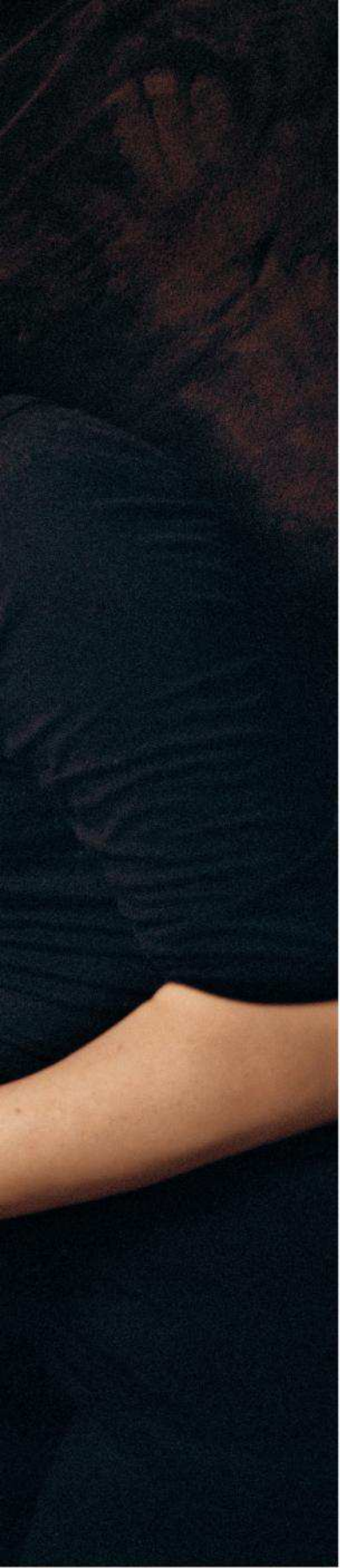
Almost 100 percent of her native facial musculature was gone, replaced by the donor’s, and she had to exercise those muscles without being able to feel them moving. Her nerves, which Gastman said would grow at about an inch a month and eventually provide sensation and motor control, would take at least a year to regenerate. Something as simple and automatic as keeping her mouth closed when she wasn’t talking or eating didn’t happen naturally; others had to remind her, and then she had to push up under her chin with a finger. Smiling or puckering her lips took major effort without much result.

Even as Katie learned Braille and got training at the Cleveland Sight Center, the Stubblefields refused to give up hope that she would see again. They pointed to research at the University of Pittsburgh Medical Center, where a team funded by the Defense Department hopes to perform whole-eye transplants within 10 years. The Stubblefields were excited by one prediction the head of the research team made: Patients with face transplants will likely be the first eye recipients.

THEY SAW THE DONOR’S FACE every day, but she remained a mystery to the Stubblefields. They knew her age, but they didn’t know her name, or how she died, or how she lived. Katie thought about her and her family often.

She was the third donor found in the time Katie waited for a face. Twice a donor had been identified and the clinic had alerted the Stubblefields. Twice the donors hadn’t worked out. For patients waiting for an internal organ, the only match requirements are compatible size,





blood type, and, for some organs, tissue type. With faces, the sex must match, the skin tone must be similar, and the age must be reasonably close. That, along with the need to find a donor fairly nearby, means the pool is much smaller. Katie's youth made it even smaller.

More than 120,000 people in the U.S. await organs of all kinds, but they're in short supply. On average, 20 patients die each day while waiting. Faces were added to the list of organs in the national transplant system in 2014; the wait is unpredictable. The pool of candidates is very small, and the family of the potential donor must give permission to use the face, even if the person had registered as an organ donor.

Katie's doctors had said it was likely the donor would be someone who died from a drug overdose, given the opioid epidemic that has hit Ohio particularly hard. Nationwide, the epidemic has led to an increase in the number of available organs: A recent study found that the number of donors who died from drug overdoses jumped more than tenfold from 2000 to 2016. As it turned out, Katie's donor did die of an overdose, but opioids didn't kill her; cocaine did.

Lifebanc, the organ procurement organization for the region, keeps information about donors and recipients confidential, even from one another. If one side writes a letter to make contact with the other, Lifebanc will deliver it. The other side can choose whether to respond. Once they establish a connection, both must agree to meet.

Through their letters, the Stubblefields learned that Katie had the face of Adrea Schneider and that her grandmother, Sandra Bennington, was eager to meet them. On a Sunday morning in January, Katie and her parents met Sandra for the first time. Sandra was nervous, which she told herself was silly. She arrived, pulling the tank of oxygen she needs for her pulmonary disease, and walked slowly into the living room where Katie waited alone on the sofa. Katie felt nervous too. She had put on a new dress and wore stylish sunglasses covering her eyes, which still looked damaged.

Sandra had already seen a photo of Katie, taken at the moment she was wheeled out of the transplant surgery, when she looked a lot more like Adrea. The photo triggered something in Sandra. Thinking about Katie and her recovery helped her get over her grief.

Face transplant recipients undergo a

Discover more about Katie's story at ngm.com/face.

DOCUMENTARY

Watch a short film about Katie and her family as they await a donor, endure a 31-hour surgery, and prepare for an arduous recovery.

INTERACTIVE

Explore a multimedia look at Katie's transplant.

BEHIND THE SCENES

Learn how a veteran *National Geographic* photographer covered this story for two years.

8 months, 23 days after Katie's transplant

Determined to help Katie live a life as normal and valuable as possible, Robb and Alesia put their own lives on hold for more than four years. Pushing through exhaustion, relying on their faith in God, they accompany their daughter to endless appointments and therapy sessions. They're already looking into ways to improve Katie's vision, including the possibility of eye transplants. They expect to remain in Cleveland near the clinic and Katie's doctors for the near future.

MAGGIE STEBER

metamorphosis as they heal and the face adapts to their facial structure. The new face becomes a matrix, as Papay put it, not one or the other but a composite. Katie no longer looked like Adrea.

Sandra sat next to Katie and held her hand. “It’s so good to meet you,” she said. “You look beautiful.” Katie said, “Thank you so much for the incredible gift that you gave us.” Sandra leaned in, not quite understanding Katie, and Alesia repeated it for her.

Adrea was a registered organ donor, but when the family support liaison from Lifebanc asked about Adrea’s face, Sandra wasn’t sure what to do at first. “I just suddenly realized that, well, why not a face?” she told Katie and her parents. “Adrea wanted someone to have her other organs. Why not her face too? So that was my answer. I’m very thankful that I did that.”

Robb and Alesia joined them on the sofa, and Sandra told them a little about Adrea. She didn’t tell them about how hard Adrea’s life had been, from the moment she was born, with drugs in her system, to her addicted mother. She didn’t tell them that she’d raised Adrea since she was four years old and adopted her at 11, or that Adrea’s mother had died when she was just 13.

Instead she told them that Adrea loved horses and dogs and children. She told them about Adrea’s son, who was 15 when she died. He did not know about the face transplant, she said. She didn’t know how to tell him that someone else had his mother’s face.

When Sandra saw how protective Alesia and Robb were of Katie, she thought about Adrea, who had her struggles but also was a good person. She thought that if Adrea knew Katie, she would be thrilled she’d helped her. But at the same time—and this always made Sandra cry when she thought it—Adrea would wish she could be Katie, so she could have loving parents and siblings.

Sandra touched Katie’s face. “You look so cute,” she told her. She looked closer. She could see a little of Adrea, in her dimpled chin and her nose, just as Alesia said she could catch a little Katie every now and then when she smiled.

Sandra wanted to tell Katie she could call her Amma, for grandma, just as Adrea had. But she didn’t. She looked at Adrea’s mouth, now Katie’s. She looked at her lips. She saw they were chapped, and she wanted so much to tend to them.

KATIE WILL LIVE the rest of her life as an experiment in the longevity of transplanted faces. Medical advances come quickly, and even her doctors can’t predict what her future holds.

Siemionow, with \$2.8 million in funding from the military, is researching an alternative to immunosuppressive drugs. She is hoping to find what many scientists call the holy grail—a chimeric cell, part donor and part recipient, that will encourage the immune system to accept new tissue as its own and make antirejection drugs unnecessary.

Fourteen months after the transplant, Katie’s doctors had completed the three major revision surgeries. They are also likely to slim her face, reduce scarring, and improve her eyelids.

Papay said he’s pleased with how Katie has adapted so far to her new face, and with the quality of her new skin. “I’m extremely happy that she has not had any rejections,” he told me. “But I’m not happy with her orbits. We’d hoped she’d have better vision. And aesthetically we could do better on how her eyes are positioned.”

Gastman agreed with Papay. “We all like her nose; her lips are pretty,” he told me. “There are things we know are going to get better when we fix them, like the jaw reduction. But some things we can only do so much to improve upon. Her injury may have been the worst injury of any face transplant injury ever. We can’t necessarily make all of her muscles move again. Her tongue is not working well because she lost a lot of tongue muscle and nerves.”

Katie intends to pick up where she left off, starting with college, online at first, and then maybe a career in counseling. “So many people have helped me; now I want to help other people,” she said. She hopes to speak to teenagers about suicide and the value of life.

For now, she’s focused on her recovery.

“I’m not on the other side,” she said recently to her mother.

“Oh, baby,” Alesia replied. “Your story is not over yet.” □

Joanna Connors is a reporter for the Cleveland *Plain Dealer* and the author of *I Will Find You: A Reporter Investigates the Life of the Man Who Raped Her*. *National Geographic* named photographer **Maggie Steber**, a regular contributor, a Woman of Vision for her work on humanitarian, cultural, and social stories. Photographer **Lynn Johnson**, also a regular contributor, has documented the human condition globally for 35 years.

Organ Donation

Ultimate Gifts

ADREA SCHNEIDER'S ORGANS AND TISSUES have helped at least seven people. From halting infections to curing blindness, a single donor can save or improve more than 70 lives. Enroll to donate organs, eyes, and tissues at RegisterMe.org and marrow at BeTheMatch.org. To donate a kidney or part of a liver or other organ while alive, contact a transplant center.

Organs

Transplants can help the afflicted return to normal life. Organs that pump blood, filter waste, and perform other crucial functions can be replaced when they're diseased.

1981 *First U.S. transplant*

Lung*
2,478 Transplants in 2017
1,518 Wait list (June 2018)

1968

Heart
3,273
4,047

1967

Liver*
8,082
13,910

1954

Kidney*
20,639
96,670

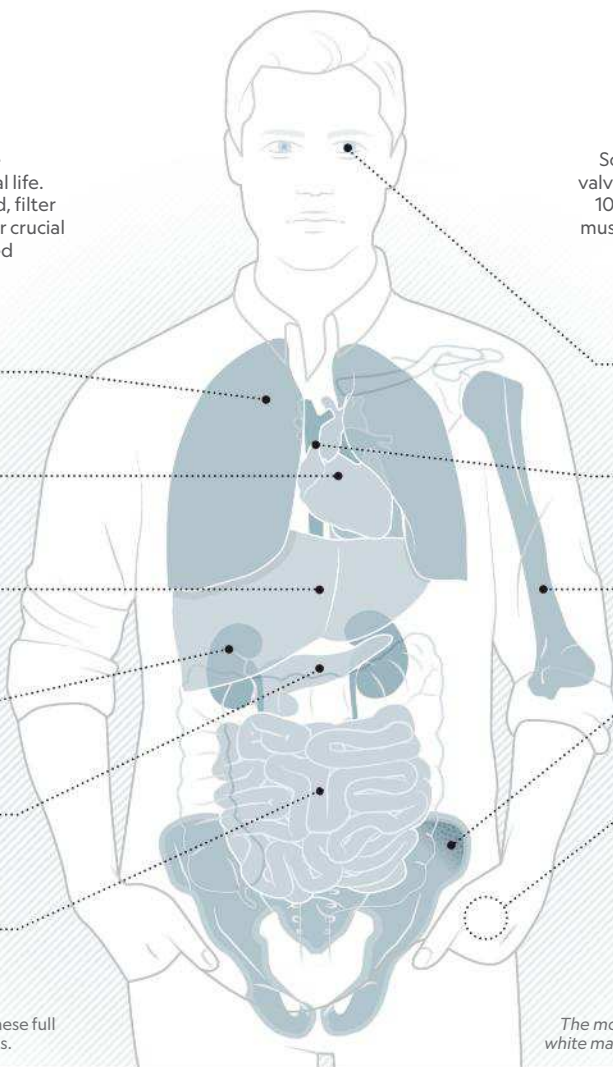
1968

Pancreas*
1,002
2,524

1987

Small intestine
109
249

*Living people can donate these full or partial organs and tissues.



Tissues

Some tissues, such as heart valves, can be stored for up to 10 years. Composite tissues must be transplanted quickly. Lack of oxygen renders them unusable.

Cornea

Eye layer is easily transplanted and can cure blindness.

Heart valve

Can save the lives of children born with heart defects.

Bone

Used to save limbs damaged by trauma or disease.

Bone marrow*

Closely matched blood stem cells can cure cancer patients.

Composite tissues

Advances in immunosuppressive drugs and microsurgery have made more complex transplants—of hands, faces, scalps, and sex organs—possible.

