

# BRIGHT IDEAS

# Smithsonian

December 2015

smithsonian.com



**EXCLUSIVE**  
HISTORIANS RANK THE BEST  
AND WORST HISTORICAL  
MOVIES OF ALL TIME

THE 2015 AMERICAN INGENUITY AWARDS

## LIGHTS! CAMERA! GENIUS!

Bill Hader and Fred Armisen of  
"Documentary Now!"



**HOPE FOR ALZHEIMER'S**  
A laboratory breakthrough  
for testing new treatments

**BROADWAY'S HIP-HOP SMASH**  
In *Hamilton*, Lin-Manuel  
Miranda sparks a revolution

**THE MAN WHO SAVED PLUTO**  
Alan Stern's out-of-this-  
world vision

**THE EMOTION MACHINE**  
The promise of a computer  
that reads your mood

**THE ART OF MANIFEST DESTINY**  
The eye-opening exhibition  
that spanned the nation

PHOTOGRAPH BY BRINSON + BANKS

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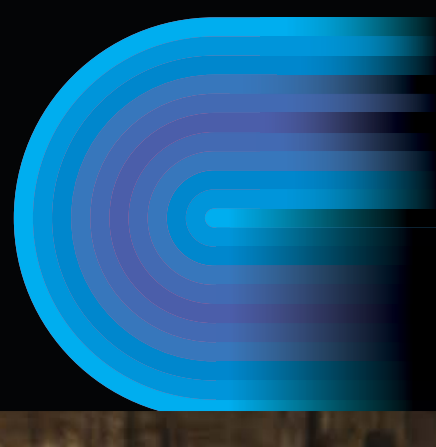


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## The 2015 American Ingenuity Awards

Pioneering researchers. Visionary artists. Superhero educators. These inspiring innovators from across the country—some prominent, some rising stars, but all improving our lives in some fashion—are honored in our fourth annual special issue.

Lin-Manuel Miranda, the star and creator of the smash Broadway musical *Hamilton*.

### Contributors



### Discussion



### Phenomenon



American Icon: Tabula Rosa

Art: Waste Land

Fast Forward: Mother & Child

### Quakers with a Vengeance



The author of *In the Heart of the Sea*, now a major motion picture, revisits Nantucket's whaling heyday BY NATHANIEL PHILBRICK

### National Treasure



### Ask Smithsonian



### Bill Hader and Fred Armisen

The “SNL” alums slay it with love in their sendups of nonfiction films in the TV series “Documentary Now!”

BY FRANZ LIDZ



### Alan Stern

His New Horizons space mission is bringing us our first-ever close-up views of Pluto

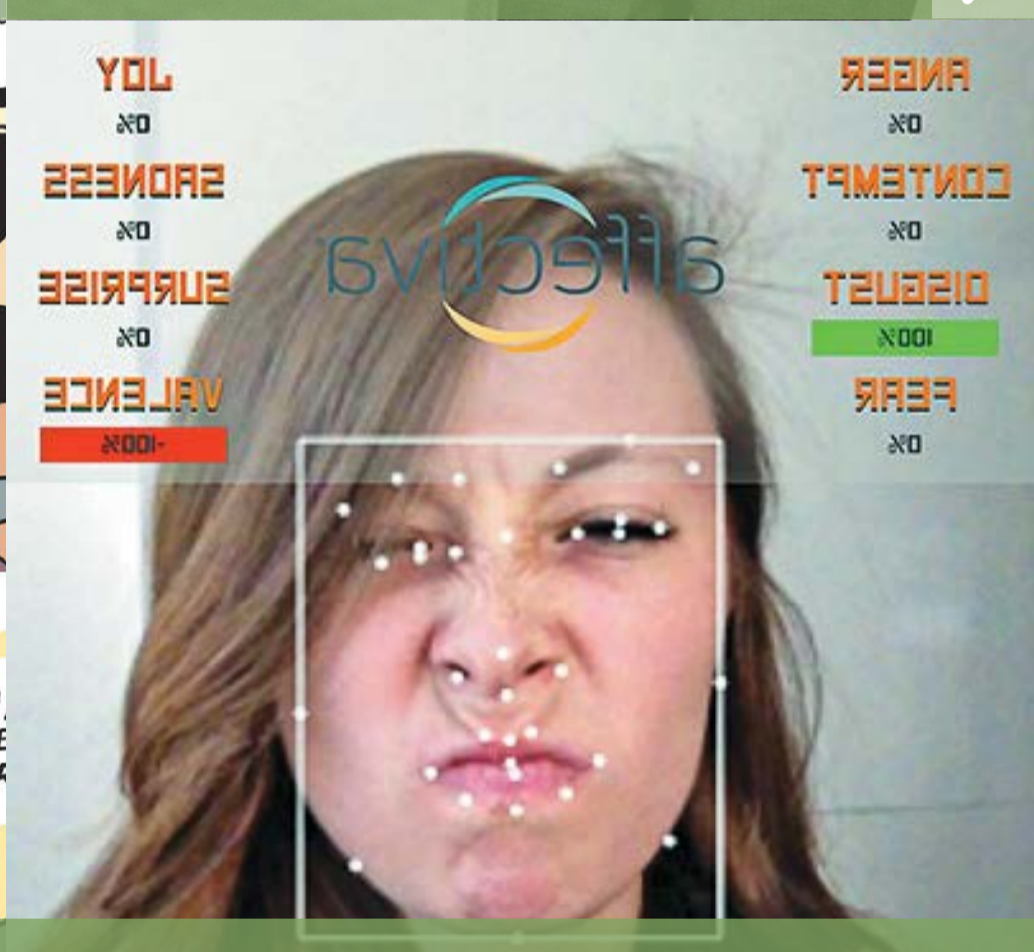
BY ELIZABETH QUILL



### Françoise Mouly

With Toon Books, her comics for kids, she's putting the fun back in literacy and learning

BY ELEANOR DAVIS



### Rana el Kaliouby

So long emoticons. The scientist is developing technology that can detect and read our expressions

BY JERRY ADLER



### Lin-Manuel Miranda

The playwright, composer and actor has created a Broadway musical like no other in history

BY JEFF MACGREGOR



### Lilianna Zyszkowski

The teenager has wowed Silicon Valley with a potentially life-saving invention, the PillMinder

BY JESSICA PRESSLER



### Theater Gates

The artist and activist is using art to revitalize Chicago's beleaguered South Side

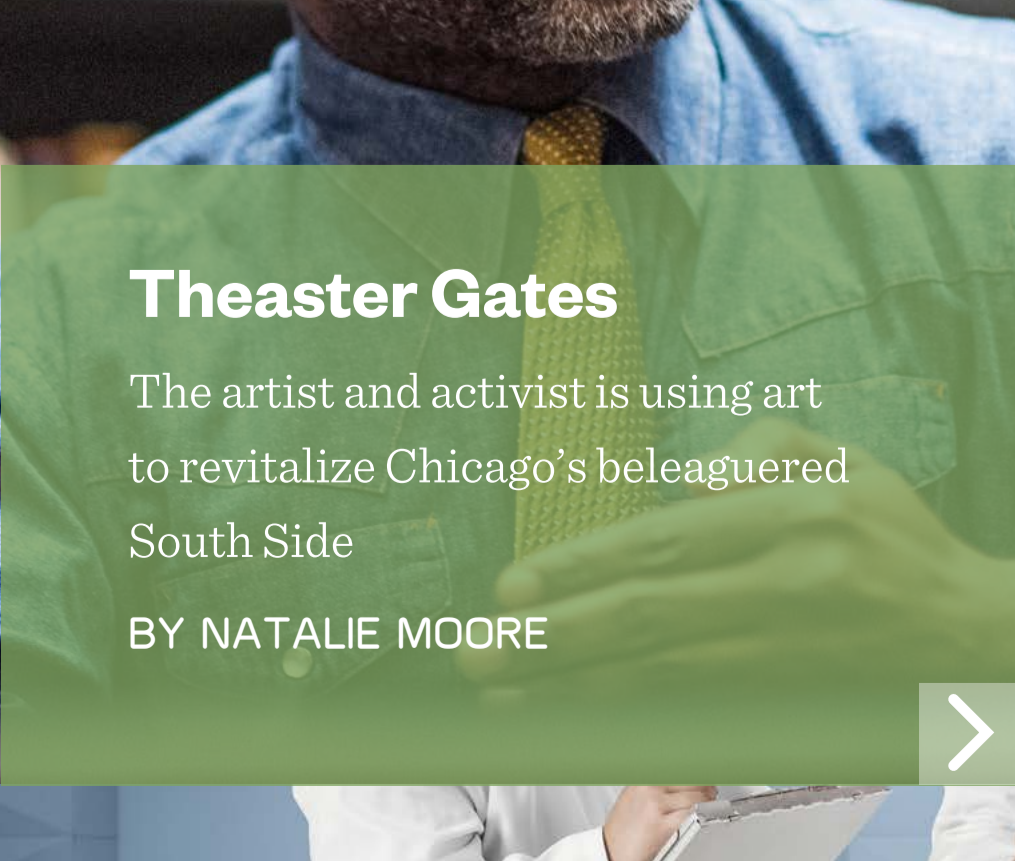
BY NATALIE MOORE



### Zoe Crosher and Shamim Momin

Their 2,400-mile-long “Manifest Destiny Billboard Project” conquers America

BY MARGOT DOUGHERTY



### Rudolph Tanzi and Doo Yeon Kim

The duo's “Alzheimer's in a dish” is a breakthrough for testing new treatments

BY NATALIE ANGIER

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# Contributors



## Natalie Angier

A Pulitzer Prize-winning science writer and the author of several books, including the National Book Award finalist *Woman: An Intimate Geography*, Angier says she hadn't realized how urgent the problem of Alzheimer's disease is "on the verge of becoming." She wants this profile to "sound alarm bells" even as it highlights Rudolph E. Tanzi and Doo Yeon Kim's research breakthrough: a laboratory model of the disease in cell culture form ("**Memory Keepers**"). "The piece was fun to work on, but it also made me very, very anxious about our future. There is a little bit of hope," she says. "Hope in a dish."

**Favorite invention: Spectacles**



## Eleanor Davis

The award-winning cartoonist and illustrator, based in Athens, Georgia, first collaborated with **Françoise Mouly** over a decade ago, when Davis was still in college. In addition to her solo work, Davis recently published a Toon Book with her husband, Drew Weing, and is half of the illustration team "Never Ever Even."

**Birth Control**

## Erin Patrice O'Brien

O'Brien has photographed many celebrities over the years, and **Lin-Manuel Miranda** is now one of her all-time favorite subjects. "He was that cool," O'Brien says. "It's pretty rare, actually." She lives in Brooklyn, and her work has appeared in the *Atlantic*, the *New York Times*, *Time* and other publications.



**Camera**



## Nathaniel Philbrick

The best-selling author of *In the Heart of the Sea*, the basis of a new movie, and *Away Off Shore* revisits the topic of **Nantucket**, his "adopted home". "What made it really interesting for me," Philbrick says of the piece, "is the issue of how society deals with family and work. It's a problem we're all struggling with today." He is currently at work on a new book, *Valiant Ambition: George Washington, Benedict Arnold, and the Fate of the American Revolution*.

**Centerboard**

## Brinson + Banks

During the photo shoot, **Fred Armisen and Bill Hader** "started im-proving," says David Banks. "One would say a joke, and the other would say a joke, they were one-upping each other," adds Kendrick Brinson. Brinson and Banks' collaboration seems less competitive; the couple met in college and helped each other for nearly a decade before deciding to work as a team in 2013. Their clients include the *New Yorker*, *Rolling Stone* and the *New York Times Magazine*.



**VW Westfalia**



## Jessica Pressler

Pressler is a contributing editor at *New York* magazine and a contributor to *Elle* and *GQ*. When she interviewed 15-year-old Lilianna Zyszkowski ("**Gadget Girl**") about her inventions, Pressler was struck by the teenager's maturity. "She was remarkably poised, articulate, self-possessed."

**Pizza in a Cup**

## Natalie Moore

The Chicago writer and WBEZ radio reporter first interviewed **Theaster Gates** four years ago. "I grew up on the South Side and I'm fascinated by his personal investment in making these neighborhoods better," says Moore. Her new book, *The South Side: A Portrait of Chicago and American Segregation*, is due out in March.



**Printing Press**



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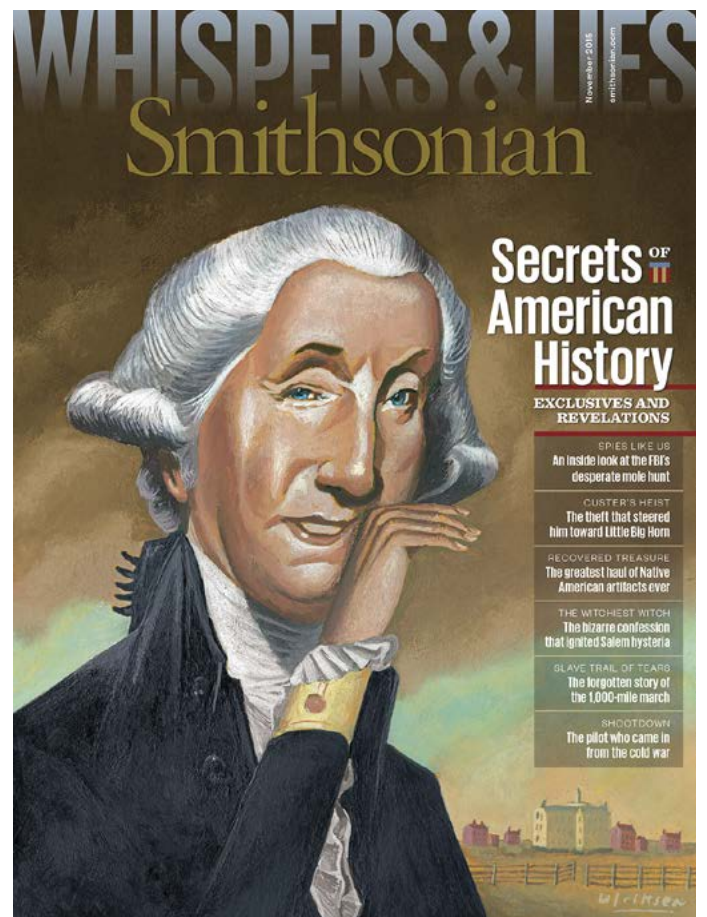
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# Discussion

These r the oldest known flowers in the world via @SmithsonianMag. Nature is a wondrous & mysterious thing of beauty

@sharpwyn ON TWITTER

**FROM THE EDITORS** Readers reacted intensely to Edward Ball's "Slavery's Trail of Tears" in the November issue. Many criticized the way the history of slavery is currently taught in America's classrooms and argued that Ball's piece should be required reading. "Mr. Ball's writing is powerful and factual. Unfortunately, that cannot be said for history textbooks of late," Donna Streetenberger wrote on Facebook. Others found unsettling personal connections in Ball's narrative. "If you dig back far enough in your family history, you might find that your ancestors participated in this," Laurie Walker Severs noted. "Mine did." Readers also debated the fate of looted Native American artifacts recovered in a massive sting operation ["The Rescue Mission"]. Many expressed hope the items could be publicly displayed in a museum owned by Native Americans. "These artifacts belong to the people, not in private collections," Kevin R. McIntosh wrote.



## Custer's Legacy

I can see I'm in the minority here, but I recognize a one-sided article ["The Horse Thief"] when I read one. As a teacher and student of the Civil War and Custer, I find this article is completely devoid of context. Custer was a complex man who lived in difficult times. Genuinely heroic at times while tyrannical and brutal at others. He was a mix of good and bad qualities like any historical figure. It's lame scholarship to try to make the theft of a horse any kind of turning point in Custer's life (which the author disclaims but surely intends), especially so soon after Lee's surrender.

### Stratton Shartel

FACEBOOK

Custer was a horse thief, murderer, cheat and a liar. There was nothing heroic about him, and he was also no gentleman. I've studied this character extensively, and his so-called "deeds" were nothing more than self-aggrandizing waste. Custer met his just end, however later than it should have been.

### Will Thornton

FACEBOOK

## Witch Hunt

The Salem witch trials ["The Devil's Tongue"] were a land and power grab. The girls were either suffering from ergot poisoning or mass hysteria or both (the attention must have been thrilling in such a repressive society) and Tituba was either saving her skin or getting righteous payback. When a powerful man's wife was accused, funny how the witch hunts suddenly ended.

### Erin Harris

FACEBOOK

## Invaluable Artifacts

The problem here ["The Rescue Mission"] is that there was no one protecting these objects and enforcing the laws that were in place. Much of what has been salvaged has no provenance or context. While some of it may be traceable to current nations, a large amount of it cannot. A consortium of tribes and scientists should determine how to proceed and hopefully salvage some knowledge and cultural value from this thievery and greed. It is every bit as tragic as what ISIS and others are doing to artifacts and sites in Iraq and Syria, perhaps worse since there was no study or documentation prior to this destruction.

### Regina Morin

SAN DIEGO, CALIFORNIA

## Saving Rhinos

If strict laws are not imposed and enforced, the rhino will see its way, as the dinosaurs have, to complete extinction ["Rhinoplasticity"]. Technology, no matter how great, cannot save these animals. It is mankind's responsibility to do so.

### Helen Maria Earls Harrison

FACEBOOK

## Correction

Our article on the forced migration of slaves in the 19th century ["Slavery's Trail of Tears"] incorrectly reported that Erin Greenwald and colleagues at the Historic New Orleans Collection had compiled the names of 70,000 slaves who had been sold in New Orleans. They have compiled data on 70,000 individuals, but not names.

## CONTACT US

Send letters to [LettersEd@si.edu](mailto:LettersEd@si.edu) or to Letters, Smithsonian, MRC 513, P.O. Box 37012, Washington, D.C. 20013. Include a telephone number and address. Letters may be edited for clarity or space. Because of the high volume of mail we receive, we cannot respond to all letters. Send queries about the Smithsonian Institution to [info@si.edu](mailto:info@si.edu) or to OVS, Public Inquiry Mail Service, P.O. Box 37012, Washington, D.C. 20013.

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A new archive adds depth to the story of the civil rights heroine

by Jeanne Theoharis

## Tabula Rosa

**“I had been pushed around all my life and felt at this moment that I couldn’t take it any more.”** Rosa Parks wrote those words just a short time after her famous refusal, 60 years ago this month, to give up her seat on a Montgomery, Alabama, city bus, a protest that galvanized a yearlong bus boycott and opened a new chapter in the struggle for American civil rights. The sentence appears in previously unseen notes in an archive of Parks’ personal papers that opened earlier this year and underscores a lesser-known dimension of her life: Far from being a meek seamstress who just happened to defy authorities that December evening, she was a fierce and persistent political activist nearly her whole life.

The Rosa Parks Collection had long been sequestered and unavailable to scholars because of a dispute over her estate and the collection’s hefty asking price. Finally, the Howard G. Buffett Foundation bought the archive and lent the 7,500 papers and 2,500 photographs to the Library of Congress for a decade. They contain letters, datebooks, financial documents and, perhaps most significantly, notes for speeches and other material that Parks apparently wrote during the boycott year and in the late 1950s. They reveal her intimate feelings about white supremacy in America and her belief in rebelling against it despite the costs. They also highlight the hardship that she and her family endured in the decade following the boycott.

Parks wrote poetically about how life under Jim Crow “walks us on a tightrope from birth”—demonizing so-called “trouble-makers” and requiring a “major mental acrobatic feat” to survive. She cast the boycott not as an outgrowth of her singular experience but as a broad reaction to injustice; she noted the case of 15-year-old Claudette Colvin, who was arrested and manhandled on a Montgomery bus earlier that year, and the savage beating of a black Army veteran by a bus driver who was fined \$25 and allowed to keep his job. In another shard of personal writing, she reframed her supposed crime: “Let us look at Jim Crow for the criminal he is and what he had done to one life multiplied millions of times over these United States and the world.”

Born in Tuskegee, Alabama, in 1913, Parks was instilled with the will to fight. Her grandfather, a supporter of the black nationalist leader Marcus Garvey, sat out with his shotgun to protect the family home from Ku Klux Klan violence, and sometimes 6-year-old Rosa would sit vigil with him. Later, she married Raymond Parks, a barber who was working to prevent the executions of the wrongfully accused Scottsboro boys; after joining the Montgomery NAACP, she spent much of the 1940s and early ’50s working alongside union activist E.D. Nixon to pursue justice for black victims of white brutality, register black voters and push for desegregation.

In 1956, five weeks into the bus boycott, Parks lost her job, and so did her husband. She spent the year traveling the country to raise attention and funds for the movement despite her family’s imperiled finances. Even after the boycott ended, neither Rosa nor Raymond could find steady work, and in August 1957, still receiving death threats, they left Montgomery for Detroit.

Parks said that she found “not too much difference” between the segregation and discrimination in Detroit and what she’d left behind in Montgomery. For the next five decades she fought racism in the North. She worked for Representative John Conyers, responding to constituents’ needs, and, calling Malcolm X her hero, took part in the growing black power movement; she served on prisoner-defense committees, showed up at scores of antiwar protests, spoke out for welfare and housing rights and volunteered for numerous black candidates.

She insisted to the end of her life in 2005 that the United States had a long way to go to address racial inequality. Yet our tributes to her often lose sight of her example and fail to see that the need for her kind of courage isn’t just a thing of the past. “Don’t give up,” Parks told students at Spelman College in 1985, “and don’t say the movement is dead!”

AMERICAN ICON

Parks wrote, “There is just so much . . . oppression one can take.”



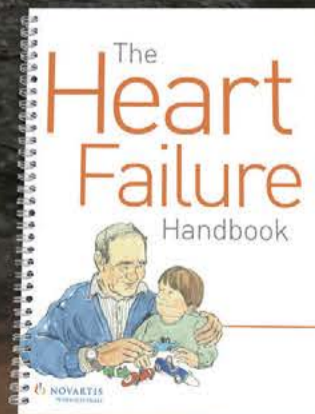
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# Waste Land

A photographer conjures the specter of environmental ruin



**When Fabrice Monteiro returned to his native West Africa after 20** years abroad, he longed to go surfing. But old fishing nets matted the shoreline; blood from slaughterhouses gushed into the sea; plastic bags festooned the trees like black leaves. “It was a shock for me to find how polluted everything had become,” the photographer says. To spotlight Senegal’s gravest ecological problems, Monteiro teamed up with Ecofund, an environmental group, for a series of photographs starring a “djinni,” or supernatural genie, warning of mankind’s folly in a way that local children might also understand. This djinni, wearing a costume by the Senegalese fashion designer Doulsy using garbage layered according to the time it takes to decompose, looms over a vast trash-burning site outside Dakar where 1,300 tons of waste are deposited each day. The djinni looks away from the camera—toward, depending on your view, a greener horizon, or a smoking abyss. **-ABIGAIL TUCKER**

**Garbage is layered by the time it takes to decompose.**

ART

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# Mother & Child

**A venerable symbol of human love, as you've never seen it before**



**A mother and her child are curled up together inside the tube of a 3 Tesla** magnetic resonance imaging scanner in April 2015. The scanner bangs and beeps, shudders and screeches. The baby is finally sleeping, pressed firmly against his mother's chest, and so is still enough for the MRI to see inside his head. A single MR image, like this one, takes several minutes to capture. Moving just a millimeter leaves a blur on the screen. The mother and baby must hold their pose, as if for a daguerreotype.

While they lie there, the scanner builds up a picture of what's inside their skulls. Often MR images are made for physicians, to find a tumor or a blocked blood vessel. Scientists also make the images, to study brain function and development. In my lab, at MIT, we use MRI to watch blood flow through the brains of children; we read them stories and observe how their brain activity changes in reaction to the plot. By doing so, we're investigating how children think about other people's thoughts.

This particular MR image, though, was not made for diagnostic purposes, nor even really for science. No one, to my knowledge, had ever made an MR image of a mother and child. We made this one because we wanted to see it.

To some people, this image was a disturbing reminder of the fragility of human beings. Others were drawn to the way that the two figures, with their clothes and hair and faces invisible, became universal, and could be any human mother and child, at any time or place in history. Still others were simply captivated by how the baby's brain is different from his mother's; it's smaller, smoother and darker—literally, because there's less white matter.

Here is a depiction of one of the hardest problems in neuroscience: How will changes in that specific little organ accomplish the unfolding of a whole human mind?

As for me, I saw a very old image made new. The Mother and Child is a powerful symbol of love and innocence, beauty and fertility. Although these maternal values, and the women who embody them, may be venerated, they are usually viewed in opposition to other values: inquiry and intellect, progress and power. But I am a neuroscientist, and I worked to create this image; and I am also the mother in it, curled up inside the tube with my infant son. -REBECCA SAXE

Scientists reconfigured a magnetic resonance scanner to capture a woman and her baby.