The most common organ donor is a white male, 18 to 34 years old (shown).

Suicide Prevention

Finding Help

Watch an interactive of Katie talking about life before her injury and how she hopes to use her experience to reach out to other young people at ngm.com/face.

AFTER SURVIVING HER SUICIDE ATTEMPT, Katie Stubblefield hopes to help people who are struggling. For Americans her age, suicide is the second leading cause of death, and the overall rate increased 28 percent from 1999 to 2016. “Whatever is going on in your life, I would say that it’s only temporary,” Katie says. “And no matter what it is, there’s always someone you can talk to.” In addition to local and state crisis hot lines, the National Suicide Prevention Lifeline offers 24/7, free, confidential assistance at 1-800-273-TALK (8255).

Multiple factors can play a role in a suicide, including mental health. These are the most commonly reported.

Relationship problem	42%
Past or near-future crisis	29%
Problematic substance use	28%
Physical health	22%
Financial problem	16%

What it means to have a new face

Katie Stubblefield has joined what Shaun Fiddler, the Cleveland Clinic's second face transplant recipient, good-naturedly calls "an elite group." They share a history of trauma, highs and lows, painful encounters in public, and acceptance of a face that will never look as good or work as well as their first one. Three people with new faces talk about those challenges.

INTERVIEWS BY **MARTIN SCHOELLER** AND **JOANNA CONNORS**
PHOTOGRAPHS BY **MARTIN SCHOELLER**

Connie Culp



In December 2008 Culp became the first face transplant recipient in the United States and the fourth in the world. She was 41 when her husband shot her, in 2004. She lost her nose, cheeks, the roof of her mouth, and an eye. Only her upper eyelids, forehead, lower lip, and chin remained. She got a new face at the Cleveland Clinic after having 30 reconstructive surgeries.

CLEVELAND CLINIC

What was life like for you before surgery?

I didn't have a nose, so they made a prosthetic nose for me, and I had to glue it on. It's a funny story because once when I was in a restaurant, I had all the glue disappear, from the heat of my coffee, so it's sort of hanging, and I got so mad. I was with my twin sister. I ripped it off my face, and I forgot that the waitress saw me with a nose and then when she came back, I didn't have a nose. And oh my God, you should've seen how white she turned. I mean, it was funny.

What made you take the risks that come with a transplant?

I really didn't think I had a choice, because I couldn't eat. I had to eat everything with a straw. My older sister was really down on me. She said, "You could die. You could get cancer." I said, "I don't care at this point."

How do you feel now?

I still have some pain, but I feel good. I never dreamed I'd live as good as I do, because I was in really bad shape. I didn't have a nose or anything. I just had to hide my face a lot.

What does a face mean to you?

Since I was shot, I can't really see. So the main thing for me is being able to talk, being able to chew my food without help, and just to smile if I'm happy. I was told that you can make anybody smile if you smile at them first, you know?



‘It’s a tough row to hoe, that’s for sure.’

Shaun Fiddler

In 2011, when he was 43, Fiddler crashed his truck into a tree, breaking many bones in his face. Following surgery, he developed a condition that ate away at his tissue, destroying much of his face and his right eye. After he went to the Cleveland Clinic, doctors in November 2014 replaced about 70 percent of his face. He still awaits surgery that might improve the vision in his left eye.

Watch videos of face transplant recipients talking about how living with a new face has changed their lives at ngm.com/face.

You didn’t have any choice but to have a face transplant, did you? Well, when it came down to it—blind and no face or a chance at vision and a face—do the math. If I wanted any quality of life, to have a chance to save the sight in my left eye, to see my grandchildren’s faces and watch them open presents, I had to do this.

How do you feel about the way it turned out? It’s all right. At least I’m living. I saved my eye by getting a transplant, because my other face was rotting off of me. The plastic surgeons got a hold of me and basically kept me from dying. So, got to be somewhat grateful for that.

Are there things you really miss doing? Yeah. I can’t ride my Harley. That’s killing me!

What would you tell people who are thinking about having a face transplant? It’s not going to be easy. It’s going to be scary as hell. But you got the best of the best working on you: technology and the things they can do.

How did you deal with the fear? You live through it, you’re going to be able to hug your loved ones, you’re going to be able to hold your grandbabies, and what you give up is nothing compared to what you gain, when it comes right down to it. The rubber meets the road; you’re still sucking air. Love every minute of it.

That was a good closing statement. Biker philosopher, I guess.





'You don't know if you're going to live or die.'

Richard Norris



While mishandling a shotgun, Norris says, he accidentally shot himself in 1997. He was 22. In a 36-hour operation in 2012, a team led by Eduardo Rodriguez at the University of Maryland Medical Center gave him a nose, lips, a tongue, teeth, and jaws. He has since moved to the New Orleans area to be close to his girlfriend. They met when she wrote to him on Facebook after seeing him on television.

EDUARDO RODRIGUEZ

What was it like to live with a disfigured face?

It was a tough time, really tough. You go out in public, and people are staring. They say really cruel things, stuff that really hurts you. It got to a point where I'd only go out at nighttime and only go to places where I knew the person who worked there, so I wouldn't get harassed.

Why did you decide to have a transplant?

The face transplant is not a first option. It's not a second option. It's the very last option. After years of surgeries, my doctor approached me about the possibility of a face transplant. I went home and spoke to my family. It really wasn't a discussion of "What do you all think?" It was a discussion of "I'm going to do this."

What do you know about your donor?

He's a great guy. He really was. He wanted to become a police officer. He had a tragic accident. Now I'm friends with his sisters. I'm friends with his mom and dad, and I stay in contact with them. Absolutely lovely people. Greatest people in the world. People say to me, "You know you're a hero, taking the risk you did." I'm not the hero. They are.

When you look in the mirror, what do you think and who do you see?

I see myself, but I'm also reminded that I'm not there. So every day I look at the mirror, I do see myself. I don't have an identity crisis like some psychologists think that you might have. I don't have that problem. But it's also a daily reminder of the sacrifices the family of a young man gave just so I could have a life again.



By PAUL SALOPEK

Photographs by MATTHIEU PALEY

Passage to Another Time

A HARROWING, INSPIRING WALK
REVEALS AN AFGHANISTAN
AT PEACE—AND A REMINDER
OF TODAY'S TENSIONS.







PREVIOUS PHOTO

Contending with snow, cold, and a tired donkey, Paul Salopek takes his last steps in Afghanistan's Wakhan corridor as he and photographer Matthieu Paley navigate the Irshad Pass into Pakistan. The ascent was supposed to take three hours, but it ended up taking nine. At the top of the pass, the clouds cleared as the sun set. "I was struck, despite exhaustion, by the light," Salopek says. "It was the sort of light you associate with birth—light you are born into."

LEFT

In the Wakhan corridor, Sidel (left), Jumagul (center), and Assan Khan (right) return on their yaks after monitoring the growth of grasses at lower elevations. Herds will be kept off that pasture so the grasses can be harvested, dried, and used by the Wakhi people for animal fodder in the winter months.

Out of Eden Walk

PART SEVEN

Her hair was dyed purple. She wore spandex.

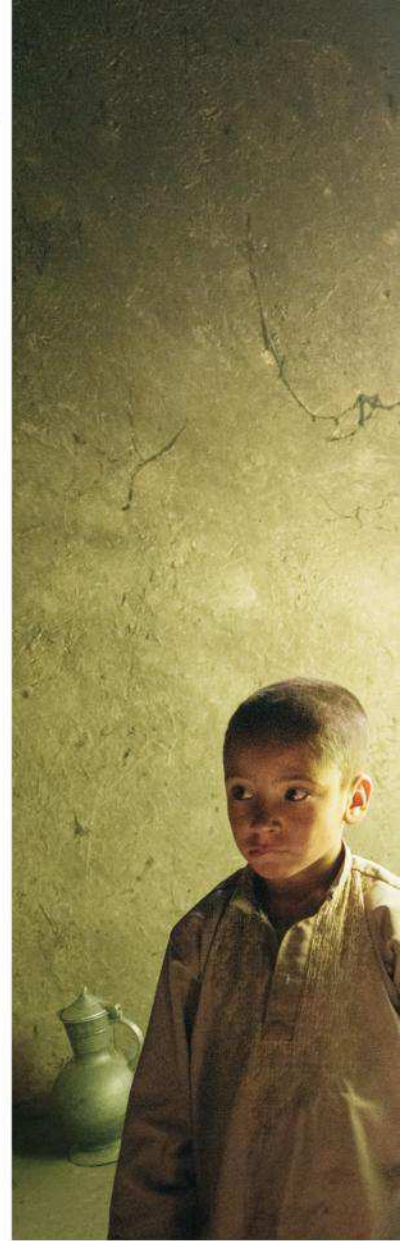
She was dancing alone, the young foreigner, swaying barefoot on the roof of a car parked at an utterly remote frontier in the rocky core of Asia, hard beside the Panj River that sees Tajikistan from Afghanistan—a notorious opium smugglers' paradise at the southern edge of the Pamir mountains. The car had EU plates. But who was she? A belated pilgrim on the old hippie trail? A mystic? An addict? A tourist? An adventurer? It was impossible to know.

I raised my sweat-pickled hat in greeting as I shuffled past, chivying a tired cargo donkey, wind-chapped, and hollow-bellied from camping more than a month among the crags of Central Asia. I am walking across the world. For five years I have been pacing off the Earth as part of a project called the Out of Eden Walk, a storytelling pilgrimage along the pathways of the first ancestors who explored the planet during the Stone Age. To walk in this way—continuously, day after river, month after continent, over a route that eventually will span 21,000 miles—is to inhabit a state of daily wonderment. So the wilderness dancer was not really a surprise. Nor did I startle her. She didn't see me. Lost in the techno beats punching out of her car's stereo, she never even opened her eyes.

"She makes me feel old," complained photographer Matthieu Paley after we had trudged by on the dirt road built by the Soviets.

Paley was voluble and earthy, a French Zorba. He was joining me for a rare foot crossing of

Paul Salopek's foot traverse of the Central Asian highlands is unprecedented by outsiders in recent history. Follow his global storytelling trek online at OutofEdenWalk.org and on Twitter (@PaulSalopek).



In the village of Qalah-ye Panjah, children gather early in the morning on the Muslim high holiday of Eid al-Adha, the Feast of Sacrifice. They're eagerly waiting to share in the meat of a sacrificed sheep. The Wakhi rarely eat meat, having no way to keep it fresh.



Afghanistan's Wakhan corridor, a forgotten redoubt tucked high behind the mountain walls of the Hindu Kush. In the mornings he performed yoga on the road to soothe a tricky back. Expanded font settings on my laptop were my own concessions to middle age. But I didn't feel old. Not at all. Walking the Earth makes you a child again. By the time I eventually reach Tierra del Fuego, my destination six or seven years away, I will be newborn.

I glanced back.

Paley was doing a Wakhi dance now—padding his arms and shimmying his hips along the desolate banks of the Panj. Across the glacial currents in Afghanistan, a few delighted Wakhi shepherds in dirt-brown *shalwar kameezes*

gathered to mimic his moves. Everyone dances in Afghanistan. During the war, in the early 2000s, I had danced into Kabul with a column of Northern Alliance troops, two-stepping behind a T-55 tank to avoid land mines: a combat conga line. I remember how one fighter broke ranks to pillage a farmhouse. A booby trap blew off his feet with a dull pop. This was a long time ago. It was before I began truly to walk, back when I was a million or more years old.

The Wakhan corridor of Afghanistan is one of the remotest inhabited landscapes on Earth. An extension of Badakhshan Province, it juts some 200 miles between Tajikistan and Pakistan to touch the ice-capped

ramparts of western China. Drawn by Russia and Britain as a buffer zone to separate their Asian empires in the 19th century, the corridor—marooned by rugged geography, geopolitics, and time—endures as a forgotten appendage of Afghanistan. About 17,000 farmers and nomads still live in its medieval pastures and rock-walled hamlets. It was my exit ramp to South Asia.

We crossed the Tajikistan border at Ishkashim. Sixteen years had elapsed since I had trodden Afghanistan's dust as a war correspondent. It wasn't the land I remembered.

My Afghan memories cartwheeled among armed men in Hilux pickup trucks and the concussions of 500-pound bombs dropped by American B-52s. Walking through the war, I had stepped unconsciously around the domes of silence that always encased the newly dead. By contrast, the Wakhan corridor—poor, utterly isolated, and shielded from violence by the Hindu Kush—seemed an oasis of peace. We hiked unafraid through fields of ripe wheat where men drove teams of oxen in circles, threshing sheaves in biblical fashion. Antique waterwheels milled their flour. The local Wakhi farmers were easygoing Ismailis, and the women went about unveiled. The farmers stacked the magnificent horns of wild Marco Polo sheep at sacred springs. Snow leopards, not militants, patrolled the snow peaks. Nobody carried guns. It was rural Afghanistan as it should be.

"We're in our glory times," said Dervish Ali, a shepherd whose homestead clung like a swallow's nest to a steep riverbank. "In the 1990s we couldn't even afford tea. Now life is good."

Ali's friendly wife, Kushnamamash, baked us hot, gritty naan—flatbread. We pitched our tents on the couple's narrow grass terrace. Ranks of poplars rustled in a silver breeze. The austere Wakhan was experiencing a green revolution. Tree plantations were shading the once naked canyon bottoms, and some Wakhi were tasting their first homegrown tomatoes and squash. It was the changing climate. Apricots were blossoming two months early, and a sudden tide of glacier melt was making irrigation easier.

It won't last, of course. Someday the glaciers of the Hindu Kush and Pamirs will drain away, and the old hungers will return. But for those shining days on foot, the roadless valleys of the Wakhan felt like a place I'd been walking toward my entire life without knowing it. Slate river shingle rang underfoot like coins. Crows

pinwheeled in seamless blue skies. In September the high pastures of the Kyrgyz nomads in the eastern Wakhan held the sun's fire like old amber. Boulders the size of houses shone like colossal mirrors on the barren mountain slopes: Their surfaces had been buffed smooth as glass by long-vanished walls of ice.

Ice ages come in cycles. The next one will shove the rubble of our cities down to lower latitudes. The ice ages will wipe out all evidence of Ali's frail woodlot and easily smear away the deep tank tracks the Soviets left in the Wakhan pastures almost 40 years ago. The ruts look brand-new. And eventually another Wakhi will appear to thresh, to prod his oxen over cut wheat—3,600 rotations, by my calculation, for each disk of bread. It's all a circle.

My walk is a circle, albeit one with the radius of the world.

On the morning of September 23, in a coarse ice mist, we set out with two pack donkeys to climb Irshad Pass, a high and desolate gateway close to where the Hindu Kush meets the Karakoram Range, dividing Afghanistan from Pakistan.


Climbing a mountain under such conditions is a strange and disorienting experience. It was like scaling a frozen and crazily tilted sea. Wind-blown ridges rippled the surface of the snow. We punched toeholds into the diamond waves with our ridiculous summer shoes. We tottered along ice-rimed cliffs. Snow hid fatal crevices. Sometimes the donkeys fell through the crust and refused to get up. We reached under their steaming bellies and lifted the animals to their feet. This exhausting ritual happened again and again. We were often lost.

By midday a blizzard was in full gust.

"Hello, Arthur, can you do me a favor?"

Paley was shouting into the satellite phone. We couldn't see a hundred steps ahead, much less the peaks far above. Paley's brother in Paris googled and read out to us the GPS coordinates for Irshad.

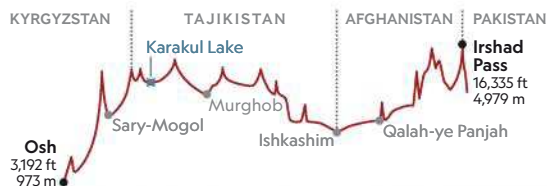
Irshad Pass rises 16,335 feet above sea level. We finally reached it at sunset. Paley ventured a feeble victory dance. I gulped air so thin and metallic it cut my lungs like razor blades. Gales had scoured the summit to raw bedrock. Without

 The nonprofit National Geographic Society, working to conserve Earth's wild places, helped fund this story.



THROUGH THE EASTERN 'STANS

Paul Salopek's 21,000-mile Out of Eden Walk traces human migrations from East Africa to the southern tip of South America. This section weaves through Kyrgyzstan, Tajikistan, Afghanistan, and Pakistan.



Route elevation profile
Distance from Osh to the Irshad Pass: 620 miles



shelter or firewood, it was a hazardous place to camp. But we had little choice. A bitter dark was rising fast from the deep valleys. We unpacked our donkeys with difficulty—the ropes were stiff as rebar—and pounded our tent stakes into iron-cold earth. My frozen pants never thawed, not even inside my sleeping bag. I staggered out into the howling night only once, to wrap the donkeys in fluttering tarps. The animals' black eyes shone back accusingly in the white bore of my headlamp. I couldn't look at them.

Plainclothes Pakistani security forces confronted us the next night while we camped at the eastern end of the Hindu Kush. We had notified the government of our plan to enter Pakistan via Irshad. We carried valid visas issued in advance. But the officers, armed with AK-47s, insisted we had trespassed into a restricted zone. They drove us to the frontier town of Gilgit. In detention there, I overheard Paley, curled on his cot, parroting in his emphatic Norman accent the lines from a film playing on his hidden mobile phone: "An eye for an eye only ends up making zee whole world blind."

"Matthieu," I whispered, "are you watching *Gandhi* in an intelligence agency safe house?"

The next afternoon plainclothes agents escorted us onto the first flight out of Pakistan. Later it all would be declared a mix-up. A confusion of paperwork. I would be allowed back into Pakistan within days to resume my disrupted global walk. But on the night we landed in exile in a steaming Arabian city—I still wore my filthy snow pants—I felt numb. Standing dazed in the noisy airport immigration queue, I stared at the backs of my sun-blackened hands. And I recalled dusk atop Irshad Pass.

A pale disk of sun had slipped beneath a chink in the storm clouds. For perhaps two minutes everything gleamed with electrum light. Silver-gold shafts sprayed the Karakoram, igniting the tops of the snow pyramids that stretched in serried ranks to the edges of the world. It was the sort of light that burned away the loss in my heart. It was light through which I could imagine walking, with all my people, into the promise of new country. □

Paul Salopek won two Pulitzer Prizes for his journalism while a foreign correspondent with the *Chicago Tribune*. Photographs of the Wakhan corridor by **Matthieu Paley**, who's been exploring the region since 1999, last appeared in the February 2013 issue.



Omina Begum rests in a hut on the roof of her house in Wuch Urgunt. The temporary structure, made of branches, leaves, and grasses, is called a *kapa*. In summer months it provides shade during the day and more comfortable sleeping at night.



Aziz Begum, nine, adjusts her scarf after Paley photographed her and her brothers. The Wakhi adhere to the moderate Ismaili branch of Islam, which doesn't require women to wear veils. But head scarves are part of the usual dress.





In Qalah-ye Ust, Bibi Hawa minds the fires as she prepares milk tea, stirred with a chunk of salt to add flavor. Pots of water—used for cooking, drinking, or washing up—stay on the boil over traditional ovens throughout the day in Wakhi kitchens. The Wakhi invariably extend hospitality to visitors and anyone passing through their villages.

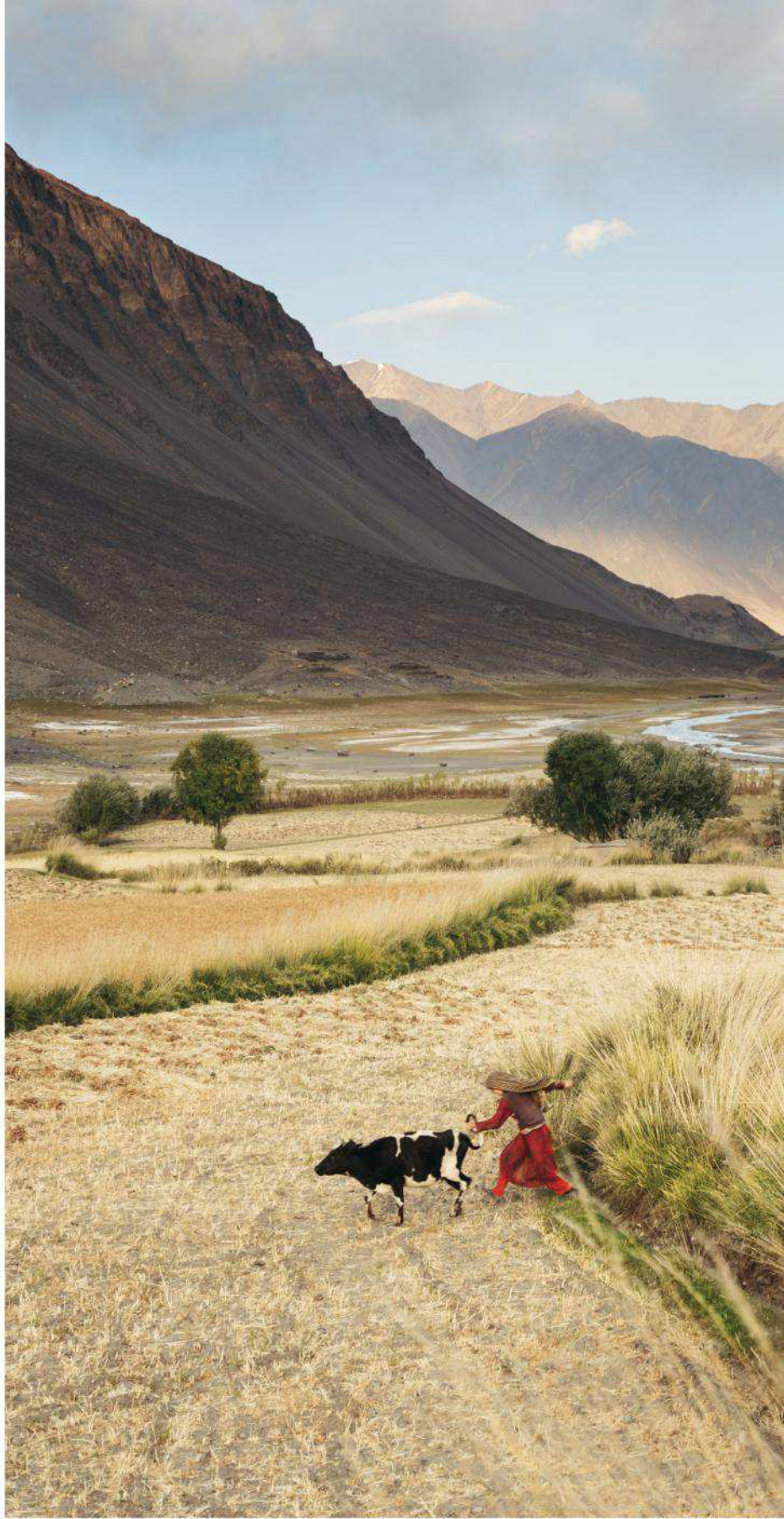


Kosim Mohammed and his son, Ato, have just taken a bath at the hot springs above the village of Shirk. Most homes in the Wakhan corridor lack running water, so having a year-round source of hot water for bathing and laundry is a luxury.



In the village of Wuch Urgunt, Bibi Bejod holds her son, Javed. The roughly 70,000 Wakhi live in the mountains that tower over Afghanistan, Tajikistan, Pakistan, and China. Their Indo-European language, also called Wakhi, is related to Farsi, spoken by Iranians.

Near the eastern end of the inhabited Wakhan corridor, where roads dwindle to footpaths, a girl twists the tail of the family cow to hurry it toward their home in the village of Nishtkhowr. The distant mountain walls, sunlit in the late afternoon, are where Salopek is headed on his unique storytelling odyssey across the Earth.





POACHED FOR ITS HORN, THIS RARE BIRD STRUGGLES



TO SURVIVE

By **RACHAEL BALE**
Photographs by **TIM LAMAN**



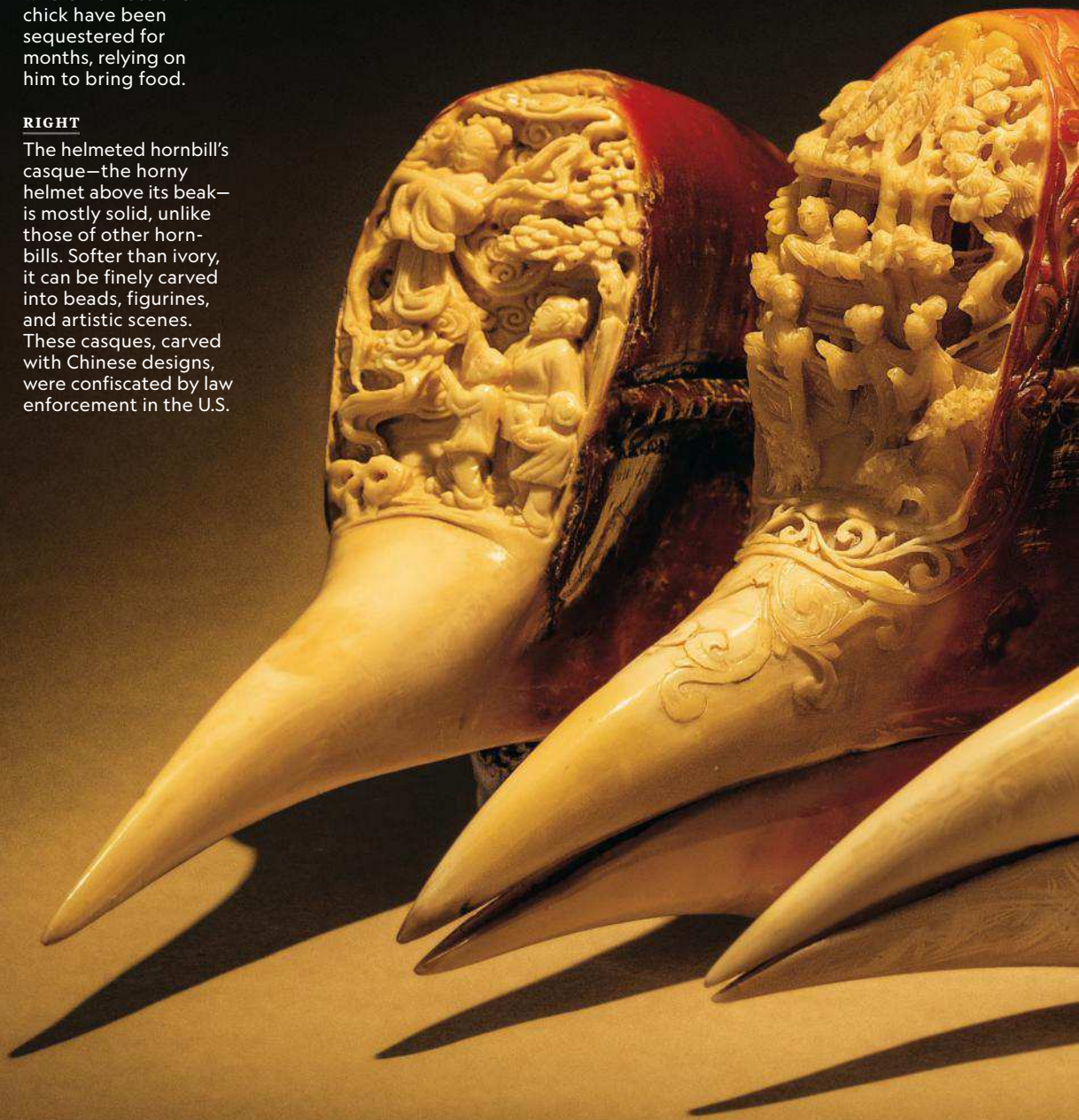
Helmeted hornbills are being targeted by the illegal wildlife trade, threatening the unusual bird as its forest habitats in Southeast Asia decline.