FAST FORWARD

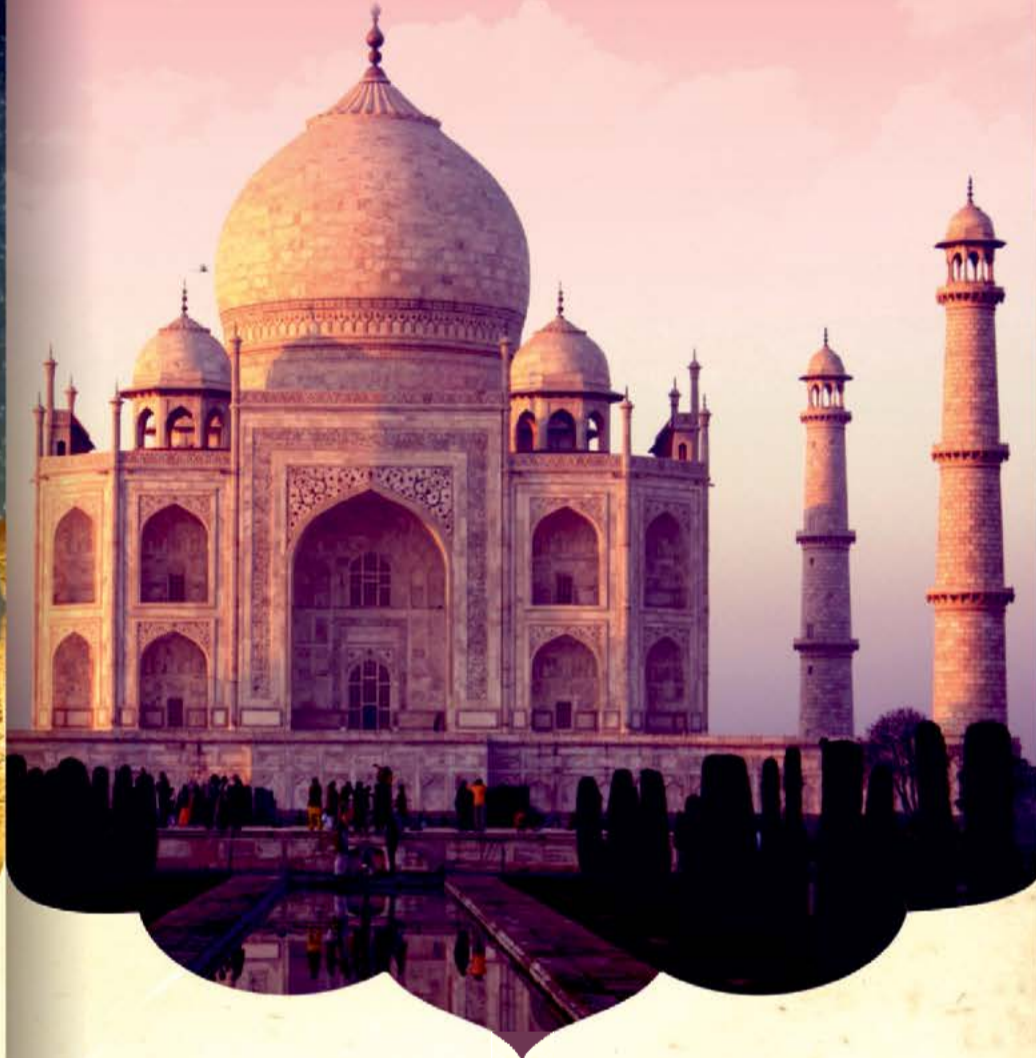
# Turkey



## Explore the world's oldest temple Gobekli Tepe 10,000 BC

Turkey is rightfully referred to as the "Cradle of Civilization". Our tour will start in Istanbul, the capital of Byzantine empire, continue through the legendary city of Troy and the biblical city of Ephesus, later through the timeless and bare rock landscape of Cappadocia. The site of Catalhuyuk, where we can see the beginning of the urban civilization is one of the first settlements where people lived together, building established houses 7 thousand years B.C! Another attraction is Mount Nemrut, considered the eighth wonder of the ancient world. The highlight of the tour is perhaps the most important archaeological discovery of the modern times – Gobekli Tepe, The World's First Temple.

# India



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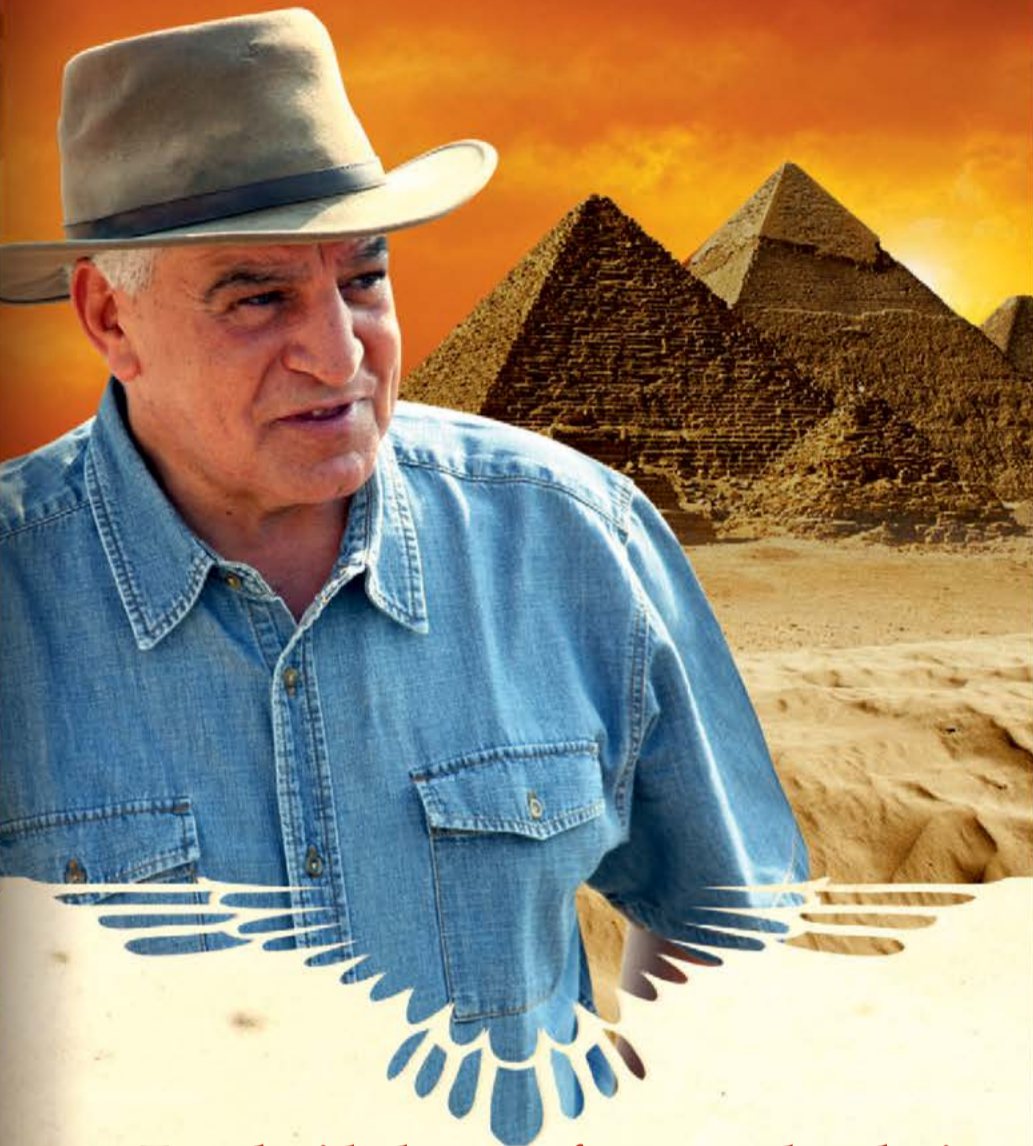


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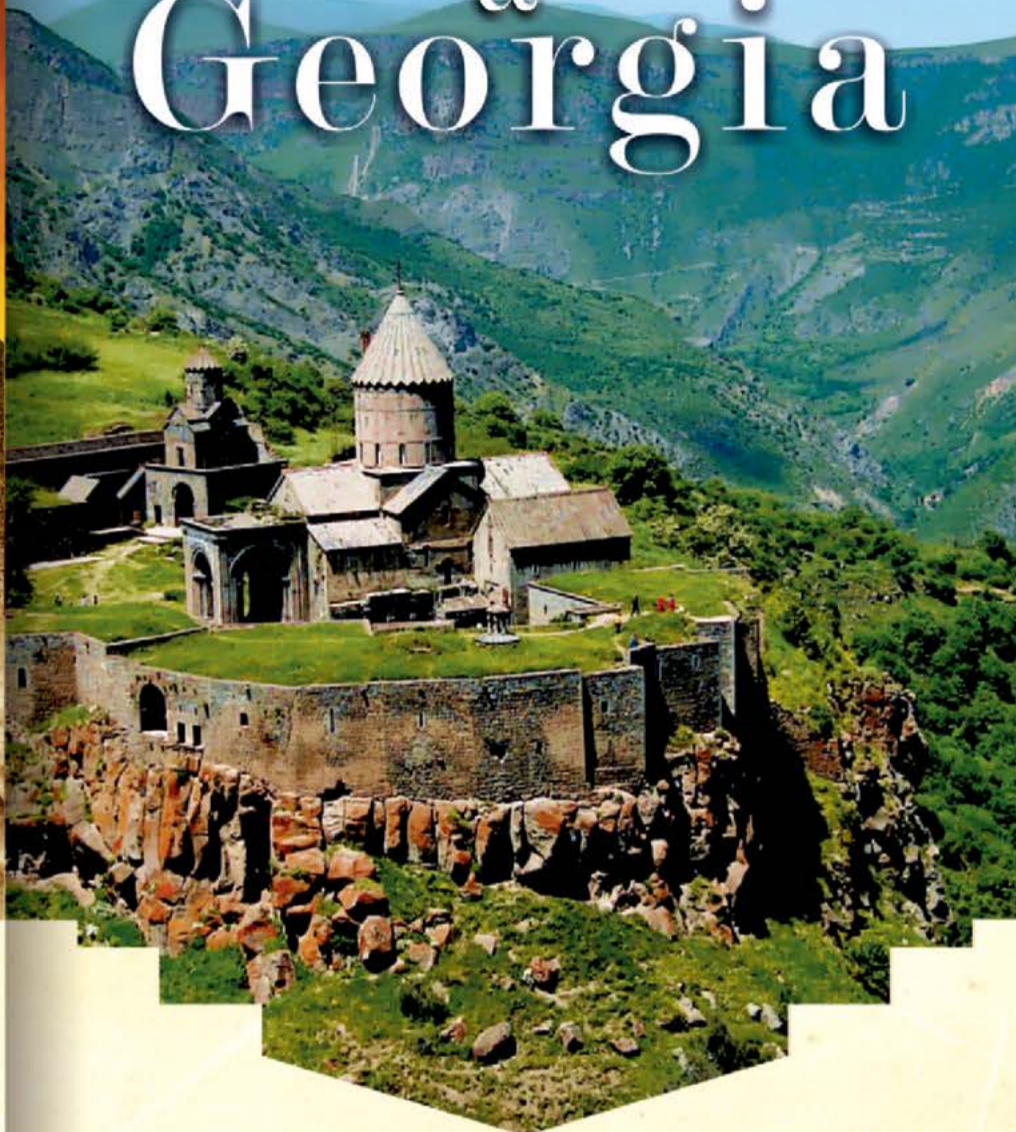
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numerous accusations against you and brand the accusers with  
the name which they richly deserve Justice



In 1856, a Nantucket sailor sketched the killing of his crew's "100-barrel" prize.

## Quakers with a Vengeance

Ron Howard's new film of *In the Heart of the Sea* captures the greed and blood lust of 1800s Nantucket

**T**oday Nantucket Island is a fashionable summer resort: a place of T-shirt shops and trendy boutiques. It's also a place of picture-perfect beaches where even at the height of summer you can stake out a wide swath of sand to call your own. Part of what makes the island unique is its place on the map. More than 25 miles off the coast of Massachusetts and only 14 miles long, Nantucket is, as Herman Melville wrote in *Moby-Dick*, "away off shore." But what makes Nantucket truly different is its past. For a relatively brief period during the late 18th and early 19th centuries, this lonely crescent of sand at the edge of the Atlantic was the whaling capital of the world and one of the wealthiest communities in America.

The evidence of this bygone glory can still be seen along the upper reaches of the town's Main Street, where the cobbles seem to dip and rise like an undulant sea and where the houses—no matter how grand and magisterial—still evoke the humble spirituality of the island's Quaker past. And yet lurking beneath this almost ethereal surface is the story of a community that sustained one of the bloodiest businesses the world has ever known. It's a story that I hadn't begun to fully appreciate until after more than a decade of living on the island when I started researching *In the Heart of the Sea*, a nonfictional account of the loss of the whaleship *Essex*, which I revisit here. While what happened to the crew of that ill-fated ship is an epic unto itself—and the inspiration behind the climax of *Moby-Dick*—just as compelling in its own quintessentially American way is the island microcosm that the Nantucket whalers called home.

**When the Essex departed from Nantucket for the last time in the summer of 1819**, Nantucket had a population of about 7,000, most of whom lived on a gradually rising hill crowded with houses and punctuated by windmills and church towers. Along the waterfront, four solid-fill wharves extended more than 100 yards into the harbor. Tied up to the wharves or anchored in the harbor were, typically, 15 to 20 whale ships, along with dozens of smaller vessels, mainly sloops and schooners that carried trade goods to and from the island. Stacks of oil casks lined each wharf as two-wheeled, horse-drawn carts continually shuttled back and forth.

Nantucket was surrounded by a constantly shifting maze of shoals that made the simple act of approaching or departing the island an often harrowing and sometimes disastrous lesson in seamanship. Especially in winter, when storms were the most deadly, wrecks occurred almost weekly. Interred across the island were the corpses of anonymous seamen who had washed onto its wave-pummeled shores. Nantucket—"faraway land" in the language of the island's native inhabitants, the Wampanoag—was a deposit of sand eroding into an inexorable ocean, and all its residents, even if they had never sailed away from the island, were keenly aware of the inhumanity of the sea.

Nantucket's English settlers, who first disembarked on the island in 1659, had been mindful of the sea's dangers. They had hoped to earn their livelihoods not as fishermen but as farmers and shepherds on this grassy isle dotted with ponds, where no wolves preyed. But as the burgeoning livestock herds, combined with the increasing number of farms, threatened to transform the island into a wind-blown wasteland, Nantucketers inevitably turned seaward.

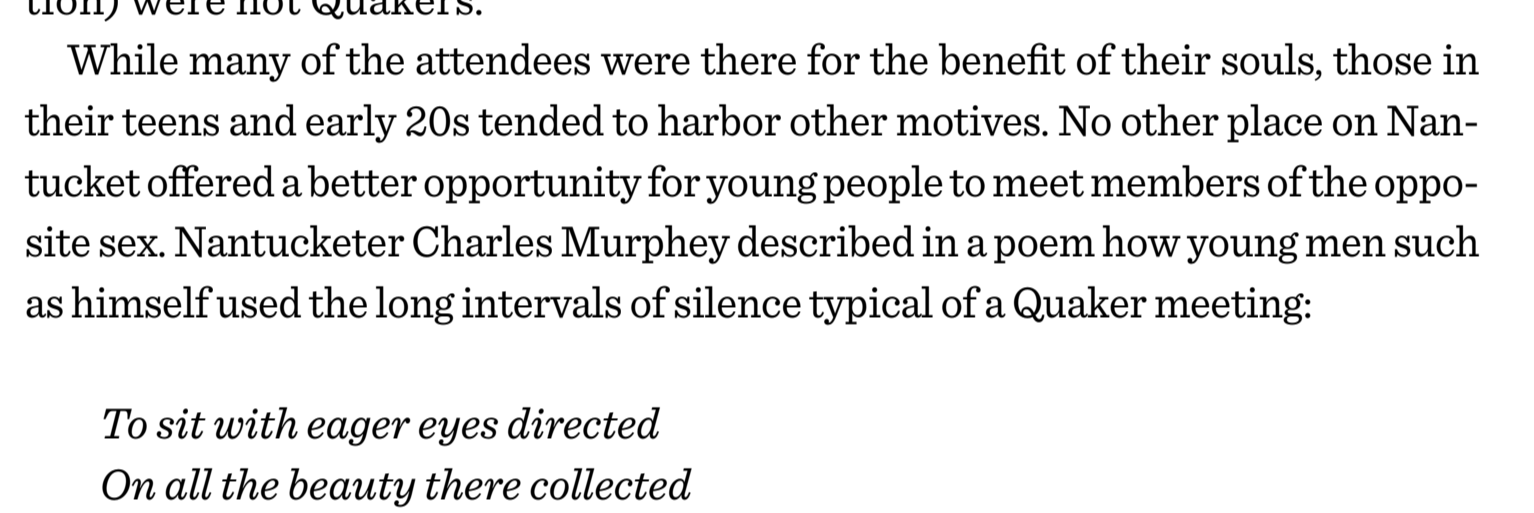
Every autumn, hundreds of right whales converged to the south of the island and remained until the early spring. Right whales—so named because they were "the right whale to kill"—grazed the waters off Nantucket as if they were seagoing cattle, straining the nutrient-rich surface of the ocean through the bushy plates of baleen in their perpetually grinning mouths. While English settlers at Cape Cod and eastern Long Island had already been pursuing right whales for decades, no one on Nantucket had summoned the courage to set out in boats and hunt the whales. Instead they left the harvesting of whales that washed ashore (known as drift whales) to the Wampanoag.

Around 1690, a group of Nantucketers was gathered on a hill overlooking the ocean where some whales were spouting and frolicking. One of the islanders nodded toward the whales and ocean beyond. "There," he said, "is a green pasture where our children's grandchildren will go for bread." In fulfillment of the prophecy, a Cape Codder, one Achabod Paddock, was subsequently lured across Nantucket Sound to instruct the islanders in the art of killing whales.

Their first boats were only 20 feet long, launched from beaches along the island's south shore. Typically a whaleboat's crew comprised five Wampanoag oarsmen, with a single white Nantucketer at the steering oar. Once they'd dispatched the whale, they towed it back to the beach, where they sliced out the blubber and boiled it into oil. By the beginning of the 18th century, English Nantucketers had introduced a system of debt servitude that provided a steady supply of Wampanoag labor. Without the native inhabitants, who outnumbered Nantucket's white population well into the 1720s, the island would never have become a prosperous whaling port.

In 1712, a Captain Hussey, cruising in his little boat for right whales along Nantucket's south shore, was pushed out to sea in a fierce northerly gale. Many miles out, he glimpsed several whales of an unfamiliar type. This whale's spout arched forward, unlike a right whale's vertical spout. In spite of the high winds and rough seas, Hussey managed to harpoon and kill one of the whales, its blood and oil calming the waves in nearly biblical fashion. This creature, Hussey quickly perceived, was a sperm whale, one of which had washed up on the island's southwest shore a few years earlier. Not only was the oil derived from the sperm whale's blubber far superior to that of the right whale, providing a brighter and cleaner-burning light, but its block-shaped head contained a vast reservoir of even better oil, called spermaceti, that could simply be ladled into an awaiting cask. (It was spermaceti's resemblance to seminal fluid that gave rise to the sperm whale's name.) The sperm whale might have been faster and more aggressive than the right whale, but it was a far more lucrative target. With no other source of livelihood, Nantucketers dedicated themselves to the single-minded pursuit of the sperm whale, and they soon surpassed their whaling rivals on the mainland and Long Island.

By 1760, the Nantucketers had virtually exterminated the local whale population. By that time, however, they had enlarged their whaling sloops and outfitted them with brick tryworks capable of processing the oil on the open ocean. Now, since it was no longer necessary to return to port as often to deliver bulky blubber, their fleet had a far greater range. By the advent of the American Revolution, Nantucketers had reached the verge of the Arctic Circle, the west coast of Africa, the east coast of South America and the Falkland Islands to the south.



In a speech before Parliament in 1775, the British statesman Edmund Burke cited the island's inhabitants as the leaders of a new American breed—a "recent people" whose success in whaling had exceeded the collective might of all of Europe. Living on an island nearly the same distance from the mainland as England was from France, Nantucketers developed a British sense of themselves as a distinct and exceptional people, privileged citizens of what Ralph Waldo Emerson called the "Nation of Nantucket."

The Revolution and the War of 1812, when the British Navy preyed upon offshore shipping, proved catastrophic to the whale fishery. Fortunately, Nantucketers possessed sufficient capital and whaling expertise to survive these setbacks. By 1819, Nantucket was well positioned to reclaim and, as the whalers ventured into the Pacific, even overtake its former glory. But the rise of the Pacific sperm whale fishery had a regrettable consequence. Instead of voyages that had once averaged about nine months, two- and three-year voyages had become typical. Never before had the division between Nantucket's whaler and their people been so great. Long vanished was the era when Nantucketers could observe from shore as the men and boys of the island pursued the whale. Nantucket was now the whaling capital of the world, but there were more than a few islanders who had never glimpsed a whale.

Nantucket had forged an economic system that no longer depended on the island's natural resources. The island's soil had long since been depleted by overfarming. Nantucket's large Wampanoag population had been reduced to a handful by epidemics, forcing shipowners to look to the mainland for crew. Whales had almost completely disappeared from local waters. And still the Nantucketers prospered. As one visitor observed, the island had become a "barren sandbank, fertilized with whale-oil only."

**Throughout the 17th century, English Nantucketers resisted all efforts to establish a church on the island**, partly because a woman named Mary Coffin Starbuck forbade it. It was said that nothing of importance was undertaken on Nantucket without her consent. Mary Coffin and Nathaniel Starbuck had been the first English couple married on the island, in 1662, and had established a profitable outpost for trading with the Wampanoag. Whenever an itinerant minister arrived in Nantucket intending to establish a congregation, he was summarily rebuffed by Mary Starbuck. Then, in 1701, she succumbed to a charismatic Quaker minister, John Richardson. Speaking before a group assembled in the Starbucks' living room, Richardson succeeded in moving her to tears. It was Mary Starbuck's conversion to Quakerism that established the unique convergence of spirituality and covetousness that would underlie Nantucket's rise as a whaling port.

Nantucketers perceived no contradiction between their source of income and their religion. God himself had granted them dominion over the fishes of the sea. Pacific killers, plain-dressed millionaires, the whalemen of Nantucket (whom Herman Melville described as "Quakers with a vengeance") were simply enacting the Lord's will.

On the corner of Main and Pleasant streets stood the Quakers' immense South Meetinghouse, constructed in 1792 from pieces of the even larger Meetinghouse that once loomed over the stoneloss field of the Quaker Burial Ground at the end of Main Street. Instead of an exclusive place of worship, the meetinghouse was open to nearly anyone. One visitor claimed that almost half those who attended a typical meeting (which sometimes attracted as many as 2,000 people—more than a quarter of the island's population) were not Quakers.

While many of the attendees were there for the benefit of their souls, those in their teens and early 20s tended to harbor other motives. No other place on Nantucket offered a better opportunity for young people to meet members of the opposite sex. Nantucketer Charles Murphey described in a poem how young men such as himself used the long intervals of silence typical of a Quaker meeting:

*To sit with eager eyes directed  
And gaze with wonder while  
in sessions  
On all the various forms  
and fashions.*

**No matter how much this nominally Quaker community might attempt to conceal it**, there was a savagery about the island, a blood lust and pride that bound every mother, father and child in a clannish commitment to the hunt. The imprinting of a young Nantucketer commenced at the earliest age. The first words a baby learned included the language of the chase—*townor*, for instance, a Wampanoag word signifying that the whale has been sighted for a second time. Bedtime stories told of killing whales and eluding cannibals in the Pacific. One mother approvingly recounted that her 9-year-old son affixed a fork to a ball of darning cotton and then went on to harpoon the family cat. The mother entered the room just as the terrified pet attempted to escape, and unsure of what she had found herself in the middle of, she picked up the cotton ball. Like a veteran boat-steerer, the boy shouted, "Pay out, mother! Pay out! There she sounds through the window!"

There was rumored to exist a secret society of young women on the island whose members vowed to wed only men who had already killed a whale. To help these young women identify them as hunters, boatsteers wore chockpins (small oak pins used to secure the harpoon line in the bow groove of a whaleboat) on their lapels. Boatsteers, outstanding athletes with prospects of lucrative captaincies, were considered the most eligible Nantucket bachelors.

Instead of toasting a person's health, a Nantucketer offered invocations of a darker sort:

*Death to the living,  
Long life to the killers,  
Success to sailors' wives  
And greasy luck to whalers.*

Despite the bravado of this little ditty, death was a fact of life all too familiar among Nantucketers. In 1810 there were 472 fatherless children on Nantucket, while nearly a quarter of the women over the age of 23 (the average age of marriage) had lost their husbands to the sea.

Perhaps no community before or since has been so divided by its commitment to work. For a whaleman and his family, it was a punishing regimen: two to three years away, three to four months at home, with their men absent for so long, Nantucket's women were obliged not only to raise their children but also to oversee many of the island's businesses. It was women for the most part who maintained the complex web of personal and commercial relationships that kept the community functioning. The 19th-century feminist Lucretia Coffin Mott, who was born and raised on Nantucket, remembered how a husband returned from a voyage commonly founded in the wake of his wife, accompanying her to get-togethers with other wives. Mott, who eventually moved to Philadelphia, commented on how odd such a practice would have seemed to anyone from the mainland, where the sexes operated in entirely distinct social spheres.

Some of the Nantucket wives adapted readily to the rhythm of the whale fishery. The islander Eliza Brock recorded in her journal what she called the "Nantucket Girl's Song":

*Then I'll haste to wed a sailor,  
and send him off to sea,  
For a life of independence,  
is the pleasant life for me.  
But every now and then I shall  
like to see his face,  
For it always seems to me to beam with manly grace. . . .  
But when he says "Goodbye my love, I'm off across the sea,"  
First I cry for his departure, then laugh because I'm free.*

**As their wives and sisters conducted their lives back on Nantucket, the island's men and boys pursued some of the largest mammals on earth.** In the early 19th century a typical whaleship had a crew of 21 men, 18 of whom were divided into three whaleboat crews of six men each. The 25-foot whaleboat was lightly built of cedar planks and powered by five long oars, with an officer standing at the steering oar on the stern. The trick was to row as close as possible to their prey so that the man at the bow could hurl his harpoon into the whale's greasy black flank. More often than not the panicked creature hurtled off in a desperate rush, and the men found themselves in the midst of a "Nantucket sleigh ride." For the uninitiated, it was both exhilarating and terrifying to be pulled along at a speed that approached as much as 20 miles an hour, the small open boat slapping against the waves with such force that the nails sometimes started from the planks at the bow and stern.

The harpoon did not kill the whale. It was the equivalent of a fishhook. Incher by incher, to within stabbing distance of the whale. Taking up the 12-foot-long killing lance, the man at the bow probed for a group of lance arteries near the whale's lungs with a violent churning motion. When the coil finally plunged into its target, the whale would begin to choke on its own blood, its spout transformed into a 15-foot geyser of gore that prompted the men to shout, "Chimney's afire!" As the blood rained down on them, they took up the oars and backed furiously away, then paused to observe as the whale went into what was known as its "furry." Pounding the water with its tail, snapping at the air with its jaws, the creature began to swim in an ever-tightening circle. Then, just as abruptly as the attack had begun with the initial harpoon thrust, the hunt ended. The whale fell motionless and silent, a giant black corpse floating fin up in a slick of its own blood and vomit.

Now it was time to butcher the whale. After laboriously towing the corpse back to the vessel, the crew secured it to the ship's side, the head toward the stern. Then began the slow and bloody process of peeling five-foot-wide strips of blubber from the whale; the sections were then hacked into smaller pieces and fed into the two immense iron trypots mounted on the deck. Wood was used to start the fires beneath the pots, but once the boiling process had commenced, crisp pieces of blubber floating on the surface were skimmed off and tossed into the fire for fuel. The flames that melted down the whale's blubber were thus fed by the whale itself and produced a thick pall of black smoke for an unforgettable stench—"as though," one whaleman remembered, "all the odors in the world were gathered together and being shaken up."