PREVIOUS PHOTO

In a forest in southern Thailand, a male helmeted hornbill approaches a tree where his mate and chick have been sequestered for months, relying on him to bring food.

RIGHT

The helmeted hornbill's casque—the horny helmet above its beak—is mostly solid, unlike those of other hornbills. Softer than ivory, it can be finely carved into beads, figurines, and artistic scenes. These casques, carved with Chinese designs, were confiscated by law enforcement in the U.S.





I have come to
this steaming
forest to
find a bird.
I'm starting to
wonder if
it's worth it.

The terrain in Budo-Su-ngai Padi National Park in southern Thailand is so steep in places that you can reach out and touch the path in front of you. With each step on the rain-drenched ground, you risk sliding back down. Insects buzz in nose and ears, and if you stop long enough to look around, you'll see an army of land leeches inching their wormy, blood-hungry little bodies toward you.

The bird my fellow trekkers and I are after is the ancient, bizarre-looking, and now increasingly rare helmeted hornbill. The leader of our group is Pilai Poonswad, a Thai scientist known as the “great mother of hornbills.” She’s been studying the birds, and working to protect them, since 1978. Photographer Tim Laman is with us, as are a videographer, several members of Pilai’s team, and some people from the village at the bottom of the mountain who are carrying

This male is about to give a meal of forest fruit to his nesting family. Helmeted hornbills regurgitate and defecate tree seeds, helping to replenish wide swaths of forest, where commercial logging and clearing for oil palm threaten their habitat.

supplies and will help set up our camp. We knew it would be a slog—these birds are shy to begin with, but the growing rate of decline makes finding them something of an odyssey.

When we finally reach the tree we’ve been aiming for, we hole up in a blind about 130 feet away made of camouflage fabric and bunches of branches. The tree is a dipterocarp, a tropical hardwood, maybe 180 feet tall, that towers above most others in the forest. Jutting from its side a little more than halfway up is a gnarled cavity in which a female hornbill had sealed herself a few months earlier to lay an egg. From our spot on the ground we can’t see in, but we know it’s only a matter of time before papa hornbill swoops in to deliver a meal.

Hours tick by as we wait, occasionally whispering but mostly daydreaming away the giant





forest ants (up to an inch long with intimidating but, I was assured, harmless pincers), those resolute leeches, and the unforgiving plywood we've turned into a bench. At one point a spider the size of my thumbnail drops down in front of me, clinging to its line of silk. We stare at each other for a while before it jumps at my face—a narrow miss. The sun's still making its way upward, but already the humidity has wrapped me in a wet, clinging hug.

I'm not a bird-watcher, but this must be bird-watching at its most dedicated.

My reverie is broken by a rush of air overhead—*Whoosh-whoosh-whoosh!* The gaps between

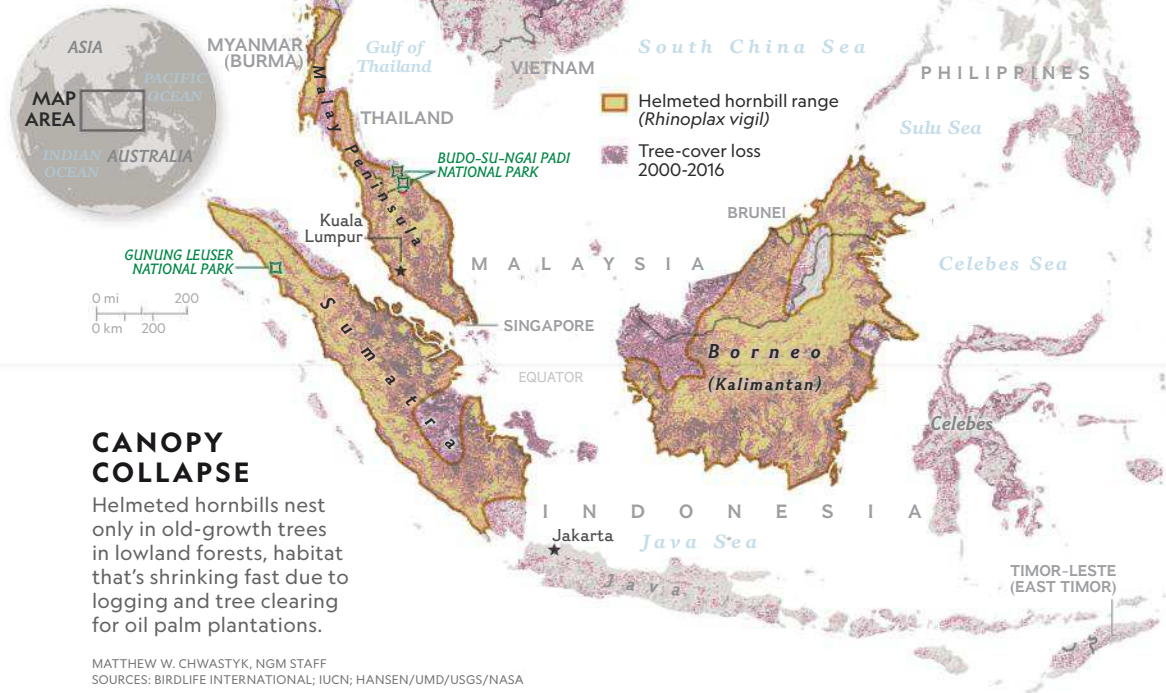
feathers in their wings make hornbills some of the noisiest fliers around.

Hoo. Hoo. Hoo-hoo-hoo, Hahahaha! It's the maniacal laughter of a helmeted hornbill. By the sound of it, this one is only a few trees away. We hold our breath. And suddenly, there it is: A living dinosaur, some four feet long (not counting its foot-long central tail feathers), perched on the protruding knot, a large stick insect dangling from its mouth, its beady eyes observing the surroundings.

Everything around me hushes. The itchy heat is gone, the stomach-churning throbbing in my ankle (sprained a few days earlier back home in Washington, D.C.) ceases. There are no more bugs, no more cicadas screaming.

We stare at that massive head, heavy with its red "helmet"—or casque—atop a wedge of

This article was produced in collaboration with the **Cornell Lab of Ornithology** and is part of a multimedia effort to raise international awareness about the plight of the helmeted hornbill.



CANOPY COLLAPSE

Helmeted hornbills nest only in old-growth trees in lowland forests, habitat that's shrinking fast due to logging and tree clearing for oil palm plantations.

MATTHEW W. CHWASTYK, NGM STAFF
SOURCES: BIRDLIFE INTERNATIONAL; IUCN; HANSEN/UMD/USGS/NASA

yellow beak. We take in the featherless, wrinkled red neck, the long black-and-white banded tail feathers, the sheer heft of the bird. It's an otherworldly vision—like seeing the Grand Canyon for the first time. Nothing prepares you for the overwhelming sense of wonder you feel when you peer over the rim.

The hornbill bends over the nest cavity and passes off the stick insect to his chick through the opening. Mission accomplished, and with another whoosh of those wings, he's gone—off no doubt to search for more food for his family.

THE HELMETED HORNBILL, one of 57 hornbill species in Africa and Asia, is found only in the lowland forests of Brunei, Indonesia, Malaysia, Myanmar, and southern Thailand. Helmeted hornbills stand apart from the other hornbills because their casques are mostly solid with a thick layer of keratin, the same material as fingernails, hair, and rhino horn. Not much is understood about helmeted hornbill behavior, but they're known to use their casques to joust while in flight, perhaps in competition for nesting sites or fruit trees.

The birds are omnivorous but favor the fruit of strangler figs, which start as a seed in the canopy of a host tree and send roots downward, slowly encasing and killing the tree. Strangler figs, when fruiting, serve as the rain forest's grocery store for the menagerie that feasts on the ripe fruit—from tree shrews, giant squirrels, gibbons, and

orangutans to nearly a thousand species of birds.

Hornbills are vital to the survival of Southeast Asia's forests. As "farmers of the forest," they disperse seeds by regurgitating or defecating them, helping to replenish trees over several square miles. It's an especially important task now, given how much primary forest has been cleared by commercial enterprises. Widespread logging also is reducing habitat for Asian hornbill species and threatening their ability to nest.

Helmeted hornbills are especially picky, requiring huge trees with a hollow cavity to nest in. Those happen to be the oldest and biggest in the forest—and are therefore highly valued by loggers. The birds are slow to reproduce, breeding once a year and raising only one chick. Because the mother and the chick live sealed inside the nest cavity for some five months until the youngster is ready to fledge, they depend on the male to feed them. If the male is killed—shot by poachers for his casque, for example—the rest of the family will likely die.

Softer than ivory and easily carved, hornbill casques are in high demand in Asia, to be fashioned into beads, pendants, and intricate works of art. For a subset of China's wealthy class, rare wildlife products such as helmeted hornbill carvings, elephant ivory, and rhinoceros horn

N The nonprofit National Geographic Society helped fund this story. To read more reporting about wildlife crime, visit natgeo.com/wildlife-watch.

RAISING A HORNBILL

After helmeted hornbills carefully select a tree cavity for their nest, the female is sealed inside. Her task: to nurture a chick in confinement for several months while the male provides a steady diet of figs, insects, and small animals.

FEMALE	MALE
Body length: 3.6 ft	4.2 ft
Weight: 5.8 lb	6.7 lb

Figs are stored in the esophagus.

Days NESTING CYCLE

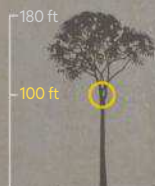
30 ① Before the female is confined, pairs spend a month or more in courtship and mating rituals near their nest.

5 ② The male helps the female seal the tree cavity with regurgitated food, mud, and feces.

5 ③ One or two eggs are laid, but only one chick survives, usually the first to hatch, enabling it to out-compete its sibling.

..... ④ The chick develops air sacs on its back. These are thought to regulate temperature until feathers begin to grow.

..... ⑤ The female breaks the seal and emerges weak and with new feathers. By withholding food and calling to it, the parents coax their chick out.



For their nests, pairs seek cavities high up old-growth trees, with perches or knobs that the male can stand on when delivering a meal to his family.

TIMELINE DAYS ARE APPROXIMATE.

FERNANDO G. BAPTISTA AND EYE CONANT, NGM STAFF; PATRICIA HEALY
SOURCES: WILLIAM MARTHY, WILDLIFE CONSERVATION SOCIETY; YOKYOK HADIPRAKARSA; ALAN KEMP; PILAI POONSWAD, MAHIDOL UNIVERSITY; TIM LAMAN

can be a sign of money, power, and luxury.

Scientists aren't sure exactly how many helmeted hornbills survive, but it's clear from recent research and law enforcement operations that they're in trouble. In 2016 the more than 180 parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the treaty that governs the international trade in wildlife, approved a proposal calling for stronger protections for the birds, which have been illegal to buy and sell internationally since 1975. In acknowledgment of this dangerous level of poaching, their conservation status recently shot up from near threatened to critically endangered, a jump of three levels and only one away from extinct in the wild. In every country where helmeted hornbills are found, they're protected by national laws, but Indonesia has emerged as a poaching hot spot.