**During a typical voyage, a Nantucket whaleship might kill and process 40 to 50 whales.** The repetitious nature of the work—a whaler was, after all, a factory ship—desensitized the men to the awesome wonder of the whale. Instead of seeing their prey as a 50- to 60-ton creature whose brain was close to six times the size of their own (and, what perhaps should have been even more impressive in the all-male world of the fishery, whose penis was as long as they were tall), the whaler preferred to think of it as what one observer described as "a self-propelled tub of high-income land." In truth, however, the whalemen had more in common with their prey than they would have ever cared to admit.

In 1985 the sperm whale expert Hal Whitehead used a cruising sailboat fitted with sophisticated monitoring equipment to track sperm whales in the same waters that the *Essex* plied in the summer and fall of 1820. Whitehead found that the typical pod of whales, which ranges between 3 and 20 or so individuals, comprised almost exclusively interrelated adult females and immature whales. Adult males made up only 2 percent of the whales he observed.

The females work cooperatively in taking care of their young. The calves are passed from whale to whale so that an adult is always standing guard when the mother is feeding on squid thousands of feet below the ocean's surface. As an older whale raises its flukes at the beginning of a long dive, the calf will swim to another nearby adult.

Young males depart the family unit at around 6 years of age and make their way to the cooler waters of the high latitudes. Here they live singly or with other males, not returning to the warm waters of their birth until their late 20s. Even then, a male's return is fairly transient; he spends only eight or so hours with any particular group, sometimes mating but never establishing strong attachments, before returning to the high latitudes.

The sperm whales' network of female-based family units resembled, to a remarkable degree, the community the whaleman had left back home on Nantucket. In both societies the males were itinerants. In their pursuit of killing sperm whales the Nantucketers had developed a system of social relationships that mimicked those of their prey.

**Herman Melville chose Nantucket to be the port of the Pequod in *Moby-Dick*,** but it would not be until the summer of 1852—almost a year after publication of his whaling epic—that he visited the island for the first time. By then Nantucket's whaling heyday was behind it. The mainland port of New Bedford had assumed the mantle as the nation's whaling capital, and in 1846 a devastating fire destroyed the island's oil-soaked waterfront. The Nantucketers quickly rebuilt, this time in brick, but the community had begun a decades-long descent into economic depression.

Melville, it turned out, was experiencing his own decline. Despite being regarded today as a literary masterpiece, *Moby-Dick* was poorly received by both critics and the reading public. In 1852, Melville was a struggling writer in desperate need of a holiday, and in July of that year he accompanied his father-in-law, Justice Lemuel Shaw, on a voyage to Nantucket. They likely stayed at what is now the Jared Coffin House at the corner of Center and Broad streets. Diagonally across from Melville's lodgings was the home of none other than George Pollard Jr., the former captain of the *Essex*.

Pollard, as it turned out, had gone to sea again after the loss of the *Essex*, as captain of the whaleship *Two Brothers*. That ship went down in a storm in the Pacific in 1823. All the crew members survived, but, as Pollard confessed during the return voyage to Nantucket, "No owner will ever trust me with a whaleship again, for all will say I am an unlucky man."

By the time Melville visited Nantucket, George Pollard had become the town's night watchman, and at some point the two men met. "To the islanders he was a nobody," Melville later wrote, "to me, the most impressive man, tho' wholly unassuming even humble—that I ever encountered." Despite having suffered the worst of all possible disappointments, Pollard, who retained the watchman position until the end of his life in 1870, had managed a way to continue on. Melville, who was doomed to die almost 40 years later in obscurity, had recognized a fellow survivor.

**In February 2011—more than a decade after publication of my book *In the Heart of the Sea***—came an astonishing news. Archaeologists had located the underwater wreck of a 19th-century whaling vessel and solved a Nantucket mystery. Kelly Gleason Keogh was wrapping up a monthlong expedition in the remote Hawaiian Islands when she and her team indulged in some last-minute exploring. They set out to snorkel the waters near Shark Island, an uninhabited speck 600 miles northwest of Honolulu. After 15 minutes or so, Keogh and a colleague spotted a giant anchor some 20 feet below the surface. Minutes later, they came upon three trypots—cast-iron cauldrons used by whalers to render oil from blubber.

"We knew we were definitely looking at an old whaling ship," says Keogh, 40, a maritime archaeologist who works for the National Oceanic and Atmospheric Administration and the Papahānaumokuākea Marine National Monument—at 140,000 square miles, the largest protected marine conservation area in the United States. Those artifacts, the divers knew, indicated that the ship likely came from Nantucket in the first half of the 19th century. Could it be, Keogh wondered, that they had stumbled across the long-lost *Two Brothers*, infamous in whaling history as the second vessel that Capt. George Pollard Jr. managed to lose at sea?

The *Two Brothers*—a 217-ton, 84-foot-long vessel built in Hallowell, Maine, in 1804—also carried two other *Essex* survivors, Thomas Nickerson and Charles Ramsdell. The ship departed Nantucket on November 26, 1821, and followed an established route, rounding Cape Horn. From the western coast of South America, Pollard sailed to Hawaii, making it as far as the French Frigate Shoals, an atoll in the island chain that includes Shark Island. The waters, a maze of flowing islands and reefs, were treacherous to navigate. The entire area, Keogh says, "acted a bit like a ship trap." Of the 60 vessels known to have gone down there, ten were whaleships, all of which sank during the peak of Pacific whaling, between 1822 and 1867.

Bad weather had thrown off Pollard's lunar navigation. On the night of February 11, 1823, the sea around the ship suddenly churned white as the *Two Brothers* hurtled against a reef. "The ship struck with a fearful crash, which whirled me head foremost to the other side of the cabin," Nickerson wrote in an eyewitness account he produced some years after the shipwreck. "Captain Pollard seemed to stand amid at the scene before him." First mate Eben Gardner recalled the final moments: "The sea made it over us and in a few moments the ship was full of water."

Pollard and the crew of about 20 men escaped in two whaleboats. The next day, a vessel sailing nearby, the *Martha*, came to their aid. The men all eventually returned home, including Pollard, who knew that he was, in his words, "utterly ruined."

Wrecks of old wooden sailing ships seldom resemble the intact hulks seen in movies. Organic materials such as wood and rope break down; only durable objects, including those made from iron or glass, remain. The waters off the northwestern Hawaiian Islands are particularly turbulent; Keogh compares diving there to being tumbled inside a washing machine. "The wave actions, the salt water, the creatures underwater have all taken their toll on the shipwreck," she says. "A lot of things after 100 years on the seafloor don't look like man-made objects anymore."

The remains of Pollard's ship went undisturbed for 185 years. "No one had gone searching for these things," Keogh says. Following the discovery, Keogh traveled to Nantucket, where she conducted extensive archival research on the *Two Brothers* and its unfortunate captain. The following year she returned to the site and followed a trail of sunken bricks (originally used as ballast) to discover a definitive clue to the ship's identity—harpoon tips that matched those produced in Nantucket during the 1820s. (The *Two Brothers* was the only Nantucket whaler shipwrecked in these waters in that decade.) That finding, Keogh says, was the smoking gun. After a visit to the site turned up shards of cooking pots that matched advertisements in Nantucket newspapers from that era, the team announced its discovery to the world.

Nearly two centuries after the *Two Brothers* departed Nantucket, the objects aboard the ship have returned to the island. They are featured in an interactive exhibition chronicling the saga of the *Essex* and her crew, "Stove by a Whale," at the Nantucket Whaling Museum. The underwater finds, says Michael Harrison of the Nantucket Historical Association, are helping historians to "put some real bones to the story" of the *Two Brothers*.

The underwater investigation will continue. Archaeologists have found hundreds of other artifacts, including blubber hooks, additional anchors, the bases of gins and wine bottles. According to Keogh, she and her team were lucky to have spotted the site when they did. Recently, a fast-growing coral has encased some items on the seafloor. Even so, Keogh says, discoveries may yet await. "Sand is always shifting at the site," she says. "New artifacts may be revealed."

**In 2012 I received word of the possibility that my book might be made into a movie** starring Chris Hemsworth and directed by Ron Howard. A year after that, in November 2013, my wife, Melissa, and I visited the set at the Warner Brothers lot in Leavesden, England, about an hour outside London. There was a wharf extending out into a water tank about the size of two football fields, with an 85-foot whaleship tied up to the pilings. Amazingly authentic buildings lined the waterfront, including a structure that looked almost exactly like the Pacific National Bank at the head of Main Street back on Nantucket. Three hundred extras walked up and down the muddy streets. After having once tried to create this very scene through words, it all seemed strangely familiar. I don't know about Melissa, but at that moment I had the surreal sense of being—even though I was more than 3,000 miles away—home. **O**

Additional reporting by Max Kutner and Katie Nodjimbalom



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# History Versus Hollywood

**Schindler, Pocahontas are best, worst in poll**

**LIKE ALL MOVIES** “based on a true story,” *In the Heart of the Sea* will make viewers ask where reality ends and Hollywood begins. That question is so important we addressed it in a unique way—studying expert and public opinion of the relationship between history and film. We commissioned an online survey conducted by Harris Poll of 2,014 U.S. adults. Separately, we conducted an online survey of 152 history professionals. The survey methods differed, but trends are clear. The public seems most riveted by World War II, while historians focus on the African-American experience.

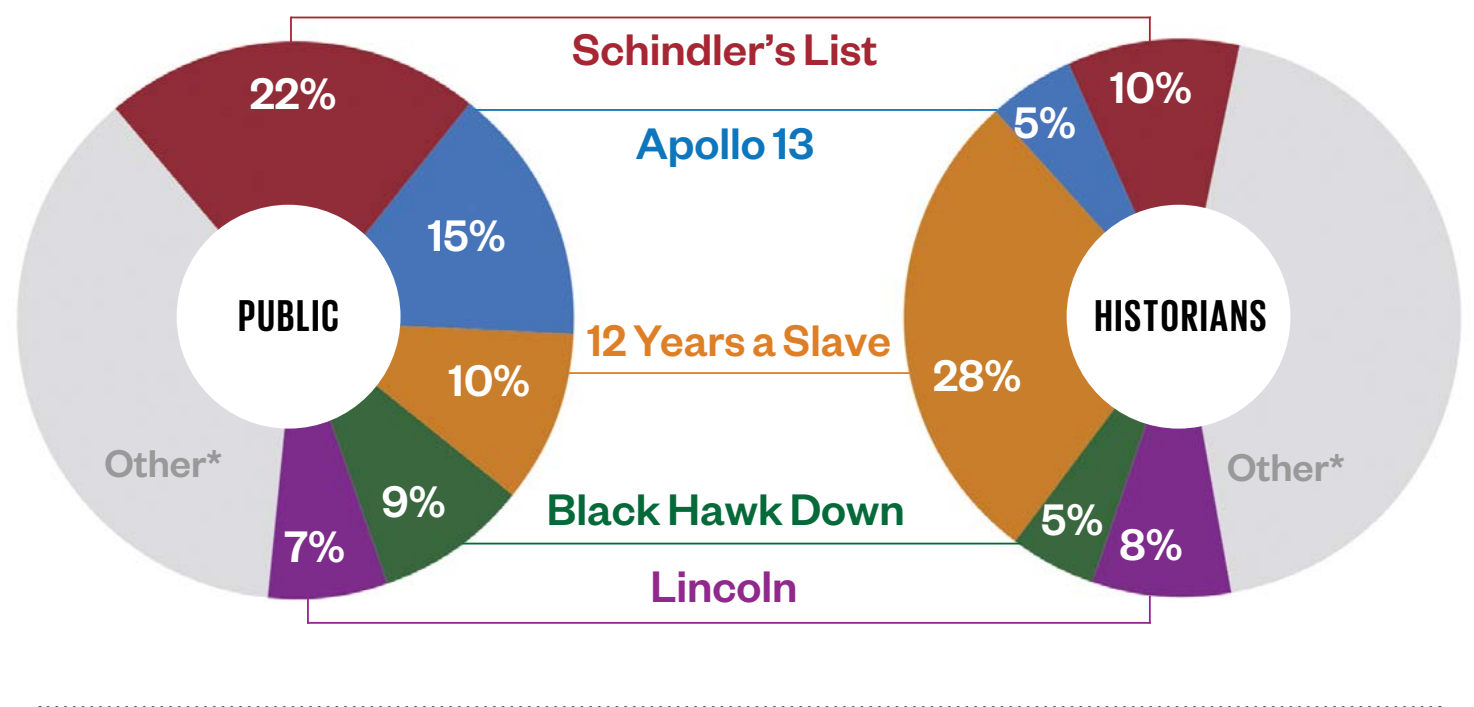
For more results, go to [Smithsonian.com/historypoll](http://Smithsonian.com/historypoll)



Based on a memoir, *12 Years a Slave* topped the historians' ranking.

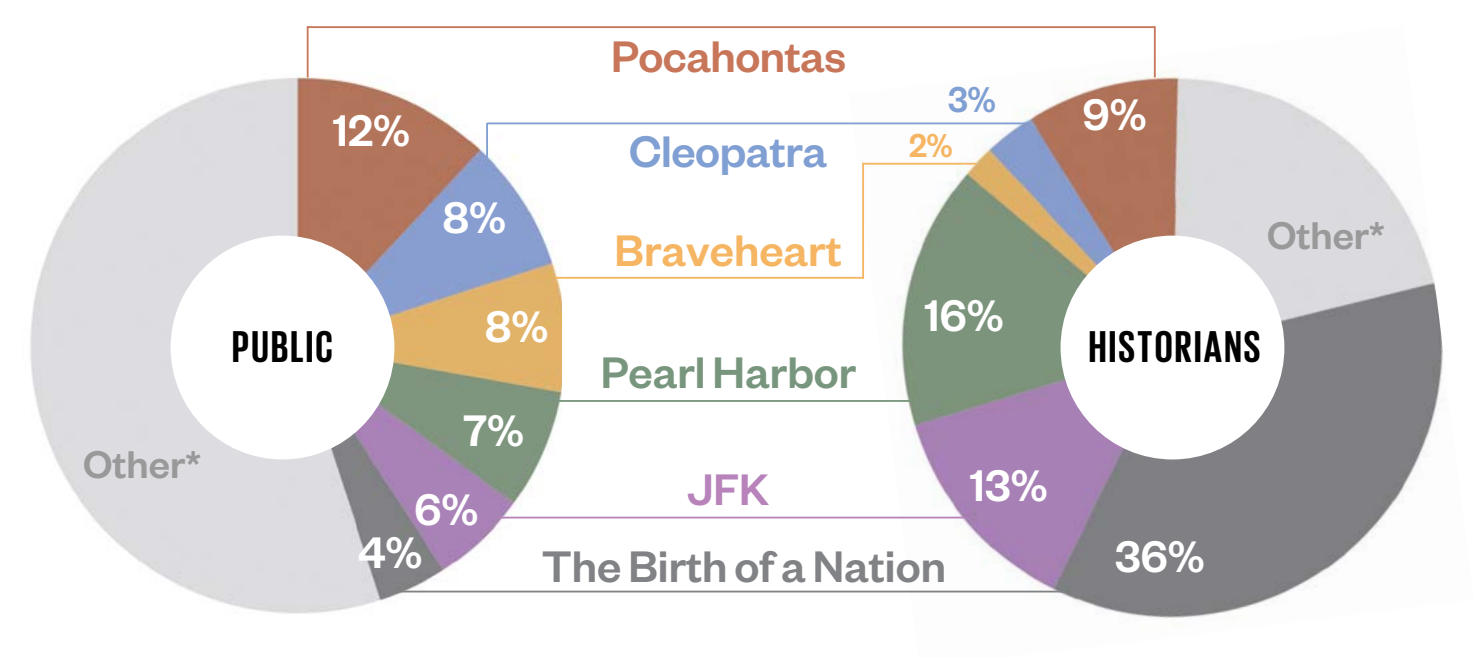
## Best historical movie

Among well-known “true story” films considered “accurate.”



## Worst historical movie

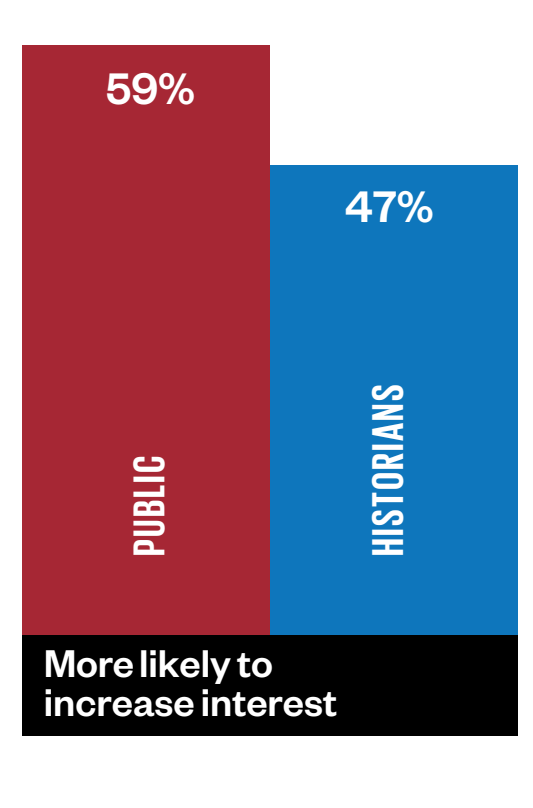
Among well-known “true story” films considered “inaccurate.”



\*Denotes titles that ranked below 5% and answers from respondents who checked “not sure” or “other.”

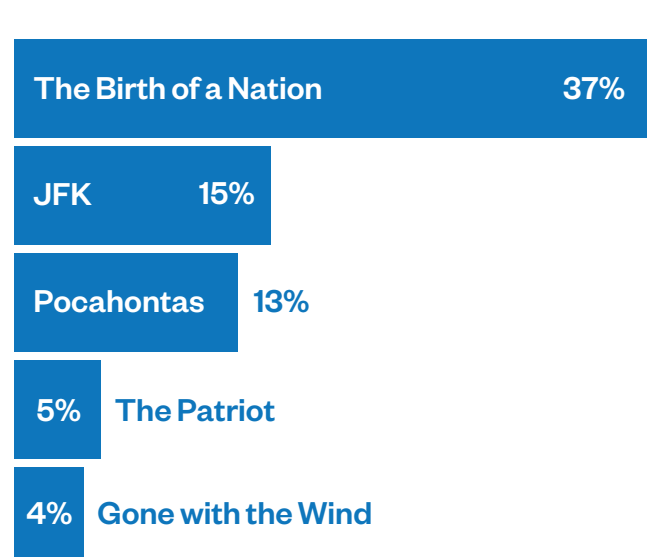
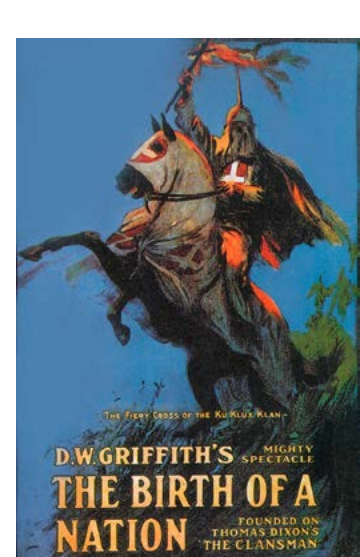
## What's in a tagline?

How does the marketing phrase “based on a true story” affect one's interest in seeing a movie? It appealed more to the public than to historians.



## Historians asked to assess the damage

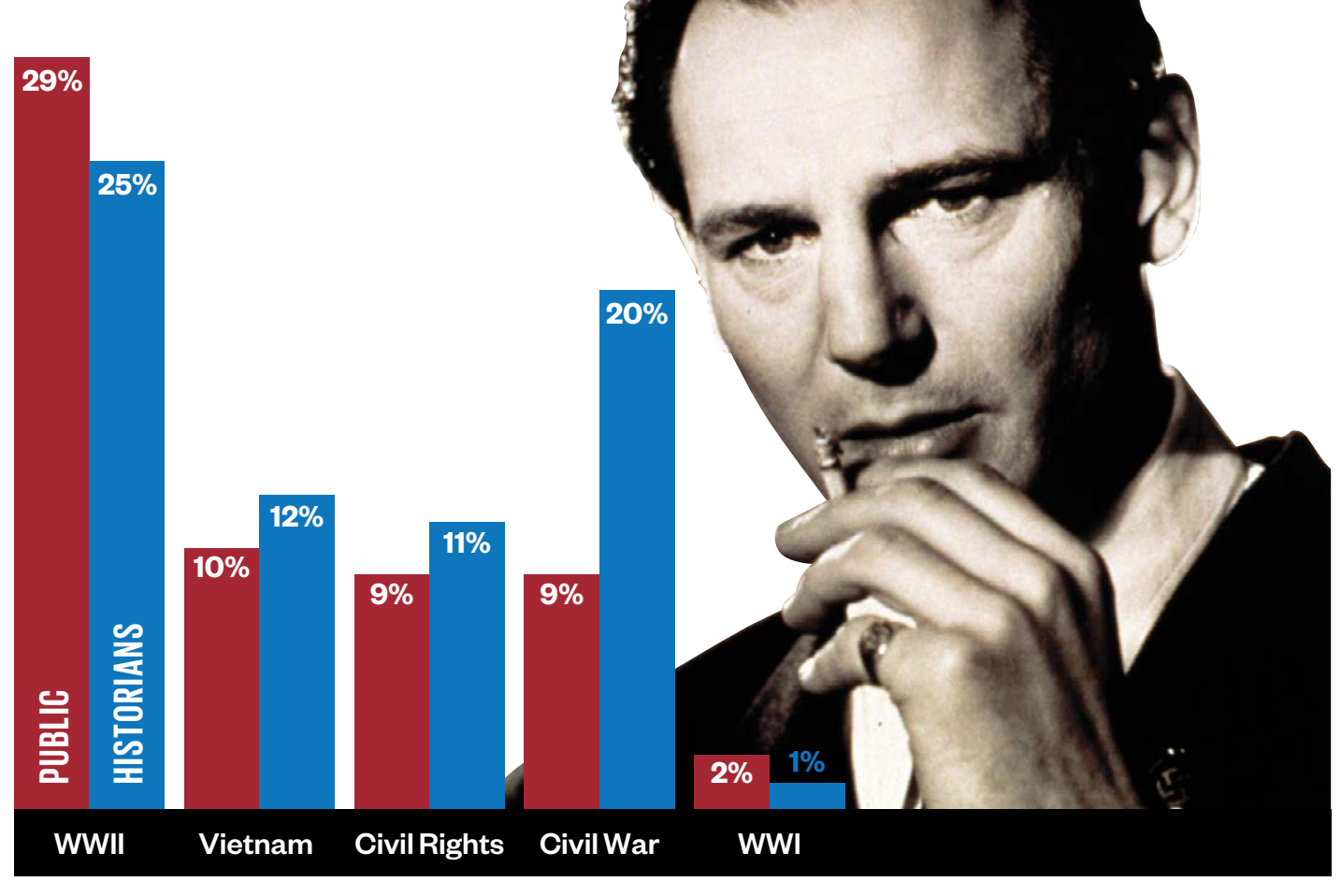
What motion picture has had the most negative impact on public understanding of history?



## Movies can be powerful teachers

The 1993 Oscar Schindler biopic was the public's favorite.

Which period or event in U.S. history have historians and the public learned most about from movies?



## According to historians...

The most historically accurate film is:

# 12 Years a Slave

and the least:

# Birth of a Nation

Despite the flaws in feature films,

# 71%

of historians say that movies can increase understanding or appreciation of history.

The survey of public opinion was conducted online within the United States by Harris Poll on behalf of Smithsonian magazine from October 15-19, 2015, among 2,014 adults ages 18 and older. This survey is not based on a probability sample and therefore no estimate of theoretical sampling error can be calculated.

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WAIT  
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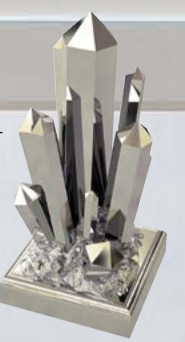
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# FAKING

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BEHIND THE SLY NEW  
SERIES "DOCUMENTARY  
NOW!" ADD A LAYER OF  
AUTHENTICITY TO THE  
ART OF SENDING UP  
NONFICTION FILMS  
BY  
FRANZ LIDZ

# IT



PHOTOGRAPHS BY **BRINSON + BANKS**  
GROOMING: CATHERINE FURNISS AND SYDNEY ZIBRAK





# Kunuk was an Inuk savant.

As chronicled in *Kunuk the Hunter*, a silent-era documentary by the Arctic explorer William H. Sebastian, he was an archetypal Eskimo who lived where nothing grew and subsisted on what he could kill. But as the sound-era exposé *Kunuk Uncovered* revealed, he was more or less invented for the screen by Sebastian. In real life, Kunuk was such a klutz that the filmmaker had to nail his gloves and boots to his dogsled to keep him from slipping off.

We learn that Sebastian actually went AWOL after the men of the Inuk village discovered he had been sleeping with their wives, and that the witless Kunuk had to take over the shoot. Though he was a natural, coming up with innovations like the tracking shot and point of view, he quickly turned on-set diva. In a series of crackly, Victrola-recorded tantrums, he whines about looking too old in the dailies, demands a craft services table and insists on filming during a blizzard because a storm would “fix [the movie’s] third-act problems.”

In case you haven’t already guessed, *Kunuk the Hunter* is a make-believe documentary. And *Kunuk Uncovered* is a make-believe documentary about the making of a make-believe documentary that sends up not only director Robert J. Flaherty and his 1922 classic *Nanook of the North*—long embraced as an authentic window on the Inuit way of life—but also *Nanook Revisited*, a 1990 follow-up that returned to the site of the original filming and showed that this milestone of early cinema con-



“Documentary Now!” host Dame Helen Mirren has introduced episodes including (from top) *Sandy Passage* (a takeoff on *Grey Gardens*), *Gentle & Soft* (a spoof of rockumentaries), *Kunuk Uncovered* (a sendup of *Nanook of the North* and *Nanook Revisited*) and *DRONEZ: The Hunt for El Chingon* (which parodies “Vice”).



tained many sequences that had been staged for the camera.

“Almost any story is almost certainly some kind of lie,” says Orson Welles in *F for Fake*, a *soi-disant* documentary that was part hoax, part true story. In that same spirit, *Kunuk Uncovered* turns out to be an episode of “Documentary Now!,” a comedy showcase that has added a new layer of sophistication to film parody.