Indonesian law enforcement first became aware of large-scale helmeted hornbill trafficking in 2012, when natural resources officers at an airport in West Kalimantan, a province on the island of Borneo, stopped two Chinese women from smuggling 96 casque pieces out of the country. Soon more confiscations followed, with some seizures of casques numbering in the hundreds. The Environmental Investigation Agency, a U.K.-based nonprofit that has been tracking seizures along with the wildlife-trade monitoring organization Traffic, says these seizures likely represent a fraction of the helmeted hornbill casques being traded.

Some thousand miles south of the forest in Thailand where we watched the papa hornbill deliver a meal, there's a storage room in a government office in the Indonesian capital of Jakarta. Behind the door are stuffed tigers and sun bears in varying poses of ferocity, the shell of a sea turtle mounted on the wall, cardboard boxes overflowing with tiger skins and elephant ivory—and suitcases filled with more than 240 neatly stacked helmeted hornbill casques, all seized from wildlife traffickers.

Indonesian authorities have confiscated more than 1,300 helmeted hornbill casques in all, many seized from smugglers linked to organized

RIGHT

A pair inspects a potential nest in a tree in Indonesian Borneo. When a nest is chosen, the female is sealed in for months, incubating the egg, then raising the chick. If poachers kill the male while the female and chick depend on him for food, they'll likely die.

NEXT PHOTO

Helmeted hornbill casques, stuffed tigers, and other wildlife contraband fill a storage room at a government office in Jakarta, Indonesia. Chinese-run criminal syndicates that smuggle tiger parts and pangolins recently diversified into helmeted hornbill casques.

criminal syndicates that traffic in commercial-level quantities of endangered wildlife parts. The government plans to destroy these caches eventually to prevent them from making their way back onto the black market. But in the meantime hornbill researcher Yokyok Hadiprakarsa is visiting stockpiles around the country to measure the casques in order to better understand the physical variations of these birds.

Yokyok is also working to get permission to extract DNA samples, which would allow him to determine whether a casque is from a male or a female. Comparing DNA with casque measurements would shed light on the differences between male and female beaks and casques, something that's never been studied in helmeted hornbills before, he says.

AMONG THE DAYAKS, the non-Muslim indigenous peoples of Borneo, lore has it that the helmeted hornbill was once a man who hated his mother-in-law. His hatred grew and grew until one day, he snapped. Taking his ax, he chopped down the stilts that held up his mother-in-law's home, with her inside. The gods punished the man by changing him into the helmeted hornbill, doomed to relive his crime again and again through his call: The accelerating *hoos* of the helmeted hornbill's call are the sound of the ax hitting the stilts, and the cackling laughter is his glee when the hut comes crashing down.

"When I first heard it, I thought it was a ghost," says one young man who accompanies our team deep into the jungle of West Kalimantan to stake out a fruiting fig tree. We're sitting in the middle of the trail, eating lunch cooked over a portable gas burner. The flies have started in on the rice, and the bees are circling the fish, but no one notices. He says his grandmother used to warn the children that the helmeted hornbill would come in the night and eat little

THE YEAR OF THE BIRD

National Geographic is partnering with the National Audubon Society, BirdLife International, and the Cornell Lab of Ornithology to celebrate the centennial of the Migratory Bird Treaty Act. Watch for more stories, books, and events throughout the year.









RIGHT

A carved casque is on sale at an antique market in Shanghai. It's unclear why the trade recently took off, but since 2010 more than 2,800 helmeted hornbill pieces have been seized in Hong Kong, elsewhere in China, Indonesia, and other countries.





LEFT

A poacher in Indonesian Borneo displays the skin and head of a wreathed hornbill (at right), the skull and casque of a rhinoceros hornbill (top), and the casque and two tail feathers of a helmeted hornbill. The middleman he sells to rejected the helmeted hornbill casque as being too small to carve.

boys' testicles if they didn't behave.

The birds have been important to the Dayaks for at least 2,000 years. Their long tail feathers are still used in headdresses, and their casques were carved into ear pendants and other adornments. By the year 700, trade between Borneo and China was flourishing, and in 1371 helmeted hornbill "ivory" was first recorded as reaching China as a tribute gift from the sultan of Brunei. The Chinese, already skilled in the art of carving elephant ivory, transformed helmeted hornbill casques into belt buckles, buttons, bracelets, snuff boxes, and more. Sometimes intricate scenes were carved into a casque that was still attached to the bird's skull. By the mid-1800s demand had shifted west, and the Chinese imported casques mainly to carve and sell to Europeans.

Today helmeted hornbill carvings are once

again in high demand in China. It's not entirely clear why—their rarity perhaps, or novelty value—but the art pieces are popular among some newly wealthy Chinese. Yokyok was among the first to recognize the growing crisis. He says it came to his attention in 2012, when a friend sent him a photo of several hornbill heads for sale in West Kalimantan.

"It was shocking," he said. "I needed to do something." He launched an investigation, which led him to conclude that some 6,000 helmeted hornbills likely had been killed in 2013 in West Kalimantan alone.

Some helmeted hornbill poachers are opportunistic hunters who will shoot any animal they can eat or sell, says Dwi Adhiasto, who oversees the wildlife crime units of the nonprofit Wildlife Conservation Society's (WCS) Indonesia Program. Others, he says, are supplied by organized criminal networks that provide them with guns and gear for expeditions into the forest specifically to hunt helmeted hornbills.

These networks, he explains, mainly target species with a more established illegal trade—such as tigers and the world's only truly scaly mammal, the pangolin—but they realized they can raise the bottom line by diversifying into helmeted hornbills.

"Tiger fangs, pangolins, and also helmeted hornbill beaks—it's those three that exist in the criminal networks in Asia operated by Chinese," Dwi says. The groups typically are headed by a Chinese kingpin who controls sophisticated transnational trade and money laundering schemes, he says. Networks include poachers, middlemen, smugglers to get the product out of the country, and people to move it within the destination country. Each time the casques change hands, their price goes up. The final customer in China is likely paying more per gram for helmeted hornbill casque than for elephant ivory, according to the Environmental Investigation Agency. The networks take advantage of the reluctance of law enforcement and the judicial system to treat wildlife crime as seriously as other types of organized crime, such as drugs and human trafficking.

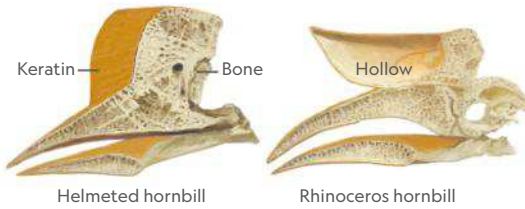
In June 2015 Indonesian authorities arrested two men suspected of smuggling casques in northern Sumatra, an entry point for poachers accessing Gunung Leuser National Park. They were believed to be operating with a team of 30 poachers who hunted inside the park using rifles modified with silencers, according to WCS,

A helmeted hornbill flies over the canopy in southern Thailand. Scientists aren't sure how many are left in the world's forests, but conservation efforts include turning former poachers into nest protectors.



HARDHEADED HORNBILLS

Only helmeted hornbills have mostly solid casques, used for hammering and fighting, as well as to indicate maturity for reproduction.



Hornbills jousting with their casques have been observed in lengthy fights, probably over access to fruit trees, with up to a dozen head-butting collisions.



which assisted in gathering information. The men confessed to selling at least 124 casques over six months to a Chinese middleman, whom they would contact using a disposable cell phone to avoid detection. During the arrest, authorities confiscated 12 casques, two rifles, a digital scale, and two cell phones.

IN BUDO-SU-NGAI PADI NATIONAL PARK, Pilai Poonswad has developed a model program for protecting hornbills. A parasitologist by training, Pilai became fascinated with the birds in 1978, after guiding a BBC film crew to search for them. She was awed by the sight of a hornbill feeding its family in a tree cavity, and soon after, she founded the Hornbill Research Foundation.

In 1995 she met Asae Jaru, a poacher who would steal hornbill chicks to sell into the pet trade. Pilai realized that many others in the man's village, which is in a predominantly Malay Muslim region of Buddhist Thailand, were doing the same thing. A man could make more money selling one or two hornbill chicks than he could in a year of farmwork.

After she learned about the poaching, she came up with a plan. She would pay villagers to protect, rather than poach, hornbills. She began meeting with people in nearby villages, trying to recruit them. "I met them in person and explained to them: 'If you won't stop poaching now, you will have no hornbill,'" she says.

Now, 23 years later, Asae is one of Pilai's most valued assistants. His village has a grove of rubber

trees, where we sit and talk. Little bowls are wired to the thin trunks, scarred by diagonal incisions to make the white, sticky latex drip out. Asae doesn't speak Thai, so we play a version of telephone: Asae addresses one of Pilai's assistants in the local Malay dialect. She translates into Thai for Pilai, then Pilai translates to English for me.

One year, Asae recounted, he stole a chick from the nest of a wreathed hornbill. The next year, he noticed, the hornbill didn't return to that nest. It made him sorry, he says. He wants his children to know hornbills, and he says he's very happy to play a role in their protection. Now he safeguards the nest of a helmeted hornbill pair. If he didn't, he says, people would steal the chick.


By early 2018, 36 people in six villages—many of them former poachers—were participating in the program. They monitor tree cavities for active nests of six hornbill species, and when one's in use, they collect data on the birds' movements, diet, and behavior for the Hornbill Research Foundation. Those like Asae who don't speak or write Thai draw their notes and ask a son or daughter to translate them.

In Indonesia, Yokyok's nonprofit organization, Rangkong Indonesia, is following a similar path, training and paying local assistants in a village in West Kalimantan to monitor and record hornbill data, with the goal of eventually establishing a bird-watching ecotourism program there. And the Indonesian government recently signed off on a 10-year national action plan for the conservation of helmeted hornbills. It includes research and monitoring, increased law enforcement, more partnerships with independent organizations and other governments, public awareness efforts, and funding to support it.

"I put my hopes high," Yokyok says, speaking of the potential to save helmeted hornbills. "In the beginning nobody cared about it. But now—look. It can be done."

Nowhere else in the world, aside from this limited part of Southeast Asia, is there a four-foot-long bird with a solid casque, naked neck, striped tail feathers, and crazed song that sounds like a ghost mocking you. I'm still not much of a bird-watcher, but I can tell you with confidence—that hike was worth it. □

National Geographic wildlife crime reporter **Rachael Bale** wrote about illegal fishing in the South China Sea in March 2017. **Tim Laman's** most recent story was his award-winning feature on orangutan culture in December 2016.

A man with a beard and a black turban stands in the foreground, wearing a dark suit jacket over a blue and white checkered shirt. He is positioned in front of a brick wall adorned with several framed portraits of men in suits. The portraits are arranged in two rows. The man in the foreground has his hands clasped in front of him. The lighting is warm, highlighting the textures of the brick wall and the gold frames of the portraits.

SOUTH ASIAN AMERICANS ARE
EXPANDING ON THE SUCCESS
OF THEIR IMMIGRANT PARENTS,
CREATING A BLENDED CULTURAL
IDENTITY—AND TURNING THE
TABLES ON OLD STEREOTYPES.



Building a New American Dream

BY YUDHIJIT BHATTACHARJEE

PHOTOGRAPHS BY ISMAIL FERDOUS

At Hoboken, New Jersey's City Hall, Ravi S. Bhalla, the new mayor, stands in front of portraits of past mayors. An Indian-American civil rights lawyer and a Sikh who wears a turban to express his faith, Bhalla was elected in November. "We are a diverse and welcoming community," he says.





Two women revel at a Holi celebration in Richmond Hill, a Queens, New York, neighborhood popular with people of Indian descent from Guyana and Trinidad and Tobago. During this Hindu holiday, which marks the arrival of spring and the victory of good over evil, festivalgoers smear one another with colored powder and paint.





Nirav Tolia, walking in San Francisco with his wife, Megha, and their three boys, is one of many entrepreneurs of Indian heritage who have achieved success in Silicon Valley. Nirav co-founded Nextdoor, a social-networking site for neighborhoods. Megha is a vice president at Method, a company making environmentally friendly cleaning products.

Diversity in America

A YEARLONG SERIES

The stand-up comic Hari Kondabolu, who is Indian American, had just finished telling a joke about being brown in America when the laughter was interrupted.

“Thank you, come again!” a heckler yelled mockingly in a thick, faux Indian accent. The phrase is instantly recognizable to millions of fans of *The Simpsons* television show as the signature utterance of Apu Nahasapeemapetilon, who is portrayed unabashedly as a racial stereotype: the thrifty, borderline unscrupulous, and somewhat servile Indian convenience store owner.

To Kondabolu, those words at a show in October 2015 were even more familiar. Like many people of South Asian heritage in the United States, Kondabolu had “Thank you, come again!” aimed at him countless times while growing up. Now his irritation found expression in a smiling comeback. “I know you from high school, even though I don’t,” he said, pointing at the heckler. “You are the reason I do comedy, sir.”



Hari Kondabolu performs at Union Hall in Brooklyn, New York. Kondabolu is one of a number of comedians of South Asian heritage who have been gaining visibility in American popular culture.