Each half-hour installment of the series, which premiered in August on IFC, is framed as a 50th-anniversary celebration of landmark docs from a fictional public-broadcasting series. Introduced in earnest deadpan by the plummy-voiced Dame Helen Mirren, the shows riff on a cherished documentary film or trope. “Saturday Night Live” alumni Bill Hader and Fred Armisen are the principal performers; fellow graduate Seth Meyers is the principal writer.

Enduring comedy is grounded in both surprise and recognition, and that recognition requires that comedy arise from the real world. We’re happy to report that the parodies of “Documentary Now!” are so needlingly accurate and filmed with such loving detail as to be homages. The anthology takes its source material seriously even while skewering it. “Authenticity is the key,” says Armisen, the Kunuk of *Kunuk Uncovered*. “That applies to form as much as content.”

Extraordinary care and cleverness have been devoted to approximating the look, period and style of such varied works as Albert and David Maysles’ cinéma-vérité *Grey Gardens* (1975), Errol Morris’ waking nightmare *The Thin Blue Line* (1988) and HBO’s achingly hip “Vice” news program. This attention to detail extends from shots and period graphics to lighting and film stock.

“It’s the kind of wonderfully anal art direction you don’t usually hear about in a comedy,” says Hader. “In fact, very few comedies are visually interesting. Which is why Terry Gilliam never really directed another Monty Python movie after *Holy Grail*. In one scene, the other members of the troupe kneeled uncomfortably in suits of armor while Gilliam held up the shoot for hours until he got the smoke right. John Cleese said, ‘Terry, how many laughs are in the smoke?’”

The elaborate put-ons of “Documentary Now!” shimmy along on the strength of its seamless ensemble—Armisen and Hader are, in a manner of speaking, perfectly mismatched—



and its remarkable depth in storytelling. *Kunuk Uncovered*, for example, examines the relationship between documentarians and their subjects, the hubris it takes to make works of art, and the very nature of creative expression. The result is a hilarious and knowing lampooning of nonfiction formats and their tension between truth and tone.

“The reason ‘Documentary Now!’ is so groundbreaking is that it harkens back to the early days of film when people saw footage of a train and dove out of the way,” says onetime “SNL” head writer Adam McKay, the director of *Anchorman* and *Talladega Nights*. “There is nothing more exciting than believing something fake is real unless you’re conned and your money is taken. And even that is kind of cool. To this day, I love crank calls and old ‘Candid Camera’ episodes for the same reason.”

McKay credits Hader, Armisen, Meyers and director Rhys Thomas with reinventing the mockumentary, that most hidebound of motion picture genres. The faux-real tradition dates at least to Welles’ radio adaptation of *War of the Worlds*, a series of simulated news bulletins that unleashed considerable mischief way back in 1938. Two decades later, the BBC broadcast a piece of fudged realism about a “Swiss spaghetti harvest” that purported to show a family plucking strands of pasta from a spaghetti tree. Hundreds of viewers phoned in asking how they could grow their own.

“Helping to build something like a mockumentary that’s its own real estate is very cool,” Armisen says. “When we came up with the premise for ‘Documentary Now!’, I asked myself, ‘Is there vegetation back there?’ After reading Seth’s first script, I realized, ‘Oh yeah, I could live on that property.’”

Documentaries that seemed more about the filmmakers than the film were scrupulously avoided, as were those with a comic tone. “Why rework stuff that’s already funny?” says Armisen. “As Nigel Tufnel and David St. Hubbins said in *This Is Spinal Tap*, ‘It’s such a fine line between stupid, and, uh, clever.’”

A genuine pop-culture touchstone, *Spinal Tap* (1984) traces the history of a heavy-metal band on its final, futile tour. From spontaneously combusting drummers to the guitarist who thinks “sexist” and “sexy” are synonyms, no one else has eviscerated rock ’n’ roll so completely—except real rock stars themselves. “Among so-called mockumentaries, I don’t think





**Sketch artists: Armisen as Liberace and Hader as Vincent Price in a “Saturday Night Live” skit from 2009.**

anything really touches it,” observes Hader. “‘The Office,’ ‘Modern Family,’ ‘Parks and Recreation’—every recent single-camera sitcom with jokey talking heads owes its existence to *Spinal Tap*.”

Still, Hader insists that the biggest inspirations for “Documentary Now!” were Woody Allen’s moc-docs *Take the Money and Run* (1969) and *Zelig* (1983). The former recounted the criminal career of the hapless Virgil Starkwell; the latter was a historical pastiche about Leonard Zelig, a “human chameleon” who took on the physical, mental and emotional attributes of any strong personality he was with, and whose discovery prompted headlines, psychiatric studies and Jazz Age dance crazes.

“I was really impressed with the interviews in *Take the Money and Run*,” Hader recalls. “The ones with Starkwell’s teachers, his music instructors, his Groucho-glasses-wearing parents—‘I tried to beat God into him!’—made you feel like you were witnessing an actual conversation.”

Hader found *Zelig* as moving as it was ambitiously mischievous. He loved how the disparate elements meshed. During the early days of “Documentary Now!,” he sent DVDs of the film to Rhys Thomas and co-director Alex Buono.





**“WE’RE ALL FANS OF THE MOVIES WE’RE PARODYING. WE’D LIKE NOTHING BETTER THAN FOR UNSUSPECTING VIEWERS TO TUNE IN TO AN EPISODE AND, HALFWAY THROUGH, FIGURE OUT THAT THEY’RE NOT WATCHING A REAL DOCUMENTARY.”**

“I told them, ‘This is the mood of the show: very serious, very dry, but with insane jokes and crazy moments. You don’t want to wink too much at the audience.’”

When mockumentaries go awry, he says, it’s often because they don’t play by the rules of documentaries. Which is why only one camera was used in the *Grey Gardens* takeoff, which is titled *Sandy Passage*. “That’s all the Maysleses had, so that’s all we had,” Armisen says. “Again, it all goes back to authenticity.”

He and Hader are both gifted mimics. Armisen’s expressions of breathtaking inanity—a highlight of his other IFC show, “Portlandia”—seem to come with worrying ease. For his part, Hader’s physical and vocal quirks allow him to sketch characters as if by shorthand. Over eight seasons on “SNL,” he developed an unequalled range of wiggly characterizations (the flamboyant Stefon, Italian talk-show host Vinny Vedecci) and eerily precise impersonations (Al Pacino, Vincent Price).

One of his finest moments on “Documentary Now!” came while playing a lightly fictionalized version of *Grey Gardens*’ Little Edie Beale, a down-and-out socialite living with her mother in a derelict mansion overrun with cats, raccoons and the flotsam of regret.

Like Little Edie, Hader’s Little Vivvy wears head wraps, though in her case they are sweatpants. (The legs are built-in scarves, she explains.) As self-effacing as the Cheshire Cat, Hader disappears into the role with a smoky smile. Whimsy morphs into menace, and this small masterpiece of mock-poetry takes a late-game turn, mixing in morsels of *Psycho* and *The Blair Witch Project*.

“We’re all fans of the movies we’re parodying,” says Hader. “We’d like nothing better than for unsuspecting viewers to tune in to an episode and, halfway through, figure out that they’re not watching a real documentary. If our remake makes them curious enough to watch the original, we’ll be very, very happy.” ●



Watch clips from episodes of “Documentary Now!” at [Smithsonian.com/docnow](https://www.smithsonian.com/docnow)



AMERICAN  
INGENUITY

THE SCIENTIST BEHIND  
NASA'S NEW HORIZONS  
MISSION GAVE  
CHEERING EARTHLINGS  
THEIR FIRST CLOSE-UP  
VIEW OF PLUTO

BY ELIZABETH **QUILL**  
PHOTOGRAPHS BY MICHAEL **SOLURI**

# OUT OF THIS WORLD

PHYSICAL SCIENCES • ALAN STERN





**A triumphant Stern holds a full-frame image of Pluto, taken just hours before the New Horizons probe (previous page, at launch in 2006) reached its closest point to Pluto.**

# Alan Stern promised his co-workers

that their Pluto flyby would make the front page of the *New York Times*, above the fold. But even Stern didn't expect the achievement to appear in the same prominent place in 450 newspapers on July 15, the morning after the New Horizons spacecraft whizzed by Pluto and transformed it forever from a mere point of light into a three-dimensional world with its own identity. "People dig exploration," Stern said by way of explaining the global fascination.

People also dig hard-won triumph, and what a triumph it was, slingshotting a device no heavier than a Smart car across the solar system and having it meet up more than nine years and three billion miles later with an icy sphere smaller than our moon. The feat showed us again that perhaps the only thing more wondrous than space itself is the human mind that relentlessly insists on understanding it.

Stern, who is a planetary scientist, aerospace engineer, associate vice president for research and development at the Southwest Research Institute and principal investigator of the New Horizons mission, set his sights on Pluto decades ago and designed spacecraft to study it several times before, only to have his plans fizzle long before they reached the launchpad. His dogged determination is one reason for this mission's shining success, but determination is also a quality shared by the many hundreds of scientists, engineers and technicians who have worked on the project over the years. Stern's singular contribution, actually, has been his shrewd pragmatism in navigating NASA's funding obstacles and the mission approval process, a world fraught with dream-killing hazards (see "Plutonic Love," June 2015). A NASA veteran, Stern put into action an idea that goes beyond the classic engineering aesthetic "less is more." Think of it as less is most.

To get to Pluto quickly, the spacecraft had to be light. It weighed just 1,054 pounds at launch. The seven onboard scientific instruments—which had a long list of tasks that included mapping Pluto and its largest moon, capturing high-resolution and color images, studying its geology and composition, measuring solar wind and detecting dust—come in at just 66 pounds. For the spacecraft to be light, the instrumentation had





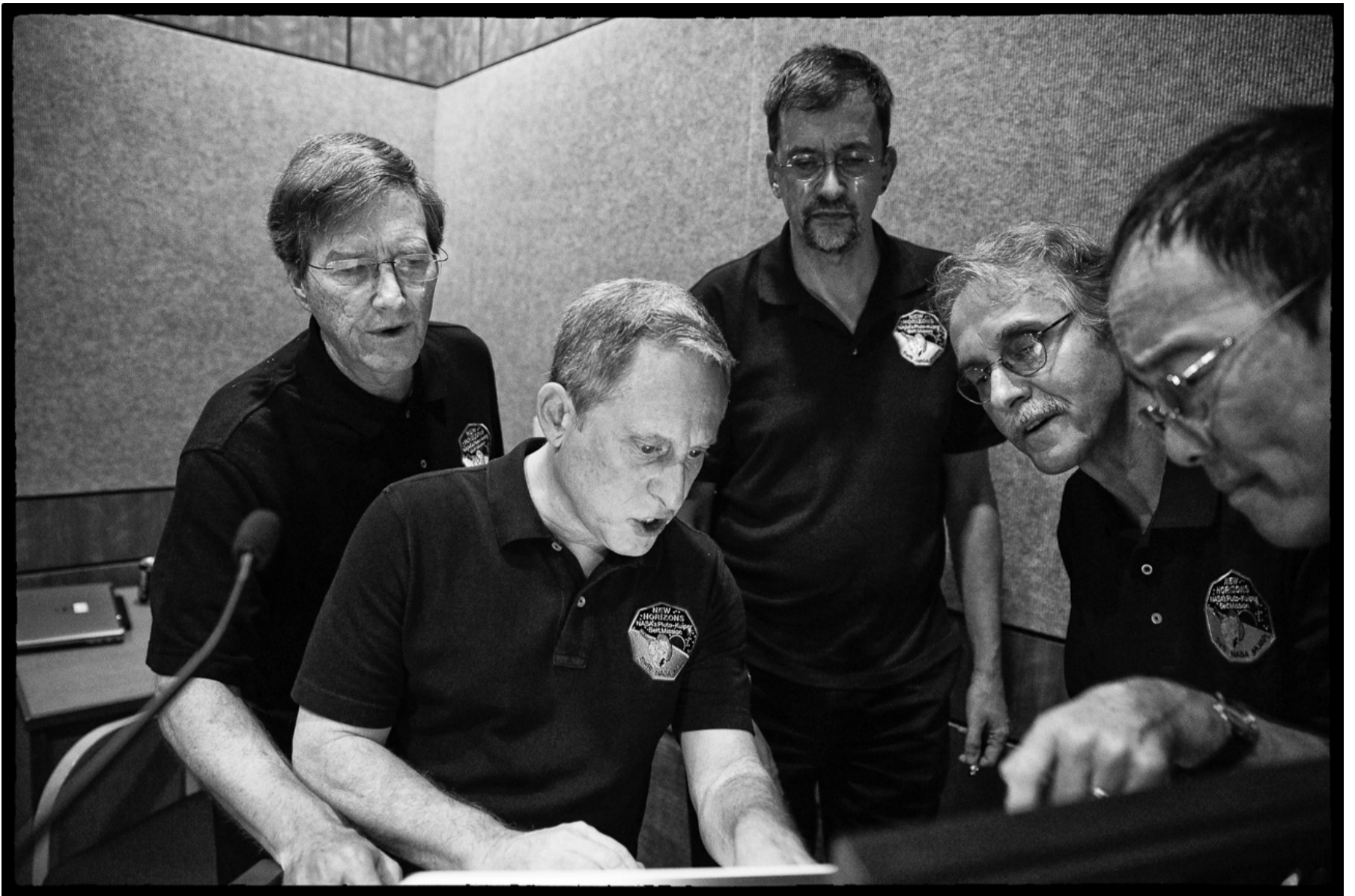
**The New Horizons spacecraft stands at the Kennedy Space Center before being launched in January 2006 on its nine-year mission to Pluto.**

to be efficient. All of the instruments operate on just 28 watts, not enough to power a light bulb.

“My God, the darn machine worked—it really worked,” David DeVorkin, a senior curator at Smithsonian’s National Air and Space Museum, says of the mission’s success. “How did he pull it off? I mean, it is a Zen sort of thing. . . . That kind of concentration and intense attention to every possible contingency plan for everything that could go wrong.” Despite, or more likely because of, its streamlined design, New Horizons managed to collect 50 gigabits of data, 5,000 times as much data as the Mariner 4 probe collected when it flew by Mars in 1965, returning the first-ever close-up view of that planet.

It was back in the 1990s, during planning for another Pluto mission that never achieved liftoff, that Stern devised the clever strategy of putting a spacecraft to sleep for long periods of time, reducing the number of people required to pilot and monitor the craft, and saving substantially on operating costs. New Horizons borrowed that strategy. After a successful boost from Jupiter’s gravity, New Horizons spent 1,892 of 3,058 days hibernating. Likewise, Stern decided to keep the spacecraft focused





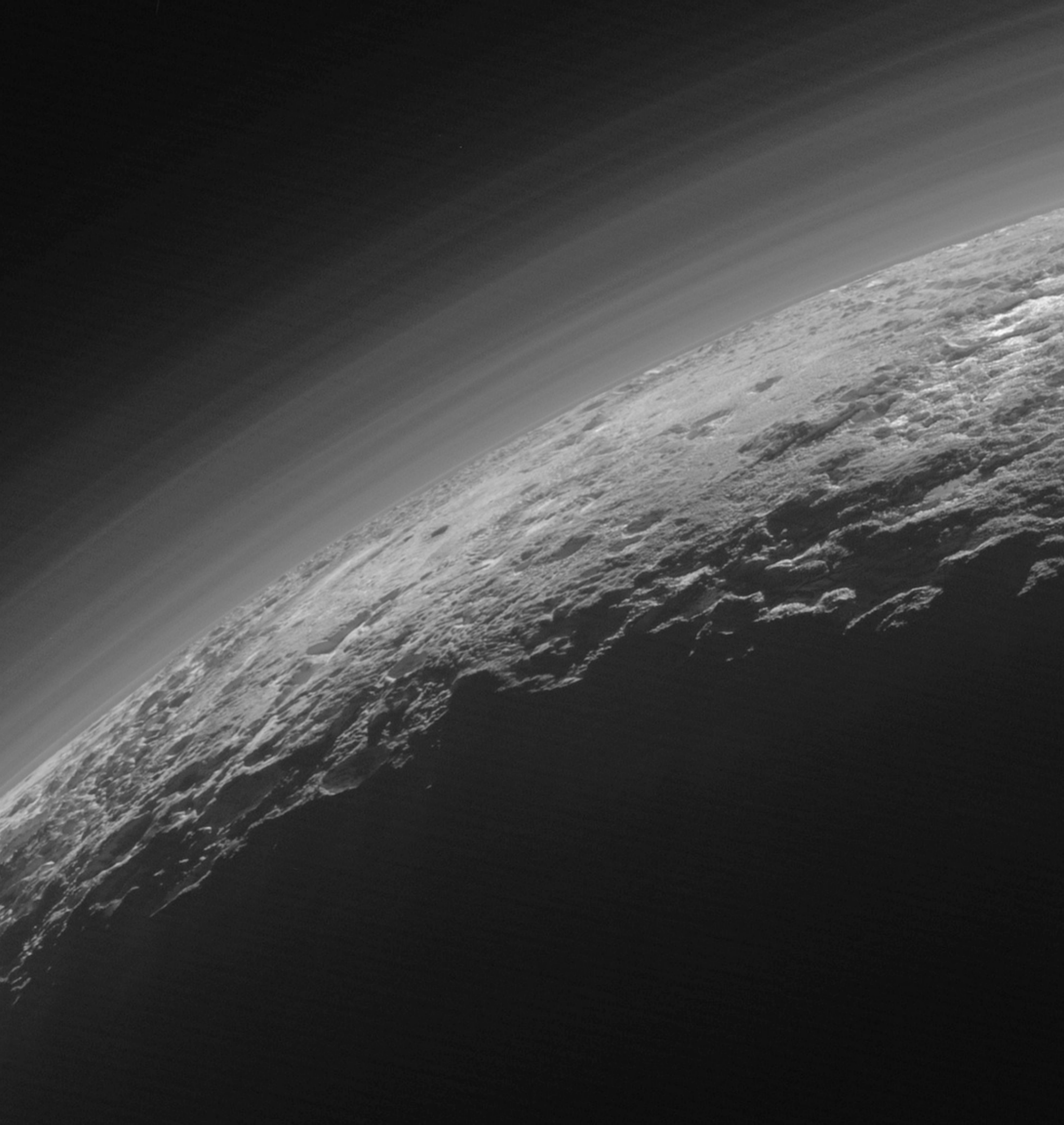
**New Horizons principal investigator Alan Stern (second from left) with four of his science team just after the unveiling of the Pluto close-up image.**

solely on its target during the flyby, to get as much precious data as possible, and only later point the craft back at Earth to transmit that data home. It meant no immediate reward, and even now the information comes in at a trickle because he packed a less powerful transmitter and smaller antenna to save on costs and weight.

The stunning first photo of Pluto's surface shows mountains that rise 11,000 feet—a delightful surprise to astronomers, because nitrogen-ice, which covers most of Pluto's surface, should collapse under its own weight. A long eight weeks later, after Labor Day weekend, New Horizons revealed Pluto's ancient craters, smooth bright plains, clustered ridges and dunes, an unexpected amalgamation of landscapes found elsewhere in the solar system, including on Mars and Jupiter's moon Europa. There are signs of flowing glaciers and crisscrossed channels caused, perhaps, by fluid or slush on the "planet." (Pluto is officially classified as a "dwarf" planet, but Stern still calls it a planet—and who's going to stop him? "Astronomers don't have a police force," he says.) Data from an instrument dubbed Alice—its partner instrument is Ralph—found an atmosphere rich in nitrogen reaching a thousand miles above Pluto's surface.



**This photo, taken near sunset on the spacecraft's closest approach to Pluto, on July 14, 2015, shows a vast, icy plain, the Sputnik Planum, flanked on the west by rugged 11,000-foot-high mountains and on the east by terrain cut by apparent glaciers. Also visible, on the horizon, are the more than a dozen layers of dust that make up Pluto's atmosphere.**





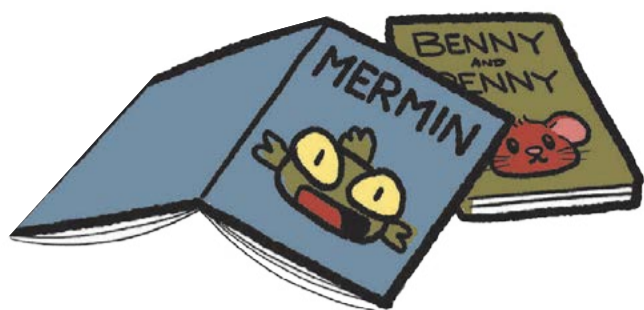
**The New Horizons Pluto team, led (in foreground, from left) by Glen Fountain, Alice Bowman, Alan Stern and Harold Weaver.**

In Stern's favorite image so far, taken 15 minutes after closest approach, separate, distinct peaks jut into the haze above, itself formed of distinct concentric rings. The last of the data won't arrive until late next year. But after waiting a long, long time—14 years to plan the mission and get approval, 4 to construct and test the craft and related systems, plus more than 9 years in transit—what's another year? "You've got to be OK with delayed gratification," says Stern.

In those early days before the mission was a go, when Pluto was still classified as a planet, Stern had another savvy idea. The probe could have fulfilled its scientific goals with just six instruments. But Stern wasn't satisfied—there must be room for one more. And so they added a high-resolution, long-range telescope that would begin observations six months early by photographing Pluto during the approach, greatly boosting the scientific return without adding much to the cost. Those early images were also a tease that made the mission all the more alluring to Plutophiles new and old here on Earth. Stern got our attention and made us want more. Now we too are willing to wait for it. ○

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# AMERICAN INGENUITY



# COMIC BOOK HERO

EDUCATION • FRANÇOISE MOULY

THE AMAZING TALE OF A DETERMINED ART DIRECTOR WHO HARNESSSED THE POWERS OF THE GREATEST ILLUSTRATORS AROUND THE WORLD TO BLOW KIDS' MINDS  
BY ELEANOR DAVIS



## Comic books? Educational?

The very idea is comical to anyone familiar with the 1954 Senate subcommittee investigation that linked juvenile delinquency to horror and crime comics. The politicians dealt the industry a staggering blow that it overcame only after superheroes, plus corny teens like Archie and a rascal named Dennis, came to the rescue. Still, comics are seldom associated with literacy. But Françoise Mouly started Toon Books precisely to get more young people reading, and thinking, and enjoying the *printed* word, lushly illustrated and handsomely bound as well.



# FRANÇOISE MOULY

PUBLISHER · ART DIRECTOR  
TRANSFORMATIVE FIGURE IN COMICS



1995

I SPENT SO MUCH TIME READING WITH MY KIDS - WONDERFUL, MARVELOUS BOOKS & COMICS.

"GOLLY, WHAT'S WRONG, TUBBY?"

"LULU! THE WESTSIDE BOYS ARE GONNA TEAR DOWN OUR CLUBHOUSE!"

Books: *Little Nemo*, *Asterix*, *Little Lulu*, *Lucky Luke*

MOM, WE NEED MORE!

OUR KIDS SURE DO LOVE READING!

COMICS ARE A GATEWAY DRUG TO LITERACY!

FRANÇOISE'S HUSBAND ART SPIEGELMAN

Books: *Marsupilami*, *Duck*, *Groo*, *Lynda Barr*

BUT THE TEXTBOOKS THEY WERE GIVEN AT SCHOOL THAT WERE SUPPOSED TO TEACH THEM TO READ ...

THIS IS... ATROCIOUS!

A IS FOR APPLE  
B IS FOR BORING

TOSS!

I DON'T BLAME YOU!

KIDS AREN'T GOING TO LEARN TO LOVE BOOKS & READING LIKE THAT!

ALL CHILDREN LOVE COMICS -

-BUT KIDS' COMICS AREN'T EASY TO FIND ANYMORE!

WHY DON'T THEY HAVE COMICS IN SCHOOLS?

THEY'RE WONDERFUL TOOLS FOR LEARNING.

IT'S LIKE KIDS CAN'T HELP BUT READ THEM!

CHILDREN **NEED** COMIC BOOKS!



1978

CHECK OUT THIS COMIC!

IT'S INCREDIBLE!

THESE CARTOONISTS ARE GENIUSES & PEOPLE STILL THINK COMICS ARE JUST KIDS' STUFF!

THESE ARE MASTERPIECES OF LITERATURE & THEY CAN'T EVEN FIND PUBLISHERS!

YOUNG ART

YOUNG FRANÇOISE

ALL RIGHT! WE'LL DO IT!!!

I WANT TO PUBLISH WHAT NO ONE ELSE WILL!

TIPPY AND THE NIGHT PARADE

WALKER BEAN

SO WE FOUNDED RAW BOOKS. WE PUBLISHED COMICS, GRAPHIC NOVELS & RAW MAGAZINE.

WE HAD TWO KIDS & I BECAME ART EDITOR AT THE NEW YORKER.

1998

I CAN JUST SEE IT! A LINE OF COMICS FOR CHILDREN THAT WILL GET THEM HEAD OVER HEELS FOR READING!

- VISUAL LITERACY IS ESSENTIAL
- VISUAL AIDS INCREASE COMPREHENSION
- LETTERFORMS AS LEARNING TOOL

+ KIDS ♥ COMICS!

WE LOVE IT!

IT'S A TERRIFIC IDEA!

1998

...BUT MY DEPT. DOESN'T DO EDUCATIONAL BOOKS.

2001

MY DEPT. DOESN'T DO PICTURE BOOKS!

2004

IT'S TOO RISKY FOR A PUBLISHER THIS BIG!

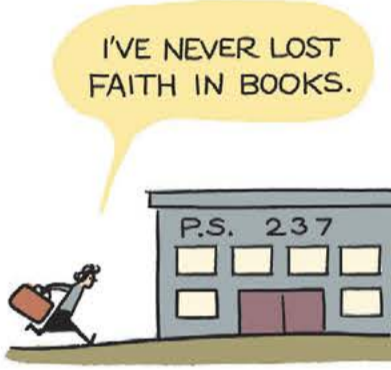
2006

WHY DOESN'T SOMEONE ELSE DO IT?

RANDOM HOUSE

BENJAMIN BEAR





“It’s something they will hold in their hand and they will feel the care we put into it,” Mouly says. Schools are catching on, spicing up reading lists with Toon titles (43 published so far). Mouly acknowledges she’s putting teachers in a bind that is sort of funny: “Can you imagine having to go see your principal and say, ‘I’m going to spend money on comic books!’”

-THE EDITORS

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AMERICAN  
INGENUITY



# FACE TO FACE

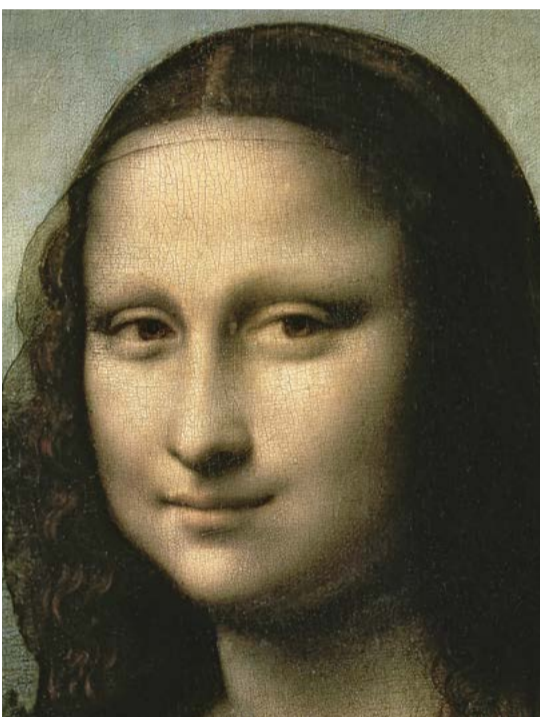
TECHNOLOGY • RANA EL KALIOUBY

AN ENGINEER'S  
PASSION FOR  
DECODING FACIAL  
EXPRESSIONS IS SET  
TO CHANGE THE WAY  
WE INTERACT WITH  
OUR DEVICES—  
AND EACH OTHER

BY JERRY ADLER

PHOTOGRAPH BY  
KEVIN TACHMAN





**Above, a 1970s stewardess displays the “Pan Am,” or faked smile, and the close-mouthed *Mona Lisa* suggests discomfort more than happiness. The open-mouthed smiley face emoji is a crude attempt to punctuate digital communications with emotion.**

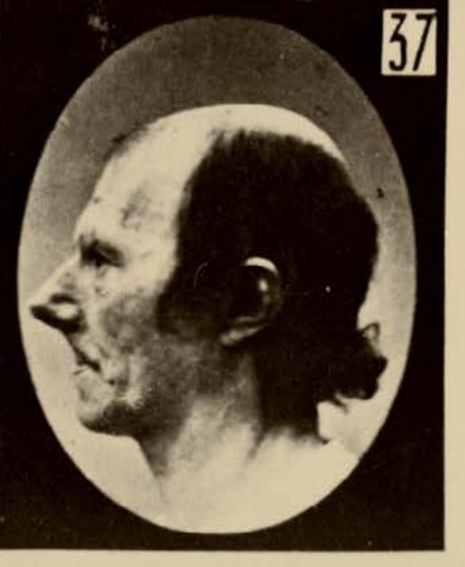
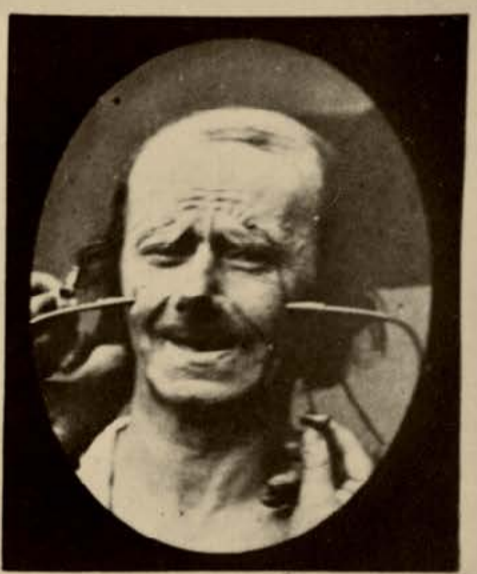
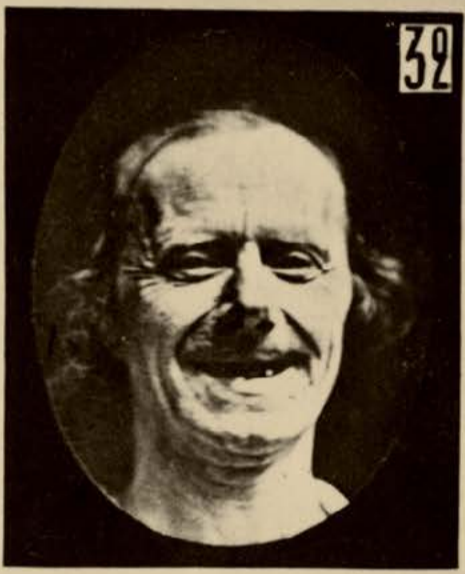
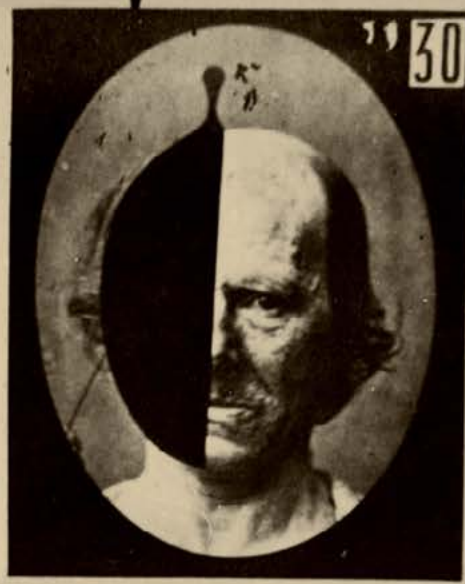
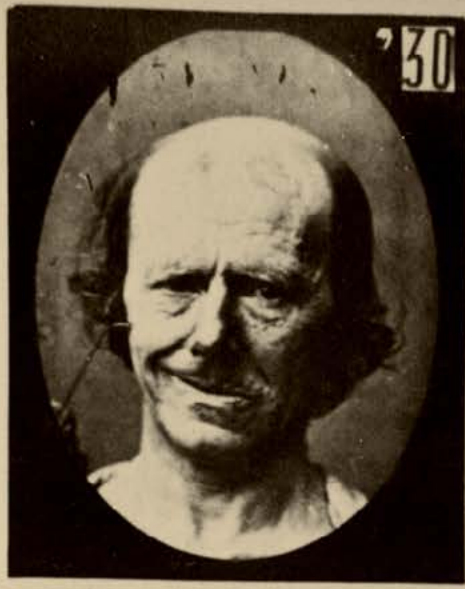
## The human face is powered, depending on

how you count them, by between 23 and 43 muscles, many of which attach to the skin, serving no obvious function for survival. An alien examining a human specimen in isolation wouldn't know what to make of them. Tugging on the forehead, eyebrows, lips and cheeks, the muscles broadcast a wealth of information about our emotional state, level of interest and alertness. It is a remarkably efficient means of communication—almost instantaneous, usually accurate, transcending most language and cultural barriers. But sometimes the data is lost, ignored or misinterpreted. If a logger smiles in the forest with no one around to see him, was he actually happy?

Rana el Kaliouby hates to see that information go to waste. Meeting el Kaliouby in her small office in Waltham, Massachusetts, I see her contract her zygomaticus major muscle, raising the corners of her mouth, and her orbicularis oculi, crinkling the outer corners of her eyes. She is smiling, and I deduce that she is welcoming me, before she even gets out the word “hello.” But many social exchanges today take place without real-time face-to-face interaction. That's where el Kaliouby, and her company, come in.

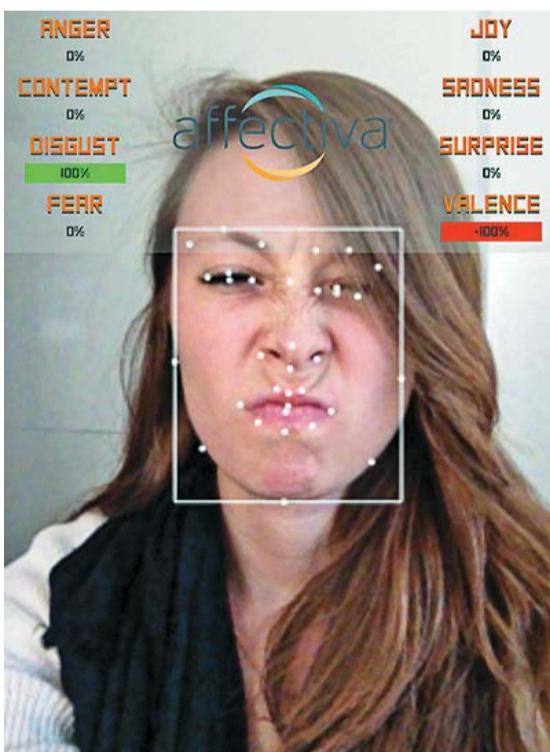
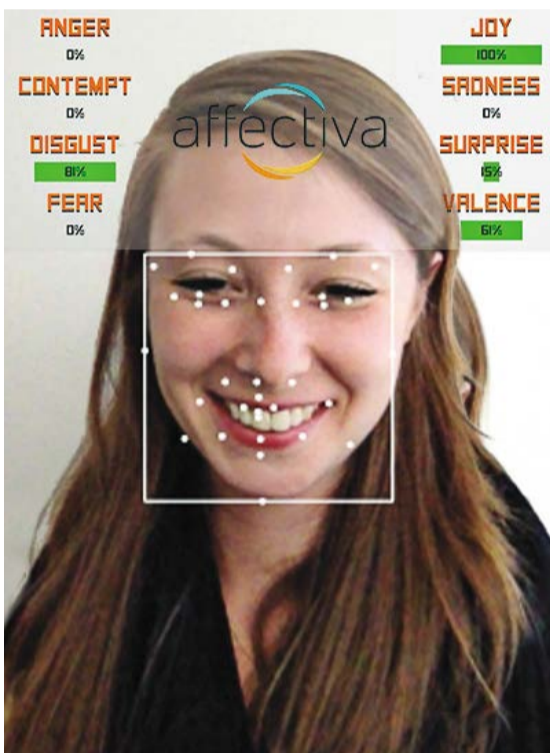
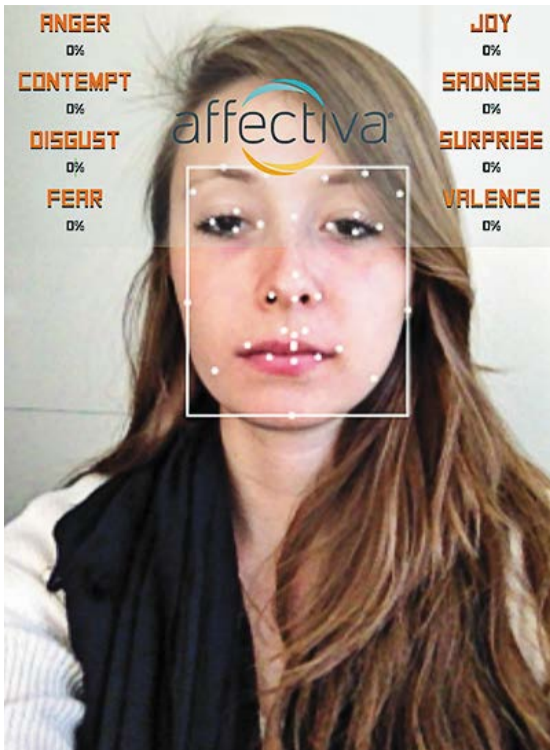
El Kaliouby, who is 37, smiles often. She has a round, pleasant, expressive face and a solicitous manner, belying her position as the co-founder of a fast-growing tech start-up—an anti-Bezos, an un-Zuckerberg. Her company, Affectiva, which she founded in 2009 with a then-colleague at the MIT Media Lab, Rosalind Picard, occupies a position on the cutting edge of technology to use computers to detect and interpret human facial expressions. This field, known as “affective computing,” seeks to close the communication gap between human beings and machines by adding a new mode of interaction, including the nonverbal language of smiles, smirks and raised eyebrows. “The premise of what we do is that emotions are important,” says el Kaliouby. “Emotions don't disrupt our rational thinking but guide and inform it. But they are missing from our digital experience. Your smartphone knows who you are and where you are, but it doesn't know how you feel. We aim to fix that.”





The French anatomist Duchenne published landmark studies of human facial expressions.





Why does your smartphone *need* to know how you feel? El Kaliouby has a host of answers, all predicated on the seemingly boundless integration of computers into the routines of our daily lives. She envisions “technology to control lighting, temperature and music in our homes in response to our moods,” or apps that can adapt the content of a movie based on your subconscious reactions to it while you watch. She imagines programs that can monitor your expression as you drive and warn of inattention, drowsiness or anger. She smiles at the mention of her favorite idea—“a refrigerator that can sense when you are stressed out and locks up the ice cream.”

In particular, she thinks Affectiva, and the technology it is helping to usher into the mainstream, will be a boon to health care. A researcher testing a new drug, or a therapist treating a patient, gets feedback only at intervals, subject to all the problems of self-reporting—the unconscious desire to please the doctor, for instance, or selective recall that favors the most recent memories. El Kaliouby envisions a program running in the background of the subject’s laptop or phone that could compile a moment-by-moment record of his or her mood over the course of a period of time (a day, a month) and correlate it to the time or anything else your device can measure or track. “It wouldn’t even have to be part of a treatment program,” she muses. “You could just have it on your phone and it tells you, every time ‘X’ calls you have a negative expression, and that tells you something you may not have known.”

El Kaliouby promotes affective computing as the logical next step in the progression from keyboard to mouse to touchscreen to voice recognition. In the spring, Affectiva released its first commercial software development kit, which developers, interested in users’ real-time emotional states, can incorporate into their own programs—music players or gaming or dating apps, for example. And just this fall Affectiva launched Emotion As a Service, a cloud-based program to which customers can upload videos for analysis. Who might use this? A candi-

**Affectiva’s basic program analyzes the face 20 times a second for 46 localized expressions of happiness, sadness, surprise, fear, anger, disgust and contempt, plus interest and confusion.**



date about to be interviewed for a job, who is worried about appearing anxious or bored or even smiling too much. Or an airline hiring flight attendants, with hundreds of video applications to sift through in search of those who can manage a convincing smile as they bid passengers goodbye. (A genuine smile, which involves a contraction of the muscles at the corners of the eyes, is called a “Duchenne” smile, named for the 19th-century anatomist; its opposite, a forced smile that uses just the mouth, is actually sometimes called a “Pan Am” smile.)

And, of course, the devices running this software are all connected to the Internet, so that the information they gather is instantaneously aggregated, sifted and networked in the way social media apps identify popular topics or personalities. Compiled, perhaps, into something like an Affectiva Mood Index, a numerical read on the gross national happiness, or broken down into regions where smiles or frowns are currently trending.

Until now, Affectiva’s main customers have been advertising, marketing and media companies. Its software automates the process of running a focus group, the cumbersome ritual of assembling a dozen people in a room to give their opinions about a new product, TV series or ad campaign; it records reactions directly, without a participant’s having to twiddle a dial or answer a questionnaire in response to a presentation. Moreover, the software expands the potential focus group to the whole world, or at least the substantial fraction of it that has a webcam-enabled computer or mobile device.

Feedback from Affectiva’s relentless, all-seeing eye helped shape a network TV sitcom, consigning two characters to oblivion for the sin of not making viewers smile. (El Kaliouby won’t identify the show or the characters.) Its software was used to build a “smile sampler,” a machine that dispensed candy bars to shoppers who smiled into its camera. With more research, it could probably be useful for crowd surveillance in airports, or to identify potential shoplifters, or as a lie detector.

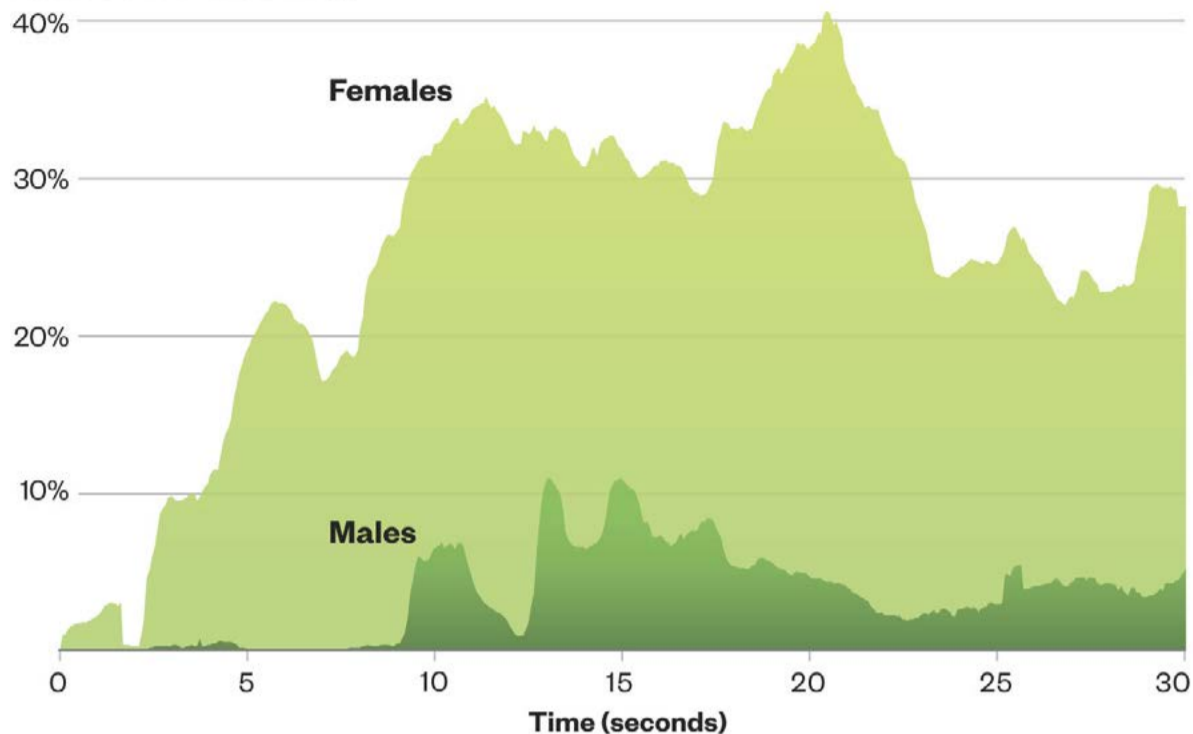
But el Kaliouby has resisted these surreptitious applications, however lucrative they might be. She thinks affective computing will change the world, including, but by no means limited to, selling candy bars. “The ethos of our company,” she says, “is to use this technology to improve people’s lives and



# SMILE AWHILE

Data compiled by Affectiva on viewers' facial expressions while watching an ad for dog food.

Percent of viewers smiling



help them communicate better, not just to help advertisers sell more products.”

**Unlike many tech entrepreneurs, getting rich wasn't on el** Kaliouby's original agenda. Born in Cairo to Egyptian parents who both work in technology, she studied computer science at the American University in Cairo, where she graduated in 1998, around the time computers were becoming powerful enough for researchers to think about endowing them with what in human terms is called emotional intelligence.

She continued studying computer science at the University of Cambridge, arriving just after the attacks on America of September 11, 2001. Her parents thought she risked being arrested, harassed or worse because of her heritage. But although she wore a Muslim head-covering until a couple of years ago, neither in Cambridge, England, nor in Cambridge, Massachusetts, where she moved in 2006, to join the MIT Media Lab, was she ever bothered about her religion or appearance. “I think it's because I smile a lot,” she says, smiling.

While at Cambridge, she had become interested in the problem of autism, specifically the difficulty autistic children have in reading facial expressions. She proposed building an “emo-



tional hearing aid” that could be worn to read faces and cue appropriate behaviors to the wearer. Turned down at first for a grant by the National Science Foundation on the grounds that the project was too difficult, she and her colleagues built a prototype, consisting of a pair of eyeglasses outfitted with a tiny camera, blinking lights and a headphone, not unlike an early version of Google Glass. A second grant application was successful, and, after she moved to MIT, she and her team worked for the next three years to perfect and test it at a school in Rhode Island. El Kaliouby describes it as “a research project, and a successful one”—the autistic children who used it had overwhelmingly positive experiences—but in 2008, as the grant ended, she faced a moment of reckoning. Commercial interest in affective computing was growing, and she wanted to see it expand and flourish; putting her efforts into developing the glasses would limit it to a tiny slice of its potential uses. So along with Picard, she spun off Affectiva, while holding out hope that another company would pick up the emotional hearing aid and bring it to market.

When Affectiva was formed, the handful of “team members” who made up the company each chose a value they wanted to embody, such as “learning” or “social responsibility” or “fun.” Hers, as chief strategy and science officer, was “passion.” The 20-person company is run as a quasi-democracy, with semiannual meetings at which employees vote on priorities to pursue over the next six months. Her office has a whiteboard covered with drawings by the young daughter of one of her colleagues; she has a 6-year-old son, Adam, and a 12-year-old daughter, Jana, who live with her in the Boston suburbs (their father lives in Egypt). Her manner is mild and considerate; an hour into a morning meeting she offers to order a sandwich for a visitor, even though she herself is skipping lunch. “It’s Ramadan for me,” she says, smiling, “but it’s not Ramadan for you.”

She seats visitors at a desk, facing a monitor and a webcam; the software locates the visitor’s face and draws a box around it on the screen. It identifies a set of points to track: the corners of the eyes and mouth, the tip of the nose, and so on. Twenty times each second, the software looks for “action units,” the often-fleeting play of muscles across the face. There are 46 of these, according to the standard system of classification, the Facial



Action Coding System (FACS). They include inner and outer brow raisers, dimplers, blinks, winks and lip puckers, funneleders, pressors and sucks. Affectiva's standard program samples about 15 of these at any time, and analyzes them for expressions of seven basic emotions: happiness, sadness, surprise, fear, anger, disgust and contempt, plus interest and confusion. Smile, and you can see the measure of happiness shoot up; curl your lip in a sneer and the program notes your disgust.

Or, more precisely, your expression of disgust. The whole premise of affective computing rests on what amounts to a leap of faith, that a smile conveys a feeling of happiness, or pleasure, or amusement. Of course, human beings are in the same position: We can be fooled by a false smile or feigned anger, so we can't really expect more from a computer program, at least not yet.

Over time Affectiva has built an archive of more than three million videos of faces, uploaded by Internet users recruited from some 75 countries all over the world. Hundreds of thousands of these have been analyzed by trained observers and coded for FACS action units—a monumental undertaking, since the videos average around 45 seconds and each takes about five times as long to process. The results from the human coders, in turn, were used to “train” the company's algorithms, which processed the rest in real time. The entire database now comprises about 40 billion “emotion data points,” a resource, el Kaliouby boasts, that sets Affectiva apart from other companies in the same field, such as California-based Emotient, probably its closest competitor.

Daniel McDuff, who joined Affectiva from MIT Media Lab and serves as director of research, is continually studying this trove for additional insights into the expression of emotions. How do they differ by age, gender and culture? (Perhaps surprisingly, McDuff has found that older people are more expressive, especially of positive emotions, than younger ones.) Can we reliably measure contempt, embarrassment, boredom, anxiety? When does a brow furrow signal confusion, and when does it indicate concentration? How can we distinguish between an expression of fear and one that signifies surprise? (Hint: Action unit 1, the “inner brow raiser,” is the marker for fear; action unit 2, the “outer brow raiser,” indicates surprise.) There is, he





“THE PREMISE OF WHAT WE DO IS THAT EMOTIONS ARE IMPORTANT ... THE ETHOS OF OUR COMPANY IS TO USE THIS TECHNOLOGY TO **IMPROVE PEOPLE’S LIVES** AND HELP THEM COMMUNICATE BETTER, NOT JUST TO HELP ADVERTISERS SELL MORE PRODUCTS.”

says, every reason to believe that the program will continue to get better at detecting expressions (although it may never completely overcome the greatest obstacle of all: Botox).

At my request, McDuff gave the program one of the great classic problems of emotion detection, the *Mona Lisa*, whose enigmatic quasi-smile has intrigued viewers for 500 years. With the caveat that the software works best on shifting expressions, not static images, he reported that it found no evidence of a genuine smile by La Gioconda, but rather some combination of action unit 28 (lip roll) and 24 (lips pressed together), possibly suggesting some level of discomfort.

**“I’m talking to you now,” el Kaliouby says, “and watching you** to gauge your interest in what I’m saying. Should I slow down and explain more? Should I go to another topic? Now, imagine I’m giving a webinar to a large group that I can’t see or hear. I get no feedback, there’s no way to tell if a joke worked or fell flat, if people are engaged or bored. Wouldn’t it be great to get that feedback in real time, aggregated, from moment to moment as I go along?”

She plays an ad for Jibo, a “social robot” available for preorder on the crowd-funding website Indiegogo and developed by a former MIT colleague, Cynthia Breazeal. Looking something like a high-tech lava lamp, Jibo sits on a table and scans its surroundings, identifying individuals by face and interacting with them—relaying messages, issuing reminders, making routine phone calls, even chatting. This is another potential application for Affectiva’s software—the companies are in talks—and it’s “a very exciting prospect,” el Kaliouby says.

Exciting to some, but the prospect of emotion-processing robots is alarming to others. Sherry Turkle, who has long studied how humans relate to computers, warns in her new book, *Reclaiming Conversation: The Power of Talk in a Digital Age*, about the “robotic moment,” when machines begin to substitute for



human companionship. Turkle believes that scientists like el Kaliouby and her team can do what they say they will. “These are all brilliant, gifted people doing brilliant work,” she says. And she agrees that in certain contexts—dangerous environments, such as outer space or around heavy machinery, where you want to enlist every possible mode of communication—affective computing has a role to play. “But the next step,” she says, “does not follow at all. The next step is, Let’s make a robot friend. I’ve interviewed parents who are happy their children are talking to Siri, and I think that’s not taking us down a road where we want to go. We define ourselves as human beings by who we associate with, and it makes no sense to me to form your sense of self-esteem in relation to a machine. Why would you want a computer to know if you’re sad?”

Even el Kaliouby is inclined to agree that “we’re spending more time than we should with our devices,” having in mind, naturally, her preteen daughter, whose gaze locks on her smartphone screen.