Kondabolu, 35, has a boyish appearance, with a mop of wavy, dark hair on top of a chubby face that seems to bear a perpetual expression of mild amusement. His friendliness belies the scathing quality of his humor. “Knowing that the accent was used to mock us made me very apprehensive to have people meet my family,” Kondabolu told me about his adolescent years, when I met him and his immigrant parents, Ravi and Uma, in Queens, New York. His response was to find a comedic voice of his own to skewer the often cartoonish, one-dimensional portrayal of brown people in American media and popular culture.

One of his early jokes was a riff on a caption he says he read on a picture of the Koh-i-Noor diamond, which is part of the British crown

jewels, describing the precious stone as having been found in India in the mid-1800s. “Right. It was just found in India. It wasn’t taken from India. It was just found there,” he says, because Indians didn’t know what diamonds were and were “grinding them up, putting them into curry,” and making “diamond biryani” until “luckily the British showed up.” Another joke was about how his mother would pretend to call adoption services whenever he and his brother were being troublesome. “One day we discovered there was nobody on the other end of the phone, and so the next time she said it, I told her I would be calling immigration, and that ended that.”

It was satisfying to Kondabolu that he could reference the same racial tropes that irked him to challenge stereotypes. “When you get to a place

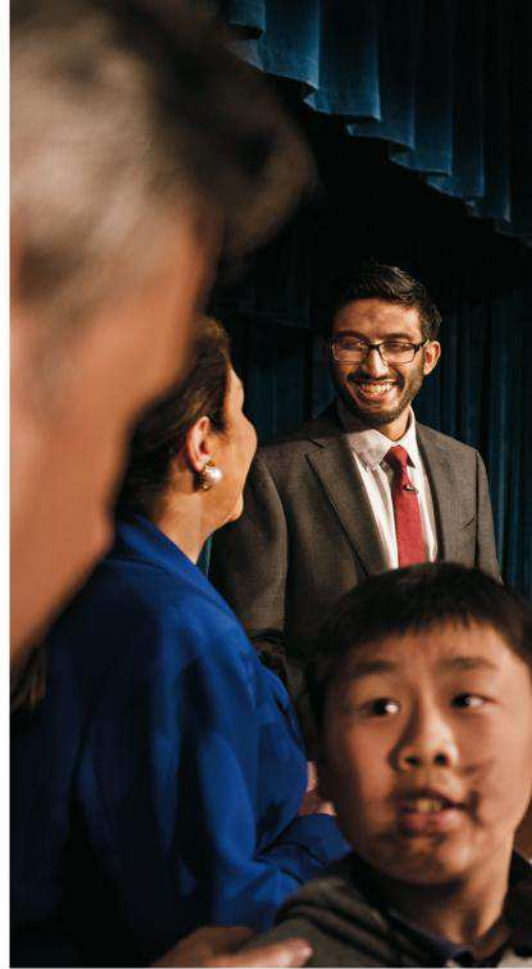
where you are telling your own stories, that's huge," he said. "That's control."

Kondabolu brought his journey as a satirist full circle with his documentary film, *The Problem With Apu*, which opens with a clip of his response to the heckler. The film argues that the character is racist. Kondabolu finds it ridiculous that one of the most visible representations of Indian Americans on TV is a caricature voiced by "a white guy doing an impression of a white guy making fun of my father." (*The Simpsons* appears on Fox TV, which is owned by 21st Century Fox, the majority owner of National Geographic Partners.)

Kondabolu is one of many second-generation South Asian Americans, predominantly of Indian heritage, who have gained prominence in mainstream American comedy in the past few years. Their success represents a significant milestone in the integration of people of South Asian descent into American society. By mining their immigrant experience for laughs, Kondabolu and others are giving expression to a self-assurance that many first-generation immigrants did not have.

The increased visibility of South Asian Americans in popular culture mirrors the rise of this relatively new immigrant group in various walks of American life—in science, medicine, technology, business—and now increasingly in politics and public service, as exemplified by Ravi S. Bhalla, the new mayor of the largely white city of Hoboken, New Jersey, who, like many Sikh men, wears a turban. In recent years South Asians have been one of the fastest growing immigrant groups in the United States, increasing in population from 2.2 million in 2000 to 4.9 million in 2015. About 80 percent of the demographic is Indian, with a median annual household income of \$100,000—nearly double the median for all U.S. households.

Even though some communities with roots in South Asian countries, like Bangladeshis and Nepalis, are generally far less affluent, the overall success of South Asian Americans is no mystery. It can be partly explained by U.S. policy, which since the 1960s has selectively encouraged educated foreign workers and high-performing students to immigrate. Owing to its large English-speaking population, a result of British colonialism, and the quality of some of its educational institutions, India became a major source of such talent. And family-based immigration opened the doors to a broad array of South Asians.



Second-generation South Asians are building on that success, with many such as Kondabolu venturing outside career paths typically favored by their immigrant parents. As they find their place in the nation's ever changing tapestry, they are forming a cultural identity that blends values and traditions they inherited into a new way of being American.

"When you are the child of an immigrant and you are running for office, or you are a journalist telling a story, or you are an actor-performer who has a platform to speak, this is all new, but it's examples of us saying, 'Hey, we are valid,'" Kondabolu told me. "Hey, see our stories? They aren't stories of foreigners. They are the stories of people here in America."

When I set out to write this piece, I had more than a journalistic interest in second-generation South Asians. I am an Indian immigrant, having arrived in 1999 to go to graduate school, where I met my future wife, who grew up in the U.S. I still hum Bollywood songs and habitually surf Indian news sites, but I have a deep sense of



Pranav Chemudupaty (center) spelled “oxyacetylene” correctly to clinch the Houston Public Media Spelling Bee this year. The co-host to his left, Anjay Ajodha, a three-time winner of the competition, is now an engineer at Microsoft. Children of Asian ancestry often excel in academic competitions in part because their families place a high value on education.

BELOW

Suni Williams, a NASA astronaut whose father is from India, has served two stints on the International Space Station, spending 322 days in space. When she first flew there, in 2006, she took a copy of the Bhagavad Gita as well as a figurine and picture of Ganesha.





Hindu weddings in America can be as elaborate as those in India. Here Radha Desai, wearing a traditional *lehenga*, makes her way to the wedding stage in Irvine, California, to

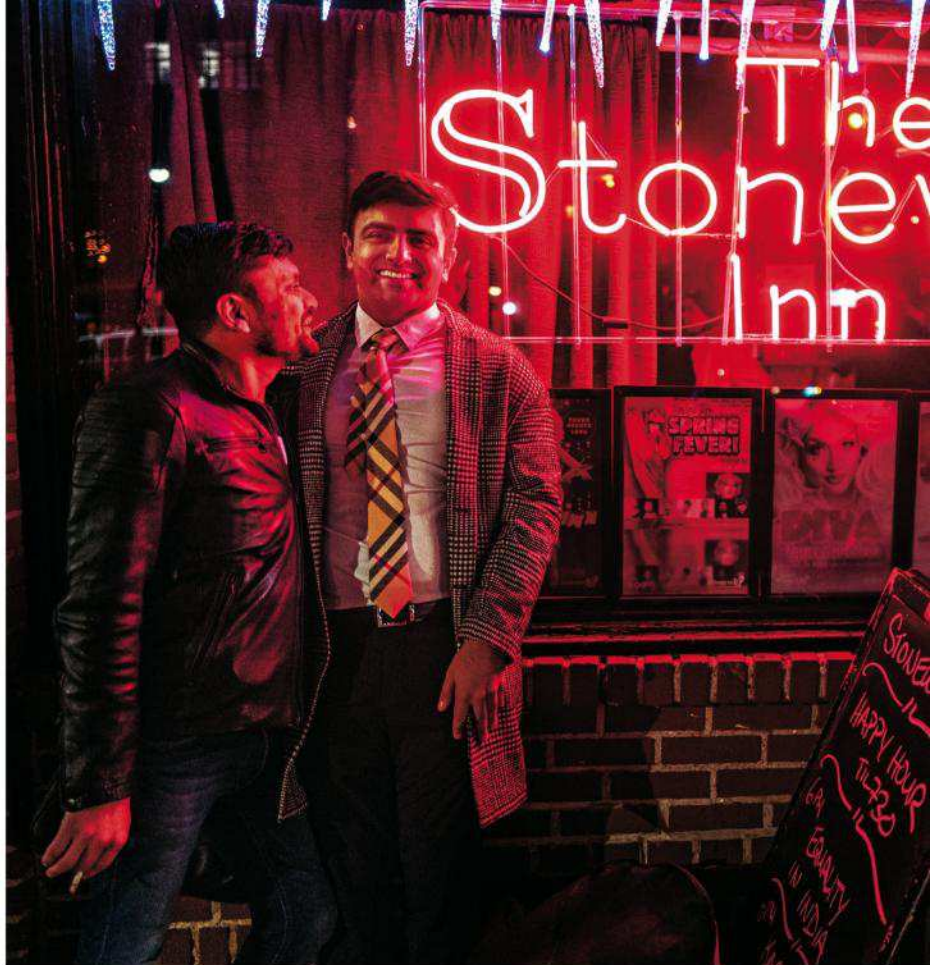
marry Neal Patel (not pictured), a fellow Gujarati American. Desai, a physician, was raised in Southern California; Patel, the owner of a medical group, grew up in Orlando, Florida.



Joshua Patel (wearing a tie) is an openly gay Indian-American activist who proudly notes that his parents are supportive. To help LGBTQ people in India, he organized a fund-raising event at the Stonewall Inn in New York City, where a police raid in 1969 sparked protests that helped fuel the gay-rights movement.

BELOW

Thenmozhi Soundararajan (standing), whose family was born into India's Dalit population, its lowest caste, shows her artwork to Shahana Hanif, a Bangladeshi American. Both women are activists who fight against religious intolerance and caste-based discrimination.





belonging to America. Our two children were born here, and last year I became a U.S. citizen. Learning about the lives of second-generation South Asians, I hoped, would help me imagine my children's future.

MANY SECOND-GENERATION SOUTH ASIANS were born to highly educated immigrant parents and have had a privileged upbringing, like that of Subash Bazaz, a 47-year-old cardiologist. On a recent Sunday morning, I went to Great Falls, Virginia, to meet his family. I took off my shoes at the door, as is customary in many Indian homes, and was greeted by three generations: Bazaz; his parents, Bansi and Veena, who immigrated from India in 1970; and his 16-year-old son, Abhishek. Bansi Bazaz, an 80-year-old retired doctor of internal medicine with large eyes and a slight frame, was visiting for a weekly ritual: driving with his grandson to his class in tabla, a pair of traditional drums played by hand.

The contrast between the lives of grandfather, son, and grandson offers a glimpse into how

being South Asian in America has evolved since the first big wave of immigrants began arriving in the 1960s, when long-standing barriers to immigration from Asia were removed. Bansi was part of that wave—one of many South Asian doctors who immigrated. “It was a gold rush,” said Bansi, who grew up in Kashmir and studied medicine in Bangalore. He took a job in Ogdensburg, New York, a town with fewer than 15,000 residents then. “What the white doctors didn’t want to do—those were the only jobs that were open.”

It was there that his son, Subash Bazaz, a mild-mannered man with a soothing voice, grew up. “There was a very small Indian community, mostly made up of other doctors like my dad,” he recalled. The families mainly socialized with each other. His parents, like many immigrant parents, wanted him to stay focused on academics. “We couldn’t go out all the time, couldn’t have sleepovers. Dating was really frowned upon,” Bazaz said. “The Indian background did put barriers between myself and my white peers.”

At school he did his best to avoid drawing attention to his Indian heritage, never bringing lunch from home because the spicy aroma would have made him stand out. Although Bazaz went through a phase of trying to shed his Indian identity—“I didn’t want to be seen clinging to other Indian folks”—by the time he finished college, his closest friends were Indian Americans. This arc of shunning and then embracing one’s heritage is a familiar theme in the lives of many second-generation immigrants.

As an immigrant doctor, Bazaz’s father told me, he had to fight for fair treatment and equal opportunity. By contrast, Bazaz says he faced no perceptible barriers. When he entered the profession, doctors of Indian ancestry were more the norm than a novelty. He had the option of pursuing opportunities in cities big and small and joined a practice in the Washington, D.C., area with three Indian-American cardiologists.

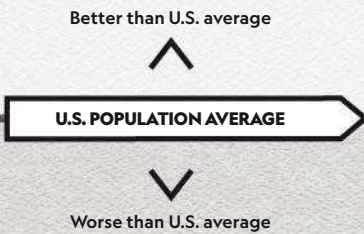
After Abhishek consumed the omelet made by his mother, Sameera, who is of Indian descent, I went with him to the house of his tabla instructor. “Playing the tabla is one way for me to appreciate Indian culture,” said Abhishek, who rarely listens to Indian music.