But she regards the trend toward ever-greater connectivity as irreversible, and she thinks that, while users should always have to opt in, we might as well make the best of it. She predicts that our devices will have “an emotion chip and a suite of apps that use it in a way that adds enough value to our lives that outweighs people’s concerns in sharing this data.” She draws an analogy to GPS devices: Affective computing can help us navigate emotional space the same way phone apps help us get around in physical space. “Everyone worried about location-sensing devices when they first came out, too: They were invading our privacy, they were tracking us all the time,” she says. “Only now, we’d all be lost without Google Maps on our phones. I think this will be the same.” ○

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*Check out Rana el Kaliouby’s TED Talk on the “emoticon engine.”*

AMERICAN  INGENUITY

COMPOSER, LYRICIST  
AND PERFORMER, HE  
WOWS BROADWAY  
AUDIENCES AND UPENDS  
U.S. HISTORY WITH HIS  
DAZZLINGLY FRESH  
HIP-HOP *HAMILTON*

BY JEFF **MAGGREGOR**

THE

HISTORY • LIN-MANUEL MIRANDA

MAESTRO

PHOTO ILLUSTRATION BY ERIN PATRICE **O'BRIEN**





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THIS NOTE IS LEGAL TENDER  
FOR ALL DEBTS, PUBLIC AND PRIVATE

*Mary Ellen Matthews*  
Treasurer of the United States

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# Back in June, down on Lafayette Street,

Lin-Manuel Miranda stands on the lip of a stage, bent at the waist, rapping hard, spitting, sweating, pigtails flying, bouncing three rhymes in two couplets off the word “ceviche.” On a rare night out while *Hamilton: An American Musical* moves uptown, he’s—¿*Cómo se dice?*—freestyling.

Freestyle Love Supreme is the comedy/improv rap troupe he’s been part of for years. *Hamilton*’s George Washington, Christopher Jackson, has been too, and tonight they’re taking audience suggestions and turning them into laughs. It’s a downtown porkpie crowd heavy on the mustache wax, seer-sucker and loggers’ boots.

Joe’s Pub is a small cabaret across the lobby from the theater where *Hamilton* began. This close to Miranda, a young 35, you can watch the mind at work, hear it, feel the wheels turn, see the poet and performer up close. His gift radiates, creates a kind of heat. The quickness of his invention is remarkable, but more remarkable is the completeness of it. The sense of a finished line in the instant he’s made it. That’s the poet. The performer dares you *not* to love him, dares you *not* to be charmed, a terrible strategy for almost anyone but him. Instead he’s magnetic. In fact, his is the rarest gift of actors or singers or comics anywhere: Not only do you like him immediately, you want him to like you back. Stranger yet: He’s a better writer than he is a performer. Slender and big-eyed and tired in jeans and beautiful shoes. His energy fills the room. His T-shirt reads, “Mr. Write.” And as is often the case in *Hamilton*, no matter who else is center stage, he’s the one you look at.

After the show Miranda plays the room for a few minutes, shaking hands, table-hopping, cracking wise with friends. He sits with his mom and his sister as the place empties. But there’s another seating after this one, another performance he’s not part of, so they shoo him toward the door. On his way, a young man reaches out a hand. “I just wanted to thank you,” he says. That’s it. That’s all.

Miranda pauses, looks, shakes the hand. “You’re welcome,” he says like he means it and walks on.



“THERE ARE SO MANY WORLD LEADERS I WOULD LOVE TO BRING TO THE SHOW JUST TO SHOW THEM GEORGE WASHINGTON STEPPING DOWN—BECAUSE THE STORY OF HISTORY IS **LEADERS LEADING ON POPULISM, THEN NOT LEAVING.**”

*Do I run or fire my gun?  
Or let it be?  
There is no beat  
No melody  
Burr, my first friend, my enemy,  
Maybe the last face I ever see  
If I throw away my shot  
Is this how you'll remember me?  
What if this bullet is my legacy?*

**The show was a hit before it ever opened.**

It was the hottest ticket on Broadway before it even *got* to Broadway, so by the time the motorcade roared up Eighth Avenue—a block-long line of lacquer-black SUVs and limousines behind a flying wedge of motorcycle cops and siren noise—the advance ticket sales were climbing fast toward \$30 million.

At the corner of 46th Street, the limousine slowed and turned and the familiar silhouette of the president of the United States leaned forward in his seat and waved to the crowds at the sidewalk barricades. In the high July heat tourists on their way to Times Square squinted and waved back and raised a small, confused cheer.

“I guess he’s here to see a show.”

“Which?”

A patrolman pointed up the block.

“*Hamilton*,” he said.

The limousine stopped in front of the Richard Rodgers Theatre, ringed with Secret Service agents and blastproof trucks filled with sand, and our first black president stepped inside to see our first president, black. Asked later about the show, Barack Obama said, “It is phenomenal.” It was a moment of perfect American history for those lucky enough to





**A performance juggernaut, historically accurate *Hamilton* packs four dozen songs into two-plus hours (Leslie Odom Jr. as Aaron Burr).**

share it, of sharp historical clarity in our summer of *Hamilton*, the runaway multiracial hit.

The origin story has already hardened into legend. Lin-Manuel Miranda, precocious Tony-winning playwright and composer, lyricist and actor, takes a well-deserved vacation from his hit musical *In the Heights*. This is 2008. He is not yet 30 years old. Looking for a beach book, he buys Ron Chernow's immense 2004 biography of Alexander Hamilton. In a white hammock under a blue sky beneath a hot yellow sun he reads the defining work of popular scholarship about our most mysterious founding father, and long before he's 50 pages into it he's wondering to himself who might have already made this extraordinary story into a play. Into a musical. He searches. Finds nothing. No one.

He takes up his keyboard and his laptop and a few months later he's rapping what will become the show's opening number at the White House. The YouTube video goes viral.

The next we hear of him it's January 2015 and he's opening a finished musical at the Public Theatre downtown with a cast as young and brash as Miranda—or Hamilton—himself.



“THE FUN FOR ME IN COLLABORATION IS, ONE, WORKING WITH OTHER PEOPLE JUST **MAKES YOU SMARTER**, THAT’S PROVEN. . . . AND TWO, IT’S ENORMOUSLY GRATIFYING BECAUSE YOU CAN BUILD THINGS SO MUCH BIGGER THAN YOURSELF.”

**On the morning of July 11, 1804, at the foot of the bluffs in Weehawken, New Jersey, Alexander Hamilton was fatally wounded in a duel by Vice President Aaron Burr. They fought over an insult. Of the founders, Hamilton burned brightest and briefest, dead before he was 50 years old. By then he had been a war hero and aide to George Washington, authored most of the *Federalist Papers* and the nation’s first political sex scandal, founded the Coast Guard and the *New York Post*, devised and implemented a national banking system, created the U.S. Mint, eased America out of postwar bankruptcy and served as our first Secretary of the Treasury. He feuded with the most powerful politicians of his time, and suffers for it two centuries later. He opposed slavery. He imagined the United States as a manufacturing powerhouse and world financial leader, as a great nation of great cities with a strong, pro-business central government. Alexander Hamilton, immigrant, is the architect of the America we stand in today and the biggest star on Broadway.**

You know the boilerplate biography, even if you don’t know you know it. The illegitimate son of a Scots merchant and a French woman separated from her husband, Alexander Hamilton was born on the island of Nevis in the Caribbean in 1755 or 1757. His father abandoned him, his mother died, and at the age of 11 he found a job as a clerk at a trading company on St. Croix. So taken were his employers and neighbors with the boy’s intelligence and potential, they paid to send him to study in America. At 16 he enters King’s College, now Columbia, and takes up revolutionary politics. By 20 he’s a lieutenant colonel, friend to the Marquis de Lafayette, frenemy to Aaron Burr, and George Washington’s right-hand man in the fight against the British. He weds Elizabeth Schuyler, marrying into one of New York’s most distinguished families. The war won, he practices law and fights for a strong central government over the objections of men like Thomas Jefferson. To swing the debate at the



Constitutional Convention in 1787, Hamilton writes at least 51 of the 85 *Federalist Papers*, and overwhelms the remaining naysayers and objectors with his public oratory. When Washington appoints him first Secretary of the Treasury, he is 32 years old. By his mid-30s, he is one of New York's great men, famous everywhere in the new nation. But his limitless ambition is undone in 1797 by the lurid scandal of his affair with Maria Reynolds. Adrift in history, he loses his eldest son, Philip, to a duel in 1801. Three years later, for redress of a minor insult and under the same trees and the same indifferent sky in Weehawken, Alexander Hamilton is mortally wounded in a duel with Aaron Burr.

Almost directly across the Hudson River from 46th Street and the Richard Rodgers Theatre are the Weehawken dueling grounds.

*How does a bastard, orphan,  
son of a whore  
And a Scotsman, dropped in  
the middle of a forgotten spot  
In the Caribbean by Providence, impoverished, in squalor,  
grow up to be a hero and a scholar?*

**Long before he ever sang those words at the White House,** Lin-Manuel Miranda sang them in Ron Chernow's living room. Chernow is a Brooklyn kid who lives in Brooklyn still, but has in the meantime won the Pulitzer Prize and the National Book Award. He is one of America's great biographers, in a very small class with the likes of Robert Caro and Edmund Morris and David McCullough. He is 66 years old.

His books on J. P. Morgan and John D. Rockefeller and George Washington are definitive. It took him five years to research and write his biography of Hamilton, and in doing so, Chernow rescued him from a period of recent relative obscurity and cynical misappropriation. Modern politicians find ways to blame Hamilton for the rise of Wall Street and the failure of Jefferson's model America, a nation of picturesque villages and doughty yeoman farmers.

There's even the question of whether or when Hamilton will come off the \$10 bill. While everyone agrees it's time for



an American woman on our paper money, very few think the father of our paper money is the guy to replace. Better bloody, bloody Andrew Jackson, who killed a lot of folks—and sold many fewer tickets on Broadway.

It's taken Miranda six years to write his own *Hamilton*, with Chernow checking accuracy at every draft and in every song. They've become close in that time, but if you want to make a person uncomfortable, ask them if someone they know is a genius.

"I'm not sure if Lin's a genius. Hamilton was a genius," Chernow says. "But Lin's made a masterpiece." (On September 28, Lin-Manuel Miranda was awarded a MacArthur Foundation "genius" grant.)

*I am not throwing away my shot  
I am not throwing away my shot  
Hey yo, I'm just like my country  
I'm young, scrappy and hungry  
And I'm not throwing away my shot.*

**And if that sounds very much like the promise of a young playwright to himself, a goad to ambition and purpose, it should. There's as much Hamilton in Miranda as there is Miranda in *Hamilton*.**

He's the son of high-achieving parents from Puerto Rico, his mother a clinical psychologist and his father a political consultant. He grew up on the uppermost tip of Manhattan, near Broadway. Thirteen miles and 28 stops south on the A Train, Alexander Hamilton is buried on the same street, in the Trinity Church graveyard.

Miranda was raised in two languages and two cultures. And he grew up in a house full of music, including Broadway cast albums. So his musical influences range from Gilbert and Sullivan to Rodgers and Hammerstein, to Kander to Sondheim to Biggie and Tupac. The whole American prayer wheel from the Beach Boys to Springsteen to Willie Colón and Eddie Palmieri and Tito Puente. His influences are everything that floats through the culture. *Everything*. He absorbs it all—the movies, the commercials, the TV shows, the games, the books, the politics, the slang, the language, the news, the sports, the arts. And it started young.

"He was always very verbal. He read by 3, 3," his father, Luis, will tell you. "We sent him to a local nursery school at 4 and he



BEHIND HIM THE SIDEWALKS TEEM AND THE TIMES SQUARE LIGHT SHOW EXPLODES. EVENTUALLY A COUPLE OF PEOPLE FIND HIM. ONE YELLS OVER THE MUSIC, **“WE JUST WANTED TO THANK YOU.”** HE SMILES AND RISES TO MEET THEM.

was the only reader, so he would read to the other kids, and the other kids would sort of be around *him*, because he was the one who could pick up a book. But the other thing that was always remarkable about him is that he works great as part of a team.”

Miranda and his sister, Luz Miranda-Crespo, both took piano lessons. She practiced, he didn't. Then and now the family lived in the Inwood neighborhood, just up from Washington Heights. By the time he started commuting to Hunter College High School on 94th Street, he was writing and performing his own shows, casting, producing and directing.

He graduated and went off to Wesleyan and began writing the musical that would become *In the Heights*, about his familiar streets and the people he saw every day. He graduated in 2002 and kept writing. He took a job teaching English at his high school, and made ends meet by writing campaign jingles for his father's clients.

By 2005 he and his friends, including director Thomas Kail, another Wesleyan grad, were able to mount a workshop production. *In the Heights* opened off-Broadway in 2007 and moved to Broadway in early 2008. It's a salsa-inflected rap snapshot of a Dominican block in Washington Heights and the lives of its residents, the complexity of love and loss, and like *Hamilton*, it too is about outsider striving and ambition, about having a foot in both worlds, about being torn between home and high achievement and whatever comes next. About insecurity and purpose and achieving your own big dreams.

It won four Tony Awards and a Grammy and it launched Miranda overnight onto the short list of great American musical composers. Sondheim. Larson. Kander. Miranda. Toast of the town stuff; corner banquette at Sardi's. Thus the *New York Times* "Vows" column covered his wedding in 2010.



Phillipa Soo, left, Renée Elise  
Goldsberry and Jasmine Cephas  
Jones as the Schuyler sisters.



He married Vanessa Nadal, a fellow Hunter student, a graduate of MIT, a scientist and a lawyer and mother to their 1-year-old son, Sebastian.

Miranda's a magpie, a poet and that's as it should be, because at its best the stage musical is a mimic of its times and a synthesizing form, an amalgam of impulses and influences from every corner of the culture, and he is an industrious recorder and rewriter of those currents and moments. Like hip-hop or jazz, "the musical" as we know it is essentially American. It's telling too that this play is at once much simpler and smarter and more complex than anything so far said or written about it by critics.

*I'm 'a get a scholarship to  
King's College  
I prob'ly shouldn't brag, but dag,  
I amaze and astonish  
The problem is I got a lot of  
brains but no polish  
I gotta holler just to be heard  
And with every word, I drop knowledge!  
I'm a diamond in the rough,  
a shiny piece of coal  
Tryin' to reach my goal, my power  
of speech unimpeachable  
Only nineteen but my mind  
is older  
These New York City streets  
get colder, I shoulder  
Every burden, every disadvantage  
I have learned to manage, I don't have a gun to brandish  
I walk these streets famished  
The plan is to fan this spark  
into a flame  
But damn it's getting dark so  
let me spell out the name,  
I am the —  
A-L-E-X-A-N-D-E-R.*



**His dressing room is hidden high in the rabbit warren of** walk-in closets backstage. He's in there right now, playing video games and tweeting and still—always—rewriting the season's most successful show.

“For *Hamilton* what I'd do is write at the piano until I had something I liked,” Miranda recalls. “I'd make a loop of it and put it in my headphones and then walk around until I had the lyrics. That's where the notebooks come in, sort of write what comes to me, bring it back to the piano. I kind of need to be ambulatory to write lyrics.”

He walked six years to write this show. Inwood Park. Fort Tryon Park. Central Park. Lots of shoe leather in these songs. Now he's a new father. No wonder he's tired.

The first act takes us from Hamilton's beginning in the Caribbean to the end of the Revolutionary War. The second is the rap battle for the future of the Constitution and the fight for Hamilton's marriage and reputation. And the duel.

It all moves so fast it's hard for the audience to catch its breath. There's a beat, a long quiet beat, at the end of the first act in which the audience gathers itself, then erupts in applause. Then they inch up the aisles to the lobby saying, “They should teach it like this in the schools.”

It's something about the rhyme scheme of rap—or at least of the Hamilton/Miranda rap—how two propulsive couplets can wrap around into a triplet halfway into the next line and drive you forward.

“The fun for me in collaboration is, one, working with other people just makes you smarter, that's proven,” says Miranda. “And this is not a singular art form—it's 12 art forms smashed together. We elevate each other. And two, it's enormously gratifying because you can build things so much bigger than yourself.”

The principal cast is so good you wonder how everyone seems so right for the part. “Because we spend more time casting than anyone else,” says director Thomas Kail. Everyone will come out of this show a star. Or a bigger star. “I spend time picturing them in movies and TV after this,” Miranda says. “On *Law & Order*, like the cast of *Rent*.”

It's hard to gauge who'll break biggest, but watching Leslie Odom Jr. as Burr in “The Room Where It Happens” is a lot like seeing Ben Vereen take the stage for the first time in *Jesus*



*Christ Superstar*, a watershed for performer and audience. It's his show in many ways. Daveed Diggs as a louche Thomas Jefferson channeling Cab Calloway and the Looney Tunes wolf. Jonathan Groff as King George with the show's peak comic moment, an imperial homage to Britpop teen heart-break and the early Beatles. Every Schuyler sister: Renée Elise Goldsberry, Phillipa Soo, Jasmine Cephas Jones.

This may be the most collaborative business there is, so credit goes in equal measure to every part of the creative team, even if the profiles take the "solitary genius" approach. Kail; Alex Lacamoire, music director; Andy Blankenbuehler, choreographer—Miranda calls it "The Cabinet." It's all one thing. One brain. They all worked together on *In The Heights*. You see them at rehearsal, in the calm eye of the Broadway hurricane, working and working and reworking what already works. They gesture with their coffee cups to the lights, the wings, the turntable. Maybe try this, maybe trim that. Maybe coffee is the real genius.

"It's about making the best possible thing," Miranda says.

The show is somehow overtly political without seeming so, as is the timing of its arrival. Oskar Eustis, the artistic director of the Public Theater, told the *Los Angeles Times* as much in June. "My wise friend Tony Kushner," said Eustis, "pointed out to me that the success of *Hamilton* is precisely embodied in the fact that it is convincing everybody of the need to see this nation as a nation of immigrants—the need to see people of color as central to owning the nation. I think the show is actually going to move the needle on how we think about immigration precisely because it's reaching people."

We're all here from somewhere else. America, Mother of Exiles.

There's a lottery for \$10 front-row seats before every show. A nice touch of egalitarianism in the face of Broadway prices, with a little P.T. Barnum thrown in. Crowds of 600 or 700 people gather and cross their fingers.

Somehow, in less than a year, *Hamilton* has become emblematic of something much bigger than itself. There's a lesson here for everyone, American or not. "The U.N. Security Council came to see the show at the Public," Miranda remembers one afternoon, "and our U.S. ambassador said, 'There are so many world leaders I would love to bring to the show just to show them



George Washington stepping down—because the story of history is leaders leading on populism, then not leaving.”

**The night of that presidential matinee there's a party for the** cast of *Hamilton*. Down the street and around the corner from the theater, it's upstairs at a club on Times Square. Here, inside, flattered by candlelight, everyone is beautiful, the music falls from the rafters and there's never a line at the bar. There's even a red carpet for photo ops. This is what success looks like, what you pretend for yourself as a kid hamming it up in the mirror at home in Kenosha or Youngstown or Washington Heights. Parties like this are part of the dream.

The place smells like money and the waiters glide by in silence with free drinks and tiny food. The cast arrives and the cameras strobe and the dancers dance as soon as they walk in the door. Miranda moves from group to group distributing hugs and wisecracks to cast members, their wives, their boyfriends, their husbands. Every conversation is a variation on the theme of “What a day. The *president*.” The dance floor fills. After an hour, Miranda wanders away from the noise and the crowd and tucks himself into a corner, half hidden by a column and a cocktail table. He sits on the windowsill and takes out his phone.

He sits alone for what seems a long time. Immersed. Maybe he's texting goodnight to his wife and son. But he could easily be writing notes for revisions to the show.

If it's good, why try to make it great?

“Because those are the shows we love. We love *Fiddler*. We love *West Side Story*. I want to be in that club. I want to be in the club that writes the musical that every high school does. We're *this* close.”

Or maybe he's starting on the next one. Chernow hopes he has eight or ten more of these in him. Rapt, his tired face washed smartphone blue, behind him the sidewalks teem and the Times Square light show explodes. Eventually a couple of people find him. One yells over the music, “We just wanted to thank you.” He smiles and rises to meet them.

The show is successful because the show is so good, and the show is so good largely because of Lin-Manuel Miranda. His secret is that he writes in service of character, to advance story. He doesn't write merely to be clever, to show off. Without



having to contrive event or fabricate plot he breathes life into history and Alexander Hamilton, animates him, stands him up and makes him sing, makes him human for a couple of hours.

“A genius? I’m not sure what that word means,” his father said one morning. “What I admire most about him is his humility.”

So maybe Miranda’s genius lies in his willingness not to *behave* like a genius—an outlier, a singularity—but rather to dissolve himself into the group, the collective in which ideas and improvements are argued on their merits.

A democracy in which the best idea wins.

Or maybe he’s not a genius at all, just a hard-working young playwright with a great ear and a good heart who loves words and people—so people and words love him back. All those things. None of those things. Does it matter? He helped make a masterpiece.

*And when my time is up?*

*Have I done enough?*

*Will they tell my story?*

**Three weeks later, it’s opening night. A few hours before the** six o’clock drawing for those \$10 tickets, Lin-Manuel Miranda reads aloud into the August heat the first five paragraphs of Ron Chernow’s biography of Alexander Hamilton. He chokes up, as do many of the 600 people listening to him.

“Yes,” reads the overnight review in the *New York Times*, “it really is that good.” The show is a hit. Already. Still. At midnight there’s another cast party. Fireworks on the Hudson. Everyone is there and everyone is happy and with every shot the big river brightens and burns all the way to Weehawken. The rest is history. ○

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*See Miranda rap for the crowd at the daily ticket lottery at [Smithsonian.com/miranda](https://www.smithsonian.com/miranda)*

AMERICAN  INGENUITY

# GADGET GIRL

YOUTH • LILIANNA ZYSZKOWSKI

**AT AGE 11, SHE  
DESIGNED A NEW  
LIFE-SAVING DEVICE  
TO HELP PEOPLE  
TRACK THEIR  
MEDICATION. THAT  
WAS JUST THE  
BEGINNING**

BY JESSICA **PRESSLER**  
PHOTO ILLUSTRATION  
BY **HOLLENDERX2**

## **If you were to look into the personal histories**

of the world's great inventors, you would likely find that at some point they came up with innovations that were more pedestrian than the ones that made them famous. For example, booby traps to keep their siblings out of their personal space. "One of them involved dental floss, because it was so small and strong, but you don't see it," Lilianna Zyszkowski recalls of one of her own early creations. She blushes slightly. "A lot of things I did back then—I would say they weren't very beneficial to the world."

Sitting at a café in the bucolic Berkshire Mountains, Zyszkowski straightens her spine and composes her





hands in front of her coffee in a way that makes clear that now, at the wizened age of 15, she is well past these juvenile antics. These days she is, in her own phrase, “famous-ish” for putting her talents to better use, by designing inventions that *do* help people. Her best known is the PillMinder, a device that tracks medication intake. Zyszkowski came up with the idea in the sixth grade, after her grandfather accidentally overdosed on his blood thinners and ended up in the hospital. “It was pretty scary,” she says.

Zyszkowski was not going to sit around fretting. “I’m like, OK, how can we fix this?” she says. “That’s my mentality.”

Her research suggested that the touch sensors found in common TV remote controls—capacitive chips that react to pressure—would also be useful conductors, and they were cheap and plentiful online. She ordered a batch and, with the help of videos she found online, figured out how to solder them to the bottom of plastic S-M-T-W-T-F-S pill-storage boxes she’d bought at a drugstore. Using copper wires, she connected the chips to a microcontroller, which she programmed (after reading about coding) to notify a private Twitter account whenever a person’s finger touched the sensors. Twitter sent an alert to the user’s smartphone, creating a record of pills taken.

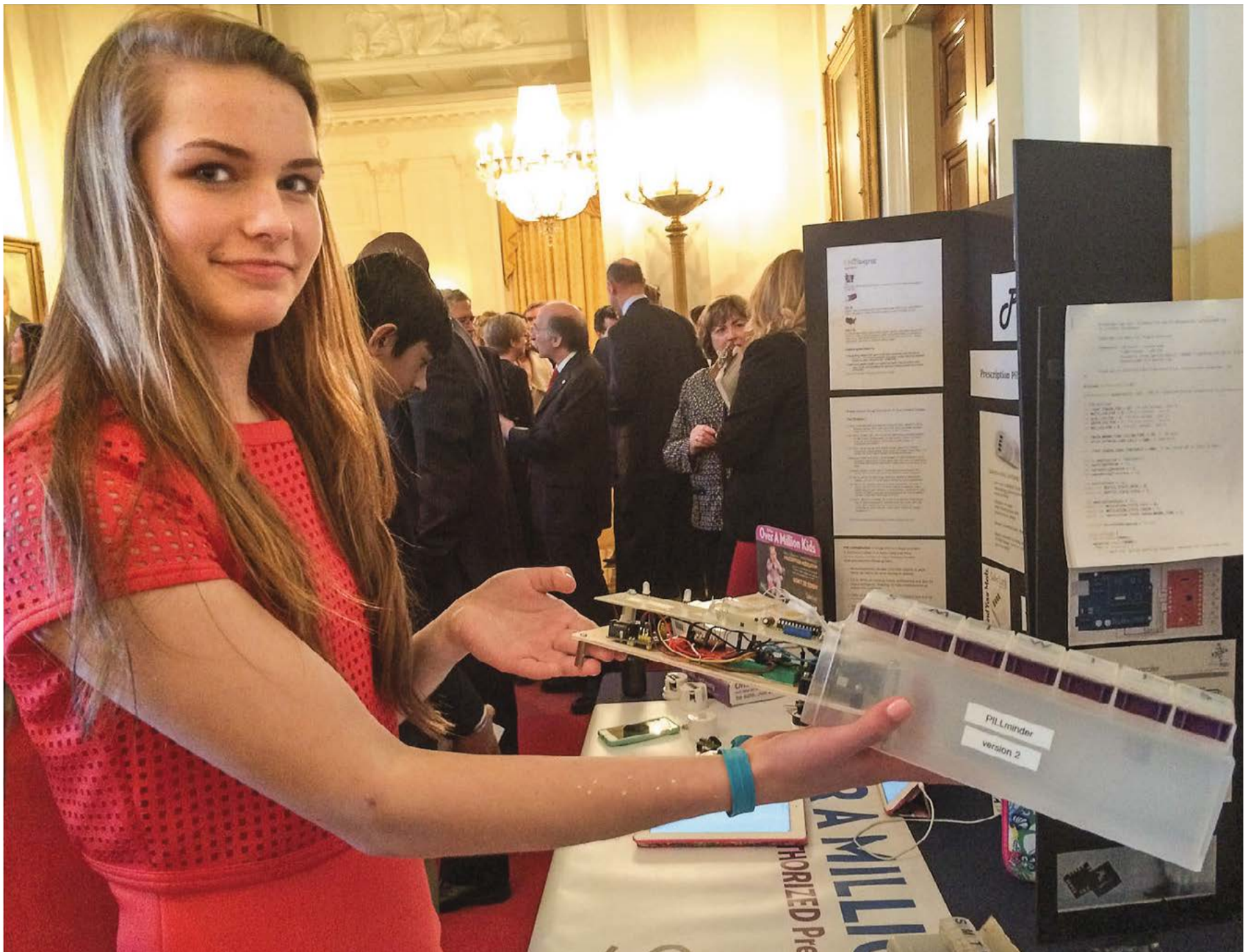
The PillMinder was a hit at the annual kids’ science fair in her area, the Connecticut Invention Convention, where Zyszkowski took home multiple prizes. Soon after, she began working with California-based Gatekeeper Innovation to add PillMinder technology to its Safer Lock combination-based pill-bottle cap. This past spring, Zyszkowski presented the device at the White House Science Fair. “There’s Obama, and there’s me, the only girl in the background,” she says, showing me a picture in which she stands out from a crowd thick with guys in glasses.

Although her business cards describe her as an “inventor,” Zyszkowski doesn’t want to paint herself with just that brush. “My big-vision thing is the Internet of Things,” she says. “Having you and the things you do talk to devices, and having the devices know what to do with that information and connect to everything else and help you—I am really into that.” She admires Elon Musk, whose interest in technological advancement spans multiple industries and applications. “I like people with big ideas,” she says.



Zyskowski solders  
a new prototype  
late into the night.





**At the 2015 White House Science Fair, Zyszkowski showcases an early version of the PillMinder.**

**A shingle for “Minder Industries” hangs outside the door of** the Zyszkowski family office, although the business is not yet incorporated. Running a company at this point in her life would be “too distracting,” Zyszkowski says, climbing the stairs to the building, which is housed on a large estate where, on the day that I visit, stonemasons are laying a terrace overlooking a deep green valley. The sprawling property does not belong to her family but to a business associate of Zyszkowski’s father.

Inside, a 3-D printer whirs incongruously in a space that, with its wood paneling and dormant Jacuzzi, gives off a ski chalet vibe. At a desk near the door, Alek, Zyszkowski’s 12-year-old brother and her early muse, stares into his laptop. Alek is an inventor, too—in fact, he tried to enter a device in the same science fair in which his sister debuted the PillMinder. “It was called the Foul Air Response Trigger,” says Lilianna, whose desk is opposite her brother’s. “So, if you figure out the initials



for that, you will know what kind of sensor it was—it would sense methane gas and then it would trigger a fan.” The Catholic school they were attending at the time refused to enter it, on the grounds that the name was offensive.

Alek shrugs. “It was funny, though,” he says.

In the center of the office, flanked by his children, sits their father, Edward Zyszkowski, a physicist, developer and venture capitalist. A veteran of Thinking Machines, the pioneering supercomputer firm, Ed Zyszkowski was part of the team that, in the 1980s and '90s, developed the subfield of computing we now know as “data mining.”

Coming up the stairs with a sandwich for Alek is the children’s mother, Lori Fena, an early Internet activist and intellectual powerhouse in her own right. Fena was the director of the Electronic Frontier Foundation, an advocacy group, and the co-author in 2000 of the prescient book *The Hundredth Window: Protecting Your Privacy and Security in the Age of the Internet*. When the couple started dating in the 1990s, it caused a *frisson* of gossip among the digerati. A 1997 *People* magazine interview with Fena about Internet privacy mentioned her then-boyfriend’s job mining people’s data, and Salon.com speculated about the couple’s “spirited debates at the dinner table.” After they got married, they left Silicon Valley and settled in New Marlborough, a quirky town in western Massachusetts, a choice based in part on data mining. “Ed wrote a ‘spider,’” Fena explains—an algorithm into which he plugged  $10^7$  criteria, including acreage, proximity to water and the airport, and the quality of local schools.

Over the years, Fena and Zyszkowski have collaborated on several business and nonprofit ventures, including Public Safety Guardian, a device that seeks to improve upon the body cameras worn by police by collecting and storing real-time video footage to protect against tampering.

The family office has served as something of an incubator for Lilianna. “Lili is sort of a filter feeder,” Fena explains, gesturing around the room, which contains everything from an original Tesla coil to a static electricity generator Ed rigged up using parts from an old microwave oven. “She sees all of this stuff floating around and is like, Oh, I can do something with that.”

For instance, when Lilianna was 12, a couple of her swim



teammates suffered concussions from backstroking into a wall during a race. “Basically, I hacked a car backup sensor I bought off eBay,” she says, holding up the resulting invention, called Dolphin Goggles, which use the sensor’s technology to alert swimmers when they approach a wall, using lights instead of sound because, as Zyszkowski learned, sound travels differently in water.

The following year, after hearing a story on the radio about infants who died after being left in cars, she came up with the Baby Minder. After a weekend baby-sitting for her 2-year-old cousins, she was inspired to add temperature and moisture sensors to a piece of conductive cloth that, affixed to a diaper, delivered alerts about a baby’s whereabouts, body temperature and diaper efficacy to a smartphone. “I used Bluetooth low-energy, because it had just come out,” Zyszkowski says. “I try to use something new and kind of cutting edge every time.”

During the development process, Zyszkowski says, she often asks her parents for advice. “I bring them ideas and they are, like, How are you going to solve that?”

“We send her links,” says Fena.

“All the time,” Zyszkowski says. “Articles, articles, articles.”

**It was an article that alerted Fena that the son of one of her old friends had started Gatekeeper Innovation after a family member had become addicted to pain medication.** The company’s story appealed to Lili’s humanitarian instincts, and now she and Gatekeeper have filed a provisional patent for a Safer Lock bottle with PillMinder technology, and they hope to bring the product to market next year. The prototypes she displayed at the White House Science Fair in April showed the device’s evolution. While the original microcontroller was the size of Lili’s hand, the technology had advanced to the point that it fit inside what she calls a “smartcap.” When the cap is removed, a tiny band of LEDs transmits an encrypted message via Bluetooth to a smartphone app, which notifies the patient, or a doctor or caregiver, that the pills were taken—presumably. “One thing I am running into is people saying, ‘If they open the pill cap you don’t know if they actually took the pill or not,’” says Zyszkowski. “But it will still log the fact that they opened the cap and thought about it.”

And there are other benefits, including an ability to link the



bottle cap to a pharmacy prescription, a capacity that has intrigued lawmakers looking for ways to stem the illegal distribution of prescription drugs. After the White House Science Fair, Zyszkowski was invited to meet with Senator Richard Blumenthal, the Connecticut Democrat.

“He was having a Senate meeting about trying to figure out where drugs go after the pharmacy, because there’s no, like, trackers,” Zyszkowski says.

Of course, one could argue that using the technology in this way raises questions about personal privacy. Fortunately, Zyszkowski has a panel of experts who can weigh in right at the dinner table. “It’s good to know where drugs are going,” says her mother, the Internet privacy activist. “As long as it’s a need-to-know versus public record. And not everybody will be under surveillance—only things that are aberrations.”

Her daughter nods enthusiastically. “Like, gee, it’s interesting that all of these prescriptions are ending up in the same spot. . . .”

Privacy is important to Zyszkowski, too, especially since she began her sophomore year at Phillips Exeter Academy in New Hampshire this fall. One thing you will never see from Minder Industries, she says with a grin, is a Teenager Minder.

“I didn’t invent that for a reason.” ○

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AMERICAN  
INGENUITY

# THE BUILDERS

SOCIAL PROGRESS • THEASTER GATES

Gates' Chicago studio includes a formal gallery and a wood shop.

AN ARTIST'S CREATIVE APPROACH TO REVITALIZING A CRUMBLING CHICAGO NEIGHBORHOOD OFFERS NEW HOPE FOR AMERICA'S BELEAGUERED CITIES

BY NATALIE MOORE // PHOTOGRAPHS BY JON LOWENSTEIN



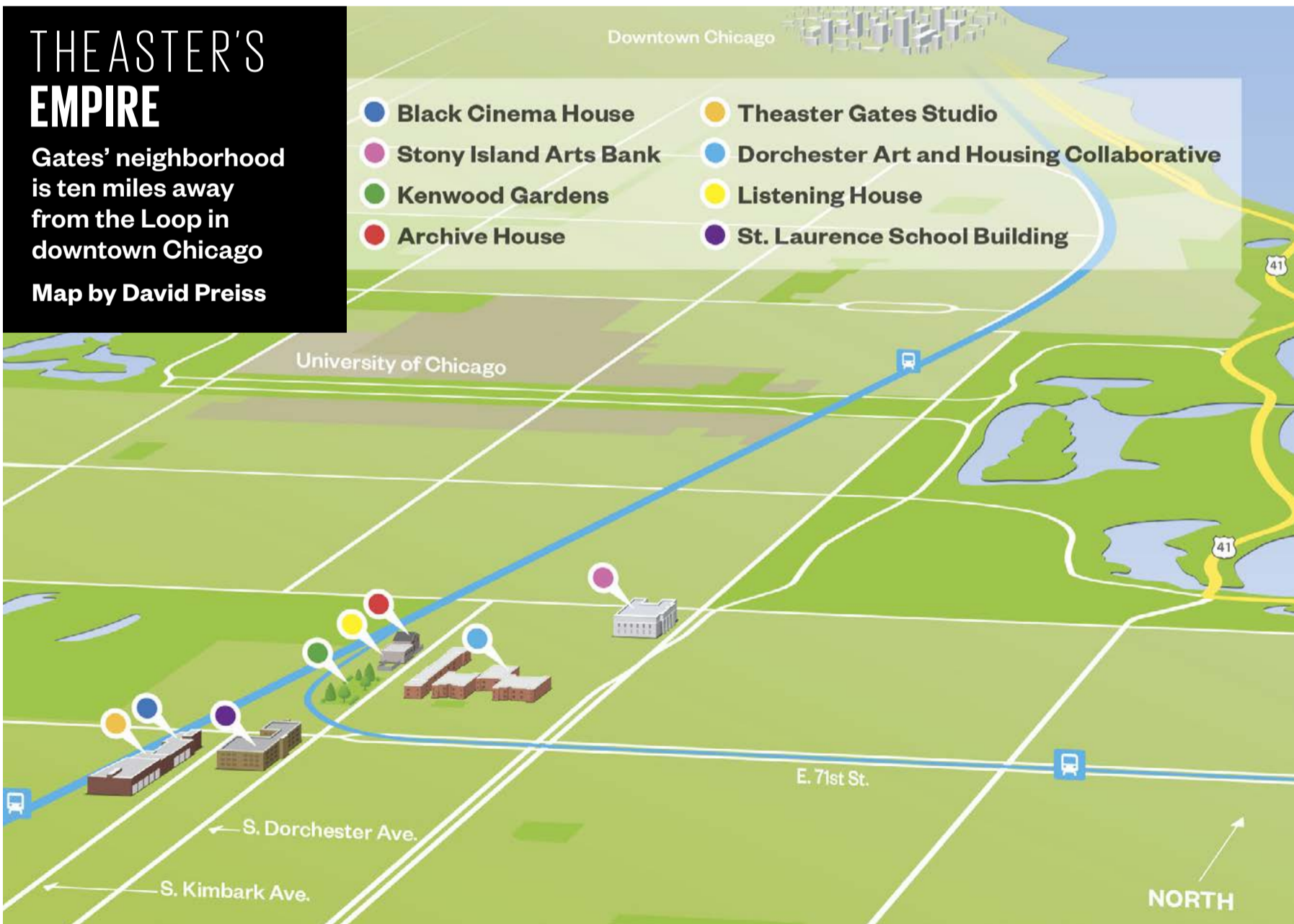
**“I’m always building, moving the mountain—whether it’s exhibition space or the South Side,” says Gates (at the opening of the Stony Island Arts Bank).**



Gates' multi-city installation *Soul Manufacturing Corporation* invited the public to mingle with "skilled makers" of art (their pottery) as well as a yoga instructor, DJ and a reader.

## Though celebrated for a dazzling range of

achievements—he's a painter, a sculptor, a performance artist, an academic, an inspirational speaker—Theaster Gates refers to himself as a potter, because that's how he started, and, after all, it is kind of magical to make something beautiful out of, well, mud. But his newest creative material is unique even by his eclectic standards. It's a neighborhood on the South Side of Chicago called Greater Grand Crossing, which for the most part isn't very grand. Weeded lots, two-flat apartments, vacant buildings, crooked frame houses, a median income level almost \$20,000 less than the city as a whole. "It's the place people leave or are stuck [in]," Gates says one day while driving through the neighborhood in his SUV, greeting youths on the sidewalks. They wave back. They recognize him and get what he's doing: pioneering a new approach to revitalizing a forsaken neighborhood, transforming it without displacing residents or changing its essential character.





**After a \$4.5 million renovation, the Stony Island Arts Bank opened to the public in October. Chicago has impressive architecture, Gates noted, but also “a major history of racism and segregation... and housing policies that work against the poor, against black and brown people.”**



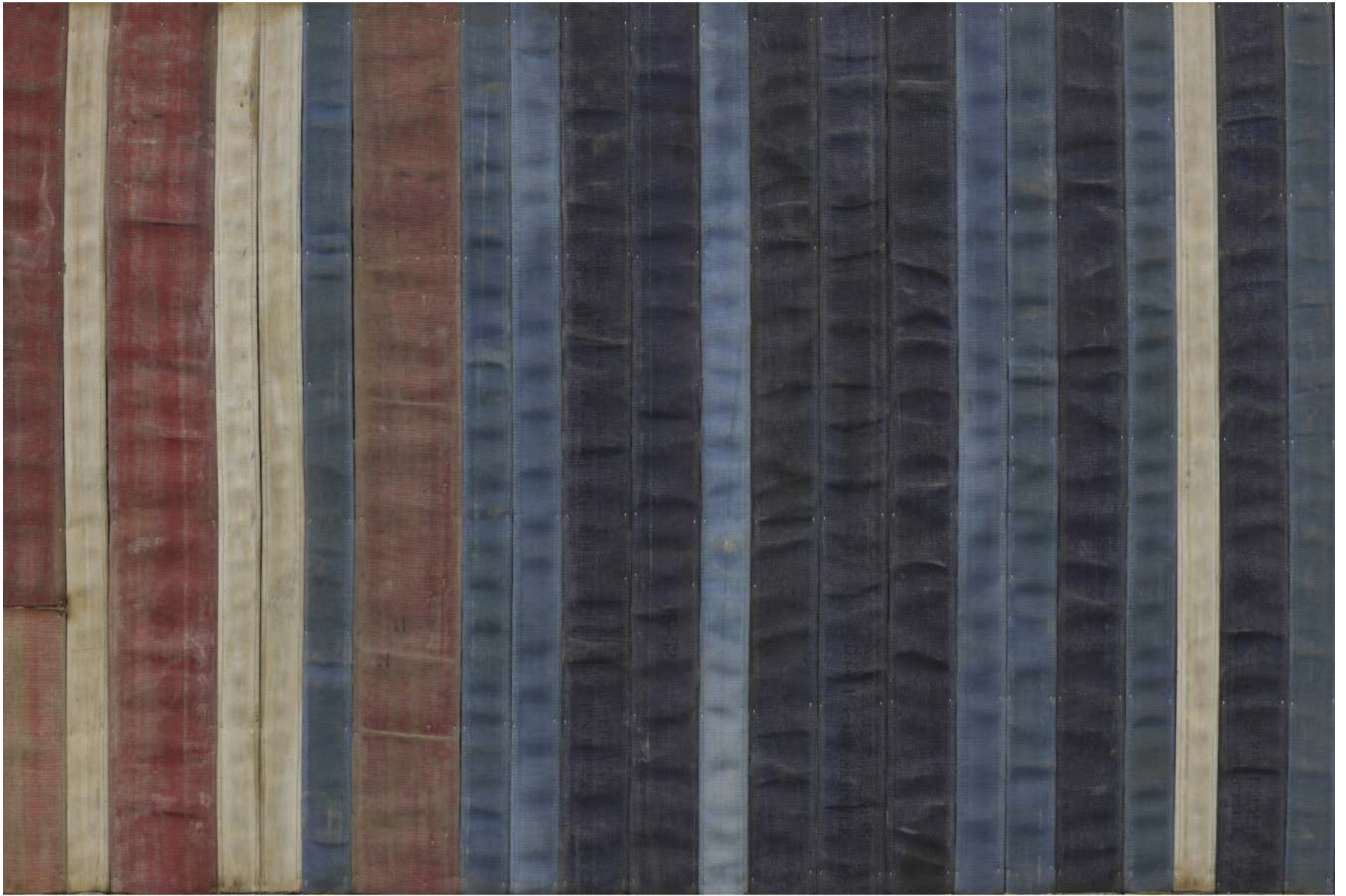


**In a nod to the bank's onetime role in redlining, it now houses a collection of racist artifacts.**

Consider the Stony Island Arts Bank, which opened in October to adoring reviews. Gates bought the dilapidated neo-Classical building, formerly the Stony Island Trust & Savings Bank, from the city for \$1 in 2013. It had several feet of standing water in the basement. Undeterred, Gates sold “bank bonds” of salvaged marble for \$5,000 each to fund the renovation. Now the space is agleam with a ground-floor atrium and a soaring exhibition hall. It's part library, part community center, part gallery. Among other culturally significant items, it will house the archives of the Johnson Publishing Company, the publisher of *Jet* and *Ebony* magazines, vinyl recordings belonging to the house music legend Frankie Knuckles, and a collection of racist relics known as negrobilia. There will be performances, artists-in-residence and possibly even a coffee bar.

Everyone, of course, knows about the need to revive down-trodden urban neighborhoods—what Gates calls the “challenge of blight”—and there are many strategies afoot, such as enticing members of the “creative class” to move in. But Gates’ “redemptive architecture” isn't about gentrification, or replacing poor





**Gates selects his materials carefully: *Flag 2012* is composed of decommissioned fire hoses, a potent reminder of their use during the civil rights struggles of the 1960s.**

people with well-to-do ones. It's about creating concrete ways for existing residents to feel that culture can thrive where they live, and there is already reason to believe that good things will follow. Mayor Rahm Emanuel calls Gates a "civic treasure."

Gates, who grew up on Chicago's beleaguered West Side and holds degrees in urban planning and religion, took his first step toward rehabilitating Greater Grand Crossing in 2006, buying a former candy store for \$130,000. "There was no grand ambition. When you root in a place, you start making things better. I wasn't on some divine mission," he says. Two years later he bought the building next door for \$16,000. That became the Archive House, which houses a micro library. A former crack house was transformed into the Black Cinema House, hosting screenings and discussions about African-American films. Gates has now invested millions in Greater Grand Crossing through a web of enterprises that includes his studio and the nonprofit Rebuild Foundation and his post as director of Arts + Public Life at the University of Chicago.

The work has boosted his stature. *ArtReview* has dubbed



**“To make great things happen requires faith and intentionality,” says Gates. He transformed a former Anheuser-Busch distribution facility into his studio (above) and turned a onetime crack house into the Black Cinema House (right).**



Gates, who is 42, “the poster boy for socially engaged art.” And earlier this year, he won the prestigious Artes Mundi Prize for a religion-themed installation featuring a revolving figure of a goat like those purportedly used by American Freemasons, a bull sculpture used to ward off bad crops in Africa and a video of soul singer Billy Forston singing “Amazing Grace.”

Gates has said he wants to turn Greater Grand Crossing into a “miniature Versailles” that would draw visitors from all around. “I want the South Side to look like my friends’ home in Aspen. I want my pocket part to look like Luxembourg.” Chicago is just the start. He’s doing similar work in Gary, Indiana, and St. Louis, advising other would-be urban potters on how to shape what they’ve got into something great. ●

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# National Treasure

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by Jerry Adler

PHOTOGRAPHS BY Hugh Talman

# Snap Judgment

A better mousetrap has long been the holy grail of American ingenuity

**It is among the most successful inventions of all time, judged by longevity; a touchstone of America's technological imperative. Build a better one, as Ralph Waldo Emerson might or might not have said, and—well, you know the rest. But within a few years of Emerson's death, in 1882, the saying was already obsolete: the better mousetrap had been built, the world had chosen it, and the rest, a billion or so mice later, is history.**

We are speaking, naturally, of the flat wooden-based snap trap—a household necessity so universally adopted that the Smithsonian National Museum of American History maintains a representative collection of mouse dispatchers—30 or so in all.





Originally patented by William C. Hooker in 1894, and modified by John Mast and others, this kind of trap is still turned out, by the tens of millions, in the same factory in Lititz, Pennsylvania, now under the brand name Victor. It is a kind of living fossil of industry, like the horseshoe crab, little altered by the winds of time and evolution. A few years later, one H.D. Gardy was issued a patent for a Combined Pan Lifter, Can Opener and Corkscrew. Try finding one of those at a hardware store.

Still, countless inventors, as if feeling personally challenged by Emerson's aphorism, have sought to match their ingenuity against the 400-milligram brain of the mouse. The Patent Office still receives applications for 20 or so mousetrap patents annually, and recently has been granting about a dozen each year. The advantage of the snap trap—the metal bar crashing down on the mouse's head with deadly speed—has the disadvantage of leaving behind a mangled corpse. Fastidiousness about disposing of the victim, or qualms about killing it in the first place, has led to a proliferation of non-lethal traps that allow the captive to be released into nature. The website of the Humane Society of the United States points out that the chances of a house mouse surviving for long out of doors are “very low,” but it will, of course, die out of sight.

Live traps can be as simple as a tube on a pivot that swivels under the weight of a mouse, letting a door fall closed behind it, or as complicated as the Little Valve, whose website describes it as made “for the sensitive in mind.” Its operation, according to the authoritative *20th-Century Mouse Traps*, by David Drummond, “requires a mouse to climb up through a hole in the trap floor. When it stands on a treadle to reach the bait on a slide-out tray at the back of the trap, a wooden plug drops down and blocks the hole and prevents the mouse's escape.”

There's no reason to think the Little Valve won't catch mice, but it's six inches long and costs \$22.95, so most people probably aren't going to use more than one. This is an inefficient approach, according to Jim Fredericks, a vice president of the National Pest Management Association. Professional exterminators use traps in multiples, hoping to wipe out an entire colony in the first couple of nights, after which the survivors might begin to apprehend that traps should be avoided.



The mouse does seem to be evolving. In 1948, the synthesizing of warfarin, a rodent poison, seemed as if it might render traps obsolete, but within a couple of decades a gene for warfarin resistance was increasingly showing up in mice. Seven hundred or so mouse generations after Hooker's great invention, though, mice are still nibbling on a dab of cheese or peanut butter smeared on a metal tab, releasing the bar and sending a spring-loaded jaw crashing into their skulls in 10 to 12 milliseconds. It is likely to be around as long as there are mice, and people. ●

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# ROAD ROAD SHOW

◀ VISUAL ARTS • ZOE CROSER // SHAMIM MOMIN ▶

AMERICAN  
INGENUITY



A WILDLY  
CREATIVE  
ART PROJECT  
TRANSFORMS A  
CLASSIC AMERICAN  
EYESORE INTO AN  
INSPIRING, 2,400-MILE-  
LONG NATIONAL NARRATIVE

BY MARGOT DOUGHERTY



MILE 2,460

**CHAPTER 10**  
LOS ANGELES, CA

**CHAPTER 9**  
PALM SPRINGS, CA

**CHAPTER 8**  
TUCSON, AZ

**CHAPTER 7**  
LAS CRUCES, NM

**CHAPTER 6**  
EL PASO, TX



**MATTHEW BRANNON**



**ZOE CROSER**



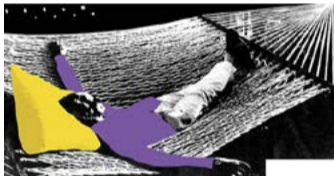
**BOBBI WOODS**



**DANIEL R. SMALL**



**JEREMY SHAW**



civil eyes



**HOW CAN YOU FEEL SO REASONABLY?**



MILE 0

**CHAPTER 5**  
SAN ANTONIO, TX

**CHAPTER 4**  
HOUSTON, TX

**CHAPTER 3**  
NEW ORLEANS, LA

**CHAPTER 2**  
MOBILE, AL

**CHAPTER 1**  
JACKSONVILLE, FL



**JOHN BALDESSARI**



**EVE FOWLER**



**SANFORD BIGGERS**



**MARIO YBARRA JR.**



**SHANA LUTKER**

Ten artists enlisted in the Manifest Destiny Billboard Project.



## Zoe Crosher spent a few years driving between

Los Angeles, where she lives, and Tempe, Arizona, where her boyfriend was studying. That's 380 miles each way; she had a lot of time to think. "There's a moment where you cross the state border that's very bleak," she says. "It's deep desert, and you're wondering, 'Where's L.A.? Where's California? Am I there yet?'" An artist whose multimedia works often explore the disconnect between fantasy and reality, Crosher imagined punctuating the arid expanse with a succession of billboards showing a lush Shangri-La of greenery "that sort of dies as you approach L.A., this decaying promise."

She envisioned other artists interpreting her vision as well, and took the idea to Shamim Momin, the founder and director of the Los Angeles Nomadic Division (LAND), a non-profit organization that generates and oversees public-art projects. Momin, a former curator for the Whitney Museum of American Art in New York City, took Crosher's idea a step further: Why not expand it to cover all 2,460 miles of Interstate 10, from Jacksonville, Florida, to Los Angeles? Why not break it up into ten "chapters" of ten billboards each, and give each chapter to a different artist? And so the "Manifest Destiny Billboard Project" was born, named for the mid-19th-century concept that assigned noble purpose to the nation's westward expansion even as it left a legacy of brutality and loss.

Daniel R. Small's inscriptions  
caused a stir in New Mexico.

To get a sense of the terrain





**ON THE ROAD:**  
Jeremy Shaw used the same image in all his billboards, reconfiguring the cover of Marty Robbins' *Biggest Hits* album featuring the single "El Paso."

and logistics involved, Momin and two other members of LAND spent 12 days driving the length of I-10 and photographed all the existing billboards along the way—more than 5,000 shots in all. "It was pretty insane," Momin says. "One forgets how giant the U.S. is."

Crosher says that as co-curators, they "wanted artists who were dealing with language in some capacity." And Momin says they sought artists "who could engage the idea [of manifest destiny] and find something innovative in the [billboard] format." Enlisting the artists proved simpler than getting the donated or discounted billboard space.

"I liked thinking about who sees the billboards and how they're different from your more expected art audience," says L.A.-based artist Shana Lutker. "They have no choice—they're driving by and have to see them." Once her chapter, "Onward and Upward," launched the project in Jacksonville in October 2013 with images of skies juxtaposed against the real sky, the billboards unfurled westward every two months over the next 20 months.