He and his grandfather both commented on how different it is growing up Indian American now because of the large South Asian population in some cities. That was in evidence at the instructor’s house, where one batch of

Asians in America

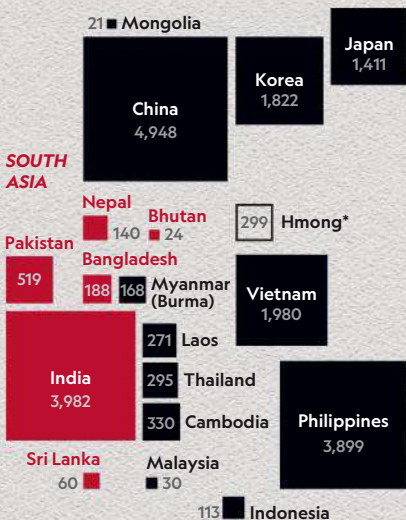
INDIAN SUCCESS IN U.S.

The experiences of Asians in the United States, as measured by socioeconomic statistics, vary greatly by country of heritage. The data here encompass the 19 largest Asian groups and include both U.S. citizens and residents, except for the STEM workforce data, which compare foreign-born Asians with U.S.-born citizens. On most measures, Indians are faring notably well, while Burmese, Bhutanese, and Hmong—many having arrived as refugees—struggle economically.



ANCESTRY OF ASIANS IN AMERICA

In thousands



*THE HMONG ARE AN ETHNIC GROUP ORIGINATING IN CHINA AND LIVING IN MULTIPLE SOUTHEAST ASIAN COUNTRIES.



EARNINGS

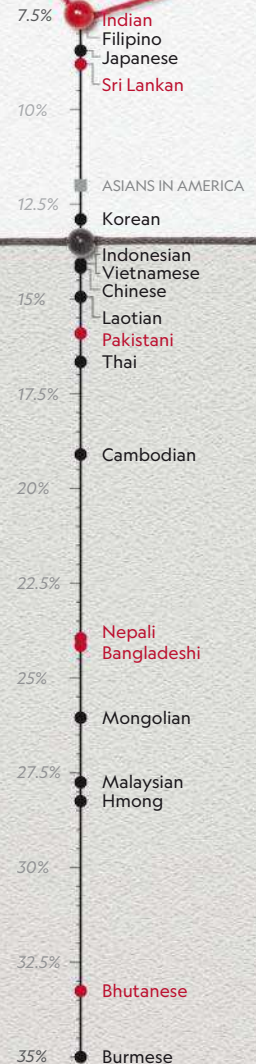


The Indian population's average annual earnings of \$75,000 exceed the U.S. average of \$46,000, largely due to high-paying science, technology, engineering, and math (STEM) careers.



POVERTY LEVEL

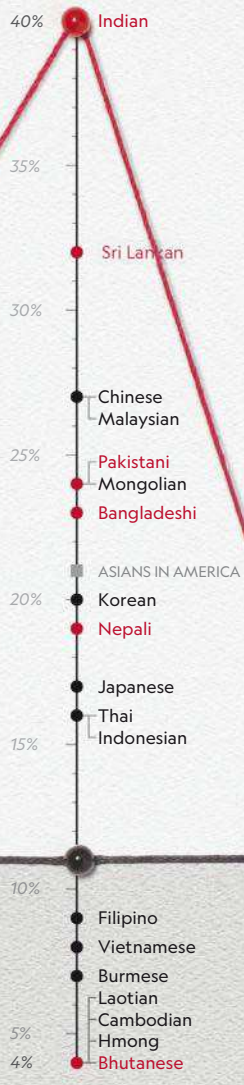
Fewer than 8 percent of Indians in America live below the poverty line, compared with 13.5 percent of the U.S. population.



†THESE DATA REPRESENT PEOPLE LIVING IN THE U.S. WHO CLAIMED ASIAN ANCESTRY AND INCLUDE THOSE OF MIXED ANCESTRY.



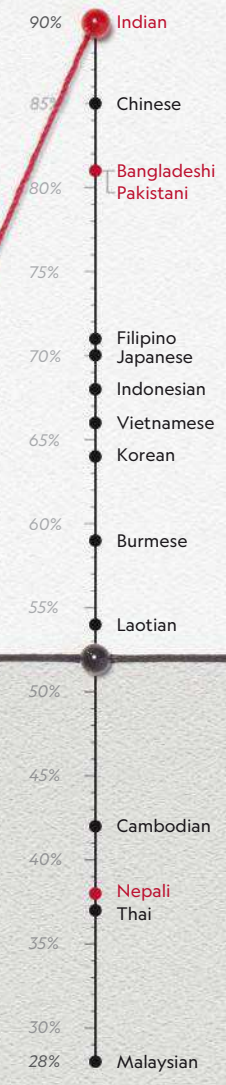
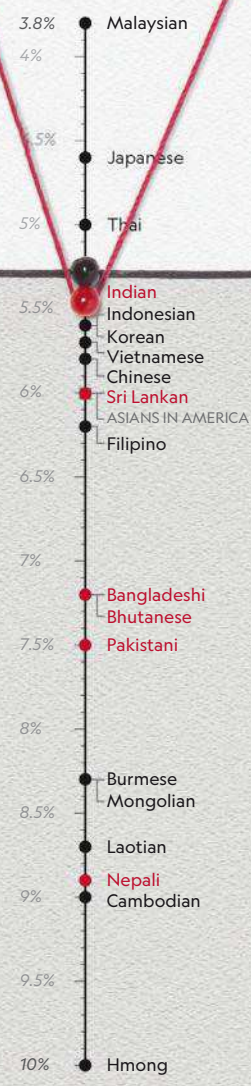
Only 17 percent of Indians age 25 or over don't have a degree beyond a high school diploma or GED certificate, compared with 41 percent of the U.S. population in the same age group.



ADVANCED DEGREES
Forty percent of Indians age 25 or over have degrees higher than a bachelor's, compared with 11 percent for the U.S. population age 25 or over.



UNEMPLOYMENT
This is the only category shown where the figure for Indians in America nearly matches the national average.



Ninety percent of Indian-born college grads in the U.S. have degrees or jobs in STEM or the social sciences. Half of all U.S.-born college grads have degrees or jobs in these fields.

Banujah Balasubramaniam and her daughter, Amisha, attend a Christmas celebration organized by the Sri Lankan community in Staten Island, New York. Dressed as Santa Claus is Sri Lankan American Dianna Sriskanda. The Tamil carol service has taken place for more than 30 years, bringing together Christians, Hindus, and others.





Halloween
polly

students—all of Indian heritage—was leaving as Abhishek, a broad-shouldered boy with a shy smile, sat down cross-legged with seven other boys. As he tapped fast and furiously on his tabla, Abhishek's fingers became a blur.

SOME SECOND-GENERATION South Asians grew up in less fortunate circumstances than Bazaz and Kondabolu. They were raised by parents who slaved away in physically demanding blue-collar jobs that more often than not were low paying. Notably many Indians from the state of Gujarat bought and ran budget motels. South Asians without money or advanced education washed dishes, stocked shelves at grocery stores, and drove taxis, which is what Tanzina Ahmed's father did.

When Ahmed came to New York City from Bangladesh in 1990 as a five-year-old, she barely spoke English. The language barrier made it difficult to make friends at school. Despite her struggles or perhaps because of them, Ahmed excelled in school. She got impressive results on the SAT, including a perfect score in the verbal section.

Ahmed's family, however, had arrived as undocumented immigrants, and she discovered this made her ineligible for most scholarships and financial-aid programs. "It was like having a window you think is open for you just a crack slammed on your face," she said. Ahmed, who has sparkling eyes and a sardonic wit, subsequently discovered a rare scholarship program—at the City University of New York—that wasn't closed to undocumented students. She received a full merit scholarship to CUNY's Macaulay Honors College.

Her parents were eager to see her on a path to citizenship. The only solution they could think of was to arrange a marriage to a U.S. citizen, and so, while Ahmed was pursuing a doctorate in psychology, she married a Bangladeshi-American man found by her parents. Their marriage ran into trouble but lasted long enough for her to get citizenship.

Ahmed, who has taught at Bronx Community College, is now remarried—to a Malaysian-Chinese American she met through mutual friends. Over the past few years, she said, "I have grown so much more comfortable with my identity as a Bengali-American, Muslim woman."

For much of her life, she says, she resented her Bengali roots—first because of bullying and harassment at school and later when her parents



found her a match. After her divorce the resentment began fading away. "I realized that there are parts of my identity and this cultural background that I'm really proud of," she said. "I like the fact that we come together as a family, and we choose to live near each other and help each other out a lot. I like the fact that we don't endorse things like going on Tinder and dating five million people."

A DEFINING CHARACTERISTIC of many South Asians—and Asians generally—is a keen aspiration for career success. The pressure to do well at school is a common theme, reflected in the prevalence of South Asian kids participating in—and winning—spelling bees and competitions in science and math. Their parents are more inclined to nudge them toward professions such as medicine and law, but increasingly second-generation South Asians are following their hearts.

Kondabolu, too, felt that pressure to walk a familiar path. When he was trying out comedy in school and in college, his parents hoped it was just a phase. "They said, 'Don't let it interfere with



Girls of Indian heritage perform Bharatanatyam, a classical South Indian dance, at a Manhattan studio. One parent, who said he struggled with his identity growing up in America, believes the classes will help his daughter be more comfortable with her Indian heritage.

BELOW

Bohemia, a Pakistani American known as the king of Punjabi rap, performs in New York City. Born to a Christian family in Karachi, he moved to the United States as a teenager. His first album was an autobiographical account of his experiences in America. His music has found an international, multiracial audience.



your studies,' which it did," he said. After college Kondabolu wanted to pursue stand-up, but his mother wanted him to go to graduate school.

At the time he felt angry. "I remember thinking, All these white kids get support—'Yeah, be what you want to be'—and I couldn't get that support." Kondabolu moved to Seattle to work as an activist for immigrant rights and did stand-up in the evenings. He got noticed. After appearing at an HBO comedy festival and on *Jimmy Kimmel Live!*, he felt ready to dive headlong into comedy. But when he was accepted at the London School of Economics to do a master's in human rights, his mother, a tall, poised woman who trained as a doctor, wanted him to go. "I had a career that had just started," he said. "And my mom said, 'You've got to do the master's.'"

Kondabolu got the degree but began doing comedy full-time after returning to New York City. "In six months I wanted to quit," he told me. "I was like, What am I doing? I have a master's degree. My classmates are working at the UN, the

that Kondabolu was, a divergence attributable perhaps to how differently the generations view their place in American society. "When we came, we knew we were entering a foreign place," Uma told me. "This country doesn't owe us anything."

Kondabolu, on the other hand, took for granted that he was entitled to a voice in America. "I believe that this isn't about me turning into you," he said. "This is about us sharing and coming up with something different. That's what America is—it's about changing with every new idea and person that comes here."

FOR SOME SOUTH ASIANS, parental expectations go beyond achieving high levels of professional success. They also can come under pressure to conform to cultural traditions. That can mean running into opposition within the family when deciding to marry outside one's religion, caste, or race—an experience that Ambar Zobairi faced.

A 44-year-old Pakistani-American woman who grew up in Carbondale, Illinois, Zobairi

More than their parents, many second-generation South Asian Americans feel they should have a voice in society.

World Bank, UNICEF, and I am telling jokes in the basement of a bar that takes me two hours to get to and two hours to get back?" But his parents, reassured he had a fallback, encouraged him.

Kondabolu kept at it, and success followed. The material that he and fellow South Asian comics present has found a diverse and growing audience over the past decade. "Because our stories were suppressed for so long, everything is new and exciting and interesting," Kondabolu said. In the early years he used a thick Indian accent in some of his comedy—like the bit about his mother calling adoption services—but later dropped it, feeling that it detracted from his desire to tell jokes from "a place of empowerment and not of self-deprecation."

With his documentary Kondabolu has arguably started one of the most important public discussions about South Asians in America. After airing on cable in November, *The Problem With Apu* sparked a debate between those who agree with his criticisms and others who feel he's being overly sensitive. His parents, Uma and Ravi, were never bothered by Apu in the way

works at the International Foundation for Electoral Systems in Washington, D.C. She has spent more than a decade helping to increase public participation in elections and governance throughout the Middle East and North Africa. In countries such as Lebanon and Libya, Zobairi, who has deep-set eyes that convey warmth, has focused on empowering women.

Twenty-five years ago Zobairi had to fight her own battle to be with the man she loved. In 1993, three months after she had begun dating a white American college classmate named Mark Henderson, her father, Riazuddin, then a professor of religious history at Southern Illinois University, gave her an audiocassette. As she listened to it in her room, tears streamed down her face.

"He said how much he loved me and that he knew that I must be in love. He expressed that he always wanted me to be happy but that he really wished for me to be with somebody who was Muslim," Zobairi recalled. She said her father also worried he would lose his standing in Carbondale's conservative Pakistani community.

Despite her emotional turmoil, Zobairi was

steadfast. She had strong, independent-minded women in her family to take inspiration from, most notably her mother, a Pakistani Christian, who had married Zobairi's father over the objections of her family. "I always knew that if there was a path I needed to take, even if it was going to be difficult, I was going to continue on that path," she said.

Zobairi stopped meeting with Henderson in public, but they kept the relationship going through phone calls and letters. Her life at home went on as usual, although tensions remained in the background. Henderson—worried about the possible estrangement between Zobairi and her father—eventually told her father he would embrace Islam. Reciting a one-sentence testimony of faith at the Islamic Center of Carbondale, he became a Muslim. In the summer of 1997, Zobairi and Henderson married.

DURING THE WEEKDAY RUSH HOUR, while riding a train in the San Francisco Bay Area, I found myself in a sea of brown faces. It was a reminder of the immense presence of people of South Asian origin—more specifically, of Indian origin—working in Silicon Valley, many of whom entered the country under the H-1B visa program to fill a shortage of technology workers. Not only do Indian immigrants and second-generation Indian Americans constitute a significant slice of the U.S. tech workforce, but they also lead major companies such as Google and Microsoft.

For a close-up of life inside this prosperous enclave, I visited Nirav Tolia, the 46-year-old co-founder of Nextdoor, a social-networking service for neighborhoods that recently was valued at more than one billion dollars. Tolia is trim, with a youthful face that has no hint of facial hair. The son of Indian immigrants who are both doctors, he grew up on a cul-de-sac in a predominantly white neighborhood in Odessa, Texas, where neighbors would give him rides to school, babysit him, and watch him when his parents were traveling. They invited him to swim in their pools and play tennis on their courts. "We'd come back from visiting relatives in India, and I'd literally want to kiss the ground," Tolia told me.

The memory of that warm and nurturing community is what inspired Tolia—along with six partners, including another Indian American—to found Nextdoor. Launched seven years ago, it enables users to connect with neighbors and share information useful to the community,

from car break-ins to used-toy giveaways. Tolia describes it as an online tool for strengthening bonds between neighbors—bonds that have frayed all over the world.

Tolia started out at Yahoo!, where many of his colleagues, including his boss, were of Indian ancestry. He was also being mentored and supported by the Indus Entrepreneurs, a South Asian networking nonprofit with thousands of members in more than a dozen countries, which helped him when he co-founded his first start-up, Epinions, a consumer review site. "Not only is my race and identity not holding me back, but I'm in a place where some of the most successful people in the industry are my race," he said.

After Epinions merged with another company and went public, Tolia made a fortune, but not without controversy. He resigned from the new company in 2004 after it was discovered that he had misrepresented his degree and experience on his résumé. He was also sued by some of his former partners, who had made nothing on the deal, resulting in an undisclosed settlement.

On a recent afternoon Tolia and his wife, Megha, an Indian American who went to Harvard Business School and is now a vice president at Method, which makes environmentally friendly cleaning products, gave me a tour of their home—an elegant, 8,000-square-foot, five-level modern mansion. While showing me the master bedroom, which opens out to a large terrace with a breathtaking view of San Francisco Bay, Tolia heard the second of their three sons, four-year-old Dylan, stirring awake from his nap. Dylan was still under the covers, yawning, when we entered his room.

Tolia had told me earlier that he and his wife were raising their boys in a way that "blends the best of multiple cultures." When Dylan jumped out of bed, Tolia asked if he would sing a Sanskrit prayer for me. Dylan sang Survivor's "Eye of the Tiger" instead. A little later, when asked again, he happily obliged. "*Twameva mata cha pita twameva, twameva bandhush-cha sakha twameva,*" he sang. The words, addressed to an eternal and universal God, loosely translate to "For you indeed are my mother, my father; you are my kin, my friend." □

Yudhijit Bhattacharjee, a contributing writer for the magazine, came to the United States from India when he was 26. **Ismail Ferdous** moved from Bangladesh to New York City about two years ago. This is his first feature for the magazine.



JAYAPRAKASH BOJAN

GRAND PRIZE, 2017 NATURE PHOTOGRAPHER OF THE YEAR

WHO

Jayaprakash Bojan, a former IT analyst who lives in Singapore, where he teaches photography

WHERE

Tanjung Puting National Park in Indonesia

WHAT

A Canon 5D Mark IV camera with a 100-400 IS II lens

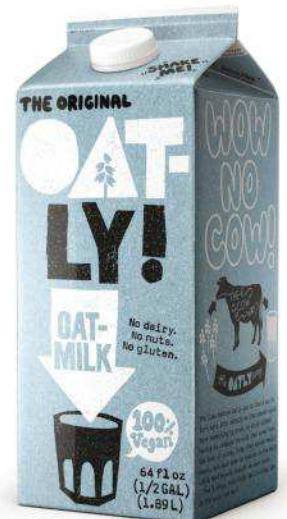
While visiting Indonesia, Bojan hoped to photograph orangutans and proboscis monkeys. After a local ranger mentioned that he'd seen an orangutan cross a nearby stretch of river, Bojan spent two days waiting for the ape to cross again. It finally did on the third morning. Despite reports of crocodiles, Bojan decided to get into the water for a more direct angle. When the orangutan appeared from behind a tree, it made a moment of eye contact, then proceeded on its way across the river.

See more images from the 2017 Nature Photographer of the Year contest at natgeo.com/photocontest.

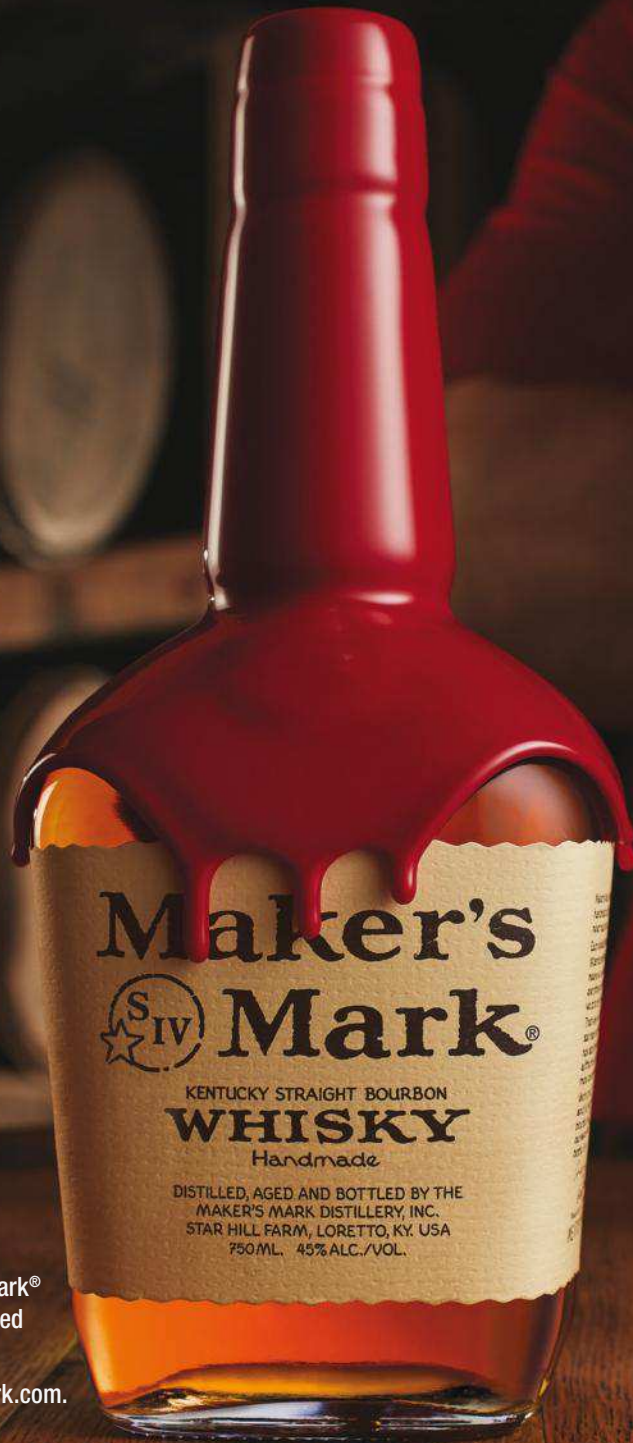
Au revoir, middleman.



Many of today's most influential companies have become successful by cutting out the middleman and passing the benefits of a more direct relationship on to you, the consumer. It's a strategy that has proven beneficial to nearly everyone except, of course, the middleman. "When I finish my degree, I want to become a middleman," is not currently the chosen dream of our most ambitious youth. This development is nothing new to us. We've been cutting out the middleman for over 25 years by finding a way to go straight from oats to oatmilk, instead of feeding the oats to a cow and letting the cow preprocess the oats into milk. But just because we were ahead of the middleman curve doesn't mean we know who is going to win the World Series or if we are actually living in a simulation. All we know is how to make oatmilk. Our ability to predict the future beyond that is far from dependable.



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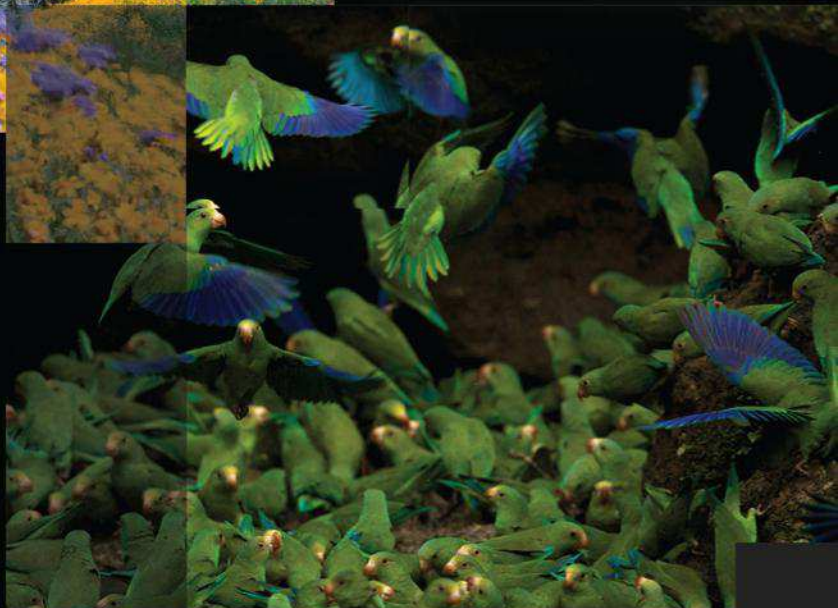
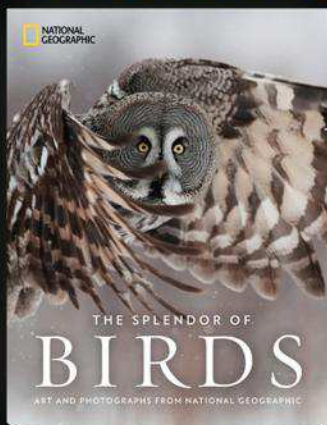
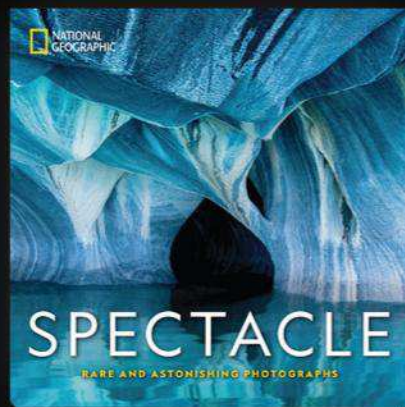
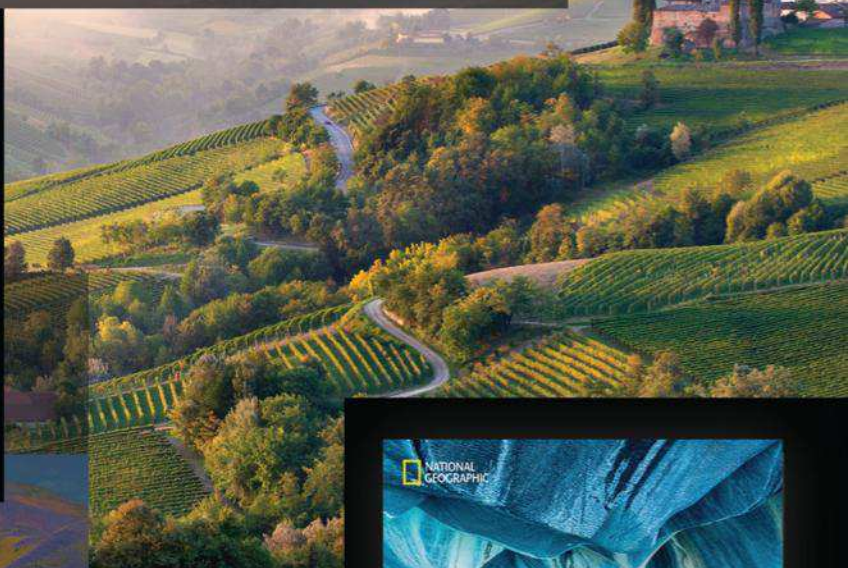
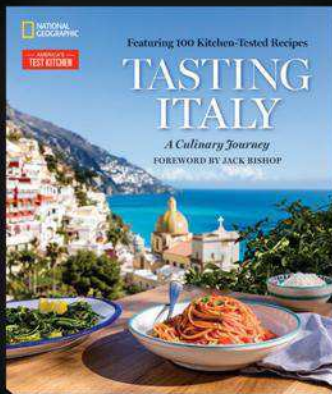
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