Eve Fowler's series, featuring quotations from Gertrude Stein, showed "there can be something poetic about being stuck in traffic," the *Houston Chronicle's* Maggie Galehouse wrote. The acclaimed California artist John Baldessari, at age 84 the group's elder statesman, provoked commuters in San Antonio by pairing images of a giant gear and a man in a hammock—work



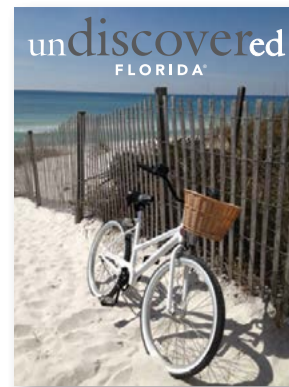
and play. Crosher realized her vision of greenery shriveling on the road out of the desert and toward Los Angeles.

Then there were Daniel R. Small's billboards in Las Cruces, New Mexico: He superimposed scrambled text from the Los Lunas Decalogue Stone, whose paleo-Hebrew inscription was said to be a pre-Columbian version of the Ten Commandments (and debunked as a hoax), on photographs of the California desert site where Cecil B. DeMille buried his Egyptian set after filming *The Ten Commandments*. Onlookers harassed Small's billboard installers, shouting that the messages were Satanic or alien or extremist. "You never know," one told the *Las Cruces Sun-News*. "We're close to the border, and you think that ISIS or some other subversives might be trying to get at us."

"I thought there'd be some debate," Small says, "but I didn't see that coming." ○

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**9. FCO/FDEP**

850-245-2099

**10. Flagler Museum**

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954-473-2955

**12. The Florida Keys & Key West**

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**13. Florida's Suwannee River Valley**

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**14. Florida State Parks**

850-245-2157

**15. Garrett Realty Services, Inc.**

1-800-537-5387

**16. Gilchrist County Tourist**

**Development Council**

352-463-3467

**17. Greater Miami and Beaches**

305-539-3000

**18. Gumbo Limbo Nature Center**

561-544-8605

**19. Hernando County Tourism Bureau**

1-800-601-4580

**20. Highlands County Visitor &**

**Convention Bureau**

1-800-545-6021

**21. HistoryMiami**

305-375-1492

**22. Hollywood Beach, Florida**

954-924-2980

**23. Key West Tropical Forest &**

**Botanical Garden**

305-296-1504

**24. Levy County Visitors Bureau**

352-486-3396

**25. Madison County Tourist**

**Development Council**

850-973-2788

**26. Martin County Office of Tourism**

**and Marketing**

1-877-585-0085

**27. The Mennello Museum of American Art**

407-246-4278

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# MEMORY KEEPERS

NATURAL SCIENCES • RUDOLPH TANZI // DOO YEON KIM

BOSTON RESEARCHERS  
HAVE INVENTED A  
REVOLUTIONARY NEW TOOL  
TO STUDY THE MYSTERIES  
OF ALZHEIMER'S DISEASE  
AND COUNTER THE COMING  
EPIDEMIC OF DEMENTIA

BY NATALIE **ANGIER** // PHOTO ILLUSTRATION BY IRVIN **SERRANO**

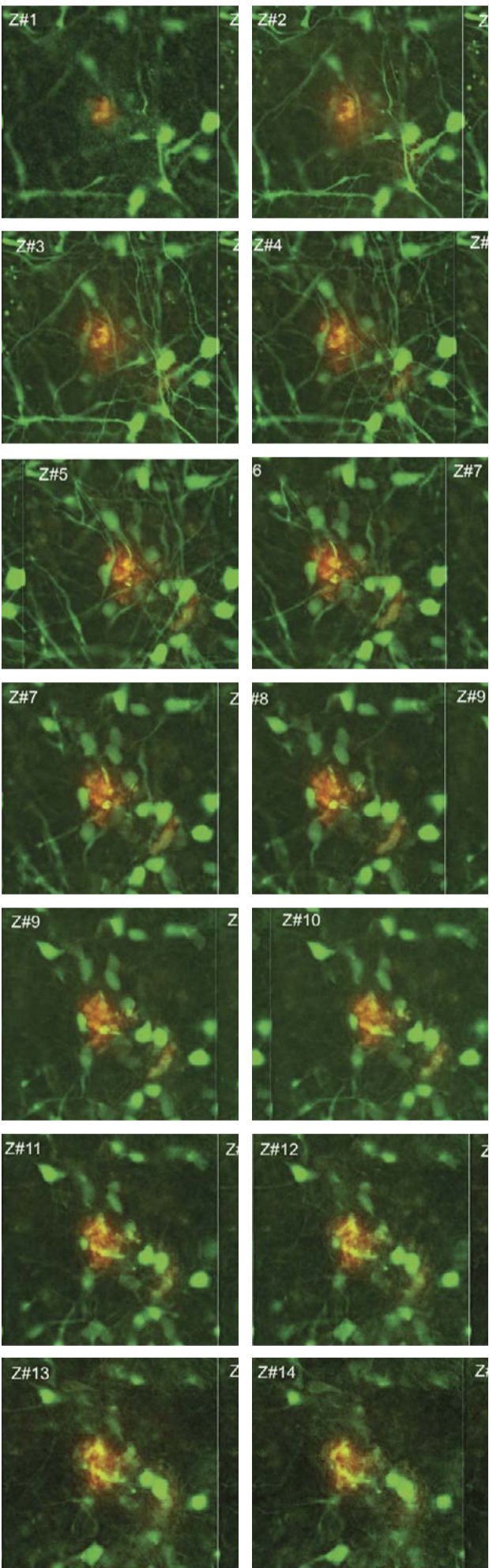






In Tanzi and Kim's lab, brain cells growing in 3-D in a dish harbor genes for familial Alzheimer's disease. Below, each microscope image shows a different level of focus on a neuron cluster and toxic amyloid plaque.

## WHAT GOES WRONG

Viewing dementia's sinister progress



 = NEURONS  
 = AMYLOID-BETA PLAQUES

## Rudolph E. Tanzi, director of the genetics and aging

research unit at Massachusetts General Hospital, professor of neurology at Harvard Medical School and a towering figure in the field of Alzheimer's research, refuses to play the piano. Yes, he's an exuberantly dedicated musician who seriously considered a musical career before going into science. He's played keyboards with the rock band Aerosmith and jammed on "The Tonight Show with Jay Leno." He practices every day at home on his handmade Bösendorfer concert grand.

But the old piano in the laboratory lounge near his office? By Tanzi's reckoning, it has the instrumental equivalent of a neurodegenerative disease. "It sounds terrible," he says. "Tinny, balky, out of tune. I won't play it." Please? Just a few bars? "I have my standards," he mutters. "I don't want to embarrass myself."

Finally, he sits down with a sigh and starts in on the jazz classic, "Round Midnight." All that warm-up whining and the ballad sounds wonderful, with elegant harmonies and a spare, inventive baseline. He moves on to Miles Davis, Billy Joel. Scientists and students from elsewhere on the floor stream into the lounge to listen, and when Tanzi finishes they burst into applause. Tanzi, who is 57, looks happy, boyish and maybe relieved. From a tattered piano he's plucked magic rabbits of song.

"Rudy is some kind of genius," says his close collaborator Doo Yeon Kim, who works down the hall. Musically, scientifically, Kim says, "Rudy always has big ideas, always wants to try new things." Kim, 45, smiles often, speaks with a strong Korean accent and seems perpetually ready to break into a run. He considers himself a nitty-gritty, flask-and-beaker sort of guy. "I focus on the science," he says. "Rudy's role is the vision, mine is the details."

The pair's contrapuntalism has proved a runaway hit. Tanzi and Kim have devised a revolutionary tool for tackling Alzheimer's disease, the world's leading cause of senile dementia and a medical crisis that looms ever larger as the teeming throngs of baby boomers lurch into old age. Reported late last year to international acclaim in the prestigious journal *Nature*, the new technique, an innovative type of cell culture, is considered the most persuasive and useful laboratory model yet invented of the





**“IF WE DON’T DO SOMETHING ABOUT THIS, IT’S GOING TO CRIPPLE US,” SAYS ANNE B. YOUNG, THE FORMER CHIEF OF NEUROLOGY AT MASS GENERAL, “AND THOSE WHO DON’T GET **ALZHEIMER’S DISEASE** WILL BE IMPACTED JUST AS MUCH AS THOSE WHO DO.”**

neurodegenerative disease. It offers researchers a chance to both track the course of Alzheimer’s in unprecedented biochemical and genetic detail, and to quickly and cheaply test thousands of potential treatments that might block or at least slow its malign progress. “It’s a fantastic model with great potential for testing new drugs,” says Sangram Sisodia, a professor and Alzheimer’s researcher at the University of Chicago. “It’s the kind of golden opportunity we haven’t seen before.”

Nicknamed “Alzheimer’s in a dish,” the new technique features colonies of genetically manipulated human brain cells that grow in three dimensions in a gooey gel. As the days pass, the cells start displaying the two most salient hallmarks of Alzheimer’s disease: plaques and tangles. Forming around and between the cells, the microscopic plaques consist of cast-off protein fragments called amyloid-beta and are as tough and unyielding as the nubs in a turkey burger, while the similarly stiff and tiny tangles develop inside the brain cells and look like twisted pieces of wire. Plaques and tangles are the very same diagnostic defects that the German neurologist Alois Alzheimer observed more than a century ago as he examined under the microscope the autopsied brains of patients who suffered from the disease that bears his name. Until now, however, scientists had not managed to generate both elements of the disorder in a single laboratory model—not in cells proliferating in petri dishes, not in genetically engineered mice (which form only plaques, not tangles). “I’m very enthusiastic,” says Sam Gandy, director of the Mount Sinai Center for Cognitive Health in New York. “We’re finally able to get key features of the human pathology that we haven’t been able to recapitulate in mice. It’s a powerful system.”

The breakthrough work serves as yet another highlight in Tanzi’s ridiculously fruitful career, in which he has helped hunt down and isolate almost all of the major genes now known



to be associated with Alzheimer's disease. The development also tags Kim as a rising star in a fiercely competitive field, and clinches his conviction that leaving the security and familiarity of South Korea years ago was the right thing to do. "My wife joked at the time, if we're going to the U.S., why not Hawaii? The weather is much better there than in Boston," Kim says. "But at Harvard, you feel like you're in the center of everything." His wife, Dong Eun Lee, has a good job as a pharmacist. His daughter Helena loves being an American high-school student, with the freedom to cross "pharmacist" and "scientist" from her list of professional aspirations.

The path to Alzheimer's in a dish was often grueling, switch-backing and potholed with despair, but in the end, Tanzi says, "the data spoke for themselves, and even my rivals were impressed." And for all Kim's claims about playing i-dotter to Tanzi's poetry, a crucial conceptual leap came not from Rudy but Doo.

"Coming here," Kim says, "was the best decision I ever made."

**The need for new treatments is dire. An estimated five million** Americans are stricken with Alzheimer's disease, and that figure is expected to quadruple in the next 30 years. Most are over 65 and suffer from a late-onset form of the disease, the result of multiple and still-mysterious slings and insults that take decades to decommission the brain; but a small proportion, roughly 5 percent, are the victims of hereditary Alzheimer's disease, carrying one of several rare genetic mutations that can cause dementia by age 50 or even younger—the kind of personal apocalypse beautifully portrayed by Julianne Moore in the movie *Still Alice*. The direct costs of caring for the national dementia burden are enormous, about \$225 billion a year today and projected to hit \$1 trillion annually by 2050. Yet Alzheimer's patients can't do without care: The disease progresses from the early stages of chronic forgetfulness, repeating questions, losing things and growing anxious and irritable, to escalating incompetence at everyday tasks like driving or finding your way home, maybe turning paranoid, stricken by delusions that your loved ones are stealing from or cheating on you, to needing help bathing, grooming, going to the toilet or eating. "It takes eight to ten years, on average, but eventually





TANZI IS NOW WORKING WITH THE CURE ALZHEIMER'S FUND ON AN INITIATIVE THAT WILL SCREEN **VIRTUALLY EVERY FDA-APPROVED DRUG** OUT THERE. "WHETHER IT'S FOR ASTHMA OR BACK PAIN, WE CAN SEE IF IT WORKS IN OUR SYSTEM AGAINST PLAQUES AND TANGLES."

the patient is in a vegetative state, unable to walk or talk," says R. Scott Turner, director of the Memory Disorders Program at Georgetown University.

"If we don't do something about this, it's going to cripple us," says Anne B. Young, the former chief of neurology at Mass General, "and those who don't get Alzheimer's disease will be impacted just as much as those who do."

**Paradoxically or appropriately, Tanzi is renowned among his** peers for his exceptional memory. "Rudy's got one of the most detail-oriented memories I've ever known," says Wilma Wasco, a neurogeneticist at Harvard. "He can remember papers he read 25 years ago, who the authors were, what they found, what the footnotes said—which is really not typical." Tanzi honed his retentive skills in childhood, while working for his parents' medical transcription service in Cranston, Rhode Island. "I would memorize all these medical terms," he says. "That's what got me interested in medicine and science."

He also fell in love with music. "At 9 years old I started playing the accordion, like a good Italian boy," he says. He improved rapidly. His father bought him a bigger accordion. A year or two later, his father asked, So, you still like the accordion? Yes, young Rudy said. "Then he asked, what do you think, should I get you a monkey and a cup to go with it?" At his father's prodding, Rudy branched out to other keyboards, and to jazz. He took up piano and mastered the Hammond organ, which is an electronic version of a pipe organ and very difficult to play. "It's really weird to hear somebody as good as he is on the Hammond organ," says Joe Perry, the lead guitarist in Aerosmith. "I love jamming with him. He inspires me to try new things on the guitar."

At the University of Rochester, Tanzi secured bachelor's degrees in both microbiology and history, writing his history





**Tanzi, who has recorded with Aerosmith, accompanies the band's lead guitarist Joe Perry at a 2012 charity concert.**

thesis on Franz Mesmer, an 18th-century German doctor who promoted the idea of “animal magnetism” and from whom we derive the word mesmerize. Tanzi remains fascinated—mesmerized?—by alternative ways of interpreting reality. He regularly rereads the mystical works of Carlos Castaneda. He meditates, practices lucid dreaming and collaborates with the new-age superstar Deepak Chopra. They’ve co-written two books that blend popular science and self-help—*Super Brain* and the just-published *Super Genes*—and they travel the world as a team, talking about the nature of consciousness. “We do the dog and pony show together,” Chopra says. “He’s a very reflective thinker, and more open than most scientists to holistic ideas. We’ve become buddies.” Yet make no mistake. When it comes to his research, Chopra says, “Rudy is very meticulous, and very careful in his language. He’s an extremely ambitious scientist.” Of Tanzi’s many pursuits, Chopra says, “science is his number one love.”

As a graduate student at Harvard Medical School, Tanzi worked with the geneticist James Gusella (“one of my heroes,”



Tanzi says), and in 1983 their team gained international acclaim for becoming the first scientists ever to locate the approximate genetic address of a disease trait by fishing at random through the bewildering megalopolis of the human genome with tagged bits of DNA. Using an approach that has since become standard among gene mappers, Gusella, Tanzi and their colleagues pinned the source of Huntington's disease, the inherited neurodegenerative disorder that killed folk singer Woody Guthrie, to a spot on chromosome 4, out of the 23 pairs of chromosomes that constitute the human genome and that nearly all human cells enfold.

From that heady career kickoff, Tanzi turned his cartographic talents to the deciphering of chromosome 21, which, when inherited in triplicate, causes Down syndrome. On learning that people with Down often end up contracting Alzheimer's disease as well, Tanzi realized he had found his life's calling. He would search for the genetic roots of Alzheimer's, starting with the tantalizing link to chromosome 21. He married an endodontist, they divorced, he married a neuroscientist named Dora Kovacs, his current wife. They have a daughter, Lyla, who's in second grade. Every weekend he makes her pancakes. Once, when Lyla had an ear infection, he made her a pancake shaped like an ear.

Since the late 1980s, Tanzi, his colleagues and his rivals have identified three different genes that, when inherited in mutant form, inevitably result in the early-onset version of Alzheimer's disease. (One of them is indeed located on chromosome 21, which is why patients with Down syndrome regularly end up bearing an Alzheimer's defect as well.) None of the mutations found on those three genes are directly involved in the common Alzheimer's of old age, but because the brains of patients display a similar mosaic of microscopic abnormalities regardless of when the disease strikes, researchers believe that patients who have inherited the familial form of the disease hold clues relevant to all.

By the looks of it, researchers say, the genetic mutations disrupt the brain's capacity to manage the everyday trafficking and processing of essential proteins. As a result, excess quantities of the amyloid-beta protein, which the brain normally uses to protect itself—perhaps against bacterial infection, Tanzi's research suggests—do not get flushed away or recycled, but



instead gum together into plaques around brain cells. Another protein, called tau, also turns rogue and twists up into tangles inside the neurons. Dendritic connections between neurons wither, short-circuiting thought. Injured brain cells flare up and then collapse, like tiny, dying suns. The brain shrinks by 20, 30 percent. The self follows suit.

But how exactly does the protein misprocessing get started? Are the plaques the worst offenders, or are they a distraction from the real villain, the tangles, or something else altogether? More important, how can the process be stopped? To answer that, researchers needed a good laboratory mimic of the disease, and even with the three disease genes in hand, they still didn't have that.

**As a graduate student in cell biology at the Korea Advanced Institute of Science and Technology**, among the nation's most competitive universities, Doo Yeon Kim became fascinated by neurons. "They're very complicated and very different from other cells of the body," he says. "I thought, I'll do basic cell biology on neurons to understand their behavior. I'll look at neurodegenerative disease to understand how they die." South Korea had few neuroscientists to work under, but Kim plugged away on his own. Through computer analysis, he identified a gene he thought might play a role in Alzheimer's. "Somebody told me, oh yes, that's a gene Rudy Tanzi is studying right now," Kim says. "Rudy was very popular in South Korea, a real star. I thought maybe I should try to go work with him." Kim sent Tanzi an email, requesting a position in his lab. Kim didn't hold much hope. He figured a guy like Tanzi was bombarded by pleas and résumés. "I didn't think I'd hear from him," Kim says. "He got back to me in one day. He said, I think you look good."

**Tanzi really wanted a better model for understanding Alzheimer's.** He also wanted proof for his hypothesis that excess amyloid-beta was at the heart of the disease: that it not only caused plaques but, by helping to turn tau protein rotten, it touched off tangles, too. Se Hoon Choi, a postdoctoral fellow in Tanzi's lab at the time, remembered a meeting when Tanzi said jocularly, "Wouldn't it be nice to show that amyloid secretion causes tau pathology?" "Rudy makes a lot of jokes," Choi says, "but they're food we can eat."



Kim wanted to try his hand at modeling Alzheimer's. He, Choi and Tanzi discussed possible approaches. They decided to use human neurons, a risky approach: Such cells rarely survive in petri dishes for the necessary long haul. Luckily, another young researcher from South Korea, Young Hye Kim (no relation to Doo), would be joining the lab for two years and had a guaranteed job to return to: She could afford to focus on the project without fearing for her professional future should it prove a flop.

The researchers started with human neurons derived from stem cells, spread them in single layers in culture dishes and bathed them in nutrient-packed liquid. Next, they used specially designed viruses to deliver mutant copies of two different familial Alzheimer's genes into each cell. The neurons thrived. They grew into reliable cell lines. Very nice. But time passed, and the cells weren't doing anything. No signs of plaques. Not a trace of tangle. "I could tell that Young was getting really depressed," Kim says. "I'd suggest something, she'd say, Why bother? It won't make any difference."

That's when Kim had his brainstorm, if you will. Maybe the problem was the liquid medium, he thought. Maybe the need to change it every three days ended up washing away any dubious proteins the cells might be secreting before those proteins had a chance to stick together into plaques. "Doo made a very simple observation," Tanzi says. "The brain is not made of liquid. It's a gel." The researchers moved the cells from dishes to little wells filled with gel. They fiddled with parameters. The cells looked happier than ever, forming feathery dendrites that pulsed with measurable electric signals. Six weeks passed, and the researchers got a jolt of their own.

There, through the confocal microscope, an unmistakable image: The cells had formed plaques. "I couldn't believe what I was seeing," Tanzi says. They were ready to publish a paper on their in vitro conjuring of plaques. Two more weeks passed. Young Hye checked the cells, sampled their protein arrays. "She called out to me excitedly," Kim says. "It was the first and last time that she used my first name." Doo! Come quick! There are tangles of tau! "It was one of those rare aha! moments in science," Tanzi says.

Another triumph soon followed. The researchers showed that if they blocked amyloid-beta output with antibodies, the



cells not only failed to form plaques, they didn't form tangles, either. "They have validated in the best way possible the idea that amyloid abnormality is driving Alzheimer's disease," said Dennis Selkoe, another Alzheimer's researcher at Harvard Medical School.

Now what we need, Tanzi and others believe, are drugs that can modulate amyloid-beta output. Not block it entirely, Tanzi says. "It's like cholesterol," he says. "You just want to dial it down." We need the equivalent of statins, he says—drugs to inhibit plaques in the brain just as statins help clear plaque from your blood vessels. Tanzi is now working with the Cure Alzheimer's Fund on an initiative that will screen virtually every FDA-approved drug out there. "Whether it's for asthma or back pain, we can see if it works in our system against plaques and tangles," he says. "It's ten times faster and a hundred times cheaper than doing the same tests in mice."

**Alzheimer's in a dish is still new and has yet to make its** mark on treatment. In the meantime, for those who seek advice on how to keep their brains young, Tanzi and others agree on these steps: Get plenty of physical exercise. Sleep seven or eight hours a night. "It's during deep, slow-wave sleep that the brain cleans out the debris," Tanzi says. Eat a healthful, Mediterranean-style diet. And keep learning, keep building up what Tanzi calls "synaptic reserve." It's never too late to learn the piano. You don't need a Bösendorfer. Any clunker will do. ●

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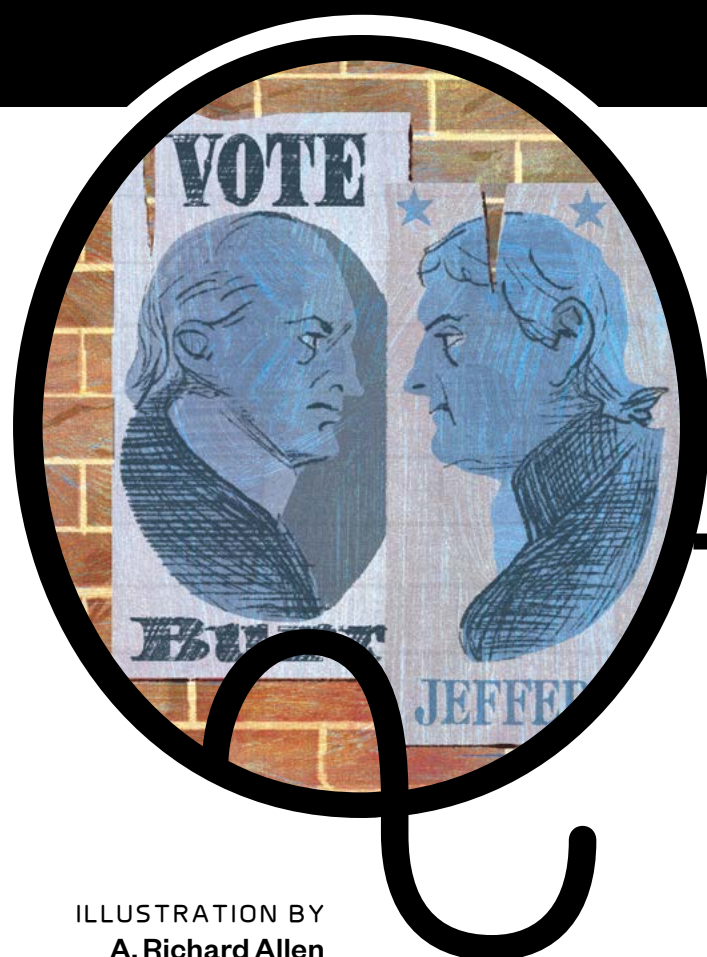


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# Ask Smithsonian

YOUR QUESTIONS ANSWERED BY OUR EXPERTS

When did the position of vice president of the United States stop going to the runner-up in the presidential election and become a separately elected office?

**Amelia Golini, Brooklyn, New York**

That was in 1804, when the 12th Amendment to the Constitution was ratified, says *David Ward, senior historian at the National Portrait Gallery*.

The amendment was proposed after the 1796 election resulted in a president (John Adams) and vice president (Thomas Jefferson) from opposing parties, and the 1800 election led to a tie between Jefferson and Aaron Burr. They were members of the same party (Democratic-Republican), but it took the House of Representatives 36 contentious ballots to break the tie, electing Jefferson president and Burr vice president. In 1804, Jefferson was re-elected and George Clinton became the first vice president under the 12th Amendment.

**Why do the ends of some airliner wings curve upward?**

**Gary N. Miller, Davenport, Florida**

Those are called “winglets,” and they’re designed to reduce drag as the wing moves through the air, says *Bob van der Linden, curator at the National Air and Space Museum*. Less drag boosts fuel efficiency.

**Where did Plains Indians get lodgepoles for their tepees?**

**Lynn Arbuckle, Chandler, Arizona**

From stands of *Pinus contorta*, a Western evergreen that grows so straight and tall it became known as the lodgepole pine. Native Americans chopped the trees down using a sharpened rock or an ax, says *Emil Her Many Horses, a specialist at the National Museum of the American Indian*. Next they stripped the branches and bark and tied the trees to either side of a horse to transport them. A tepee could easily require as many as 20 lodgepoles.

**Why do U.S. coins have three mottoes?**

**Jere Stuart French, Gulf Breeze, Florida**

“Liberty” first appeared on U.S. coins minted in 1792, says *Ellen Feingold, curator of numismatics at the National Museum of American History*. It was mandated by the Coinage Act. “*E pluribus unum*,” Latin for “Out of many, one,” followed in 1795 and referred to the unification of the former colonies. “In God we trust,” a phrase intended to suggest what U.S. Mint director James Pollock described as “a national reliance upon divine support,” was added in 1864, during the uncertainties of the Civil War.

**Why are oceans saltwater and not freshwater?**

**Sherilyn Knight, Pike Road, Alabama**

Erosion on land is responsible for the saltiness of ocean water, says *Nancy Knowlton, Sant Chair for Marine Science and invertebrate zoology staff at the National Museum of Natural History*. Slightly acidic rain erodes rocks and soil, and the resulting salts, such as sodium and chloride, and minerals are carried in the runoff to streams, rivers and eventually to oceans. In addition, water that seeps through hydrothermal vents in Earth’s crust erodes rock as it is pushed back out of the vents, carrying absorbed salts into the ocean.



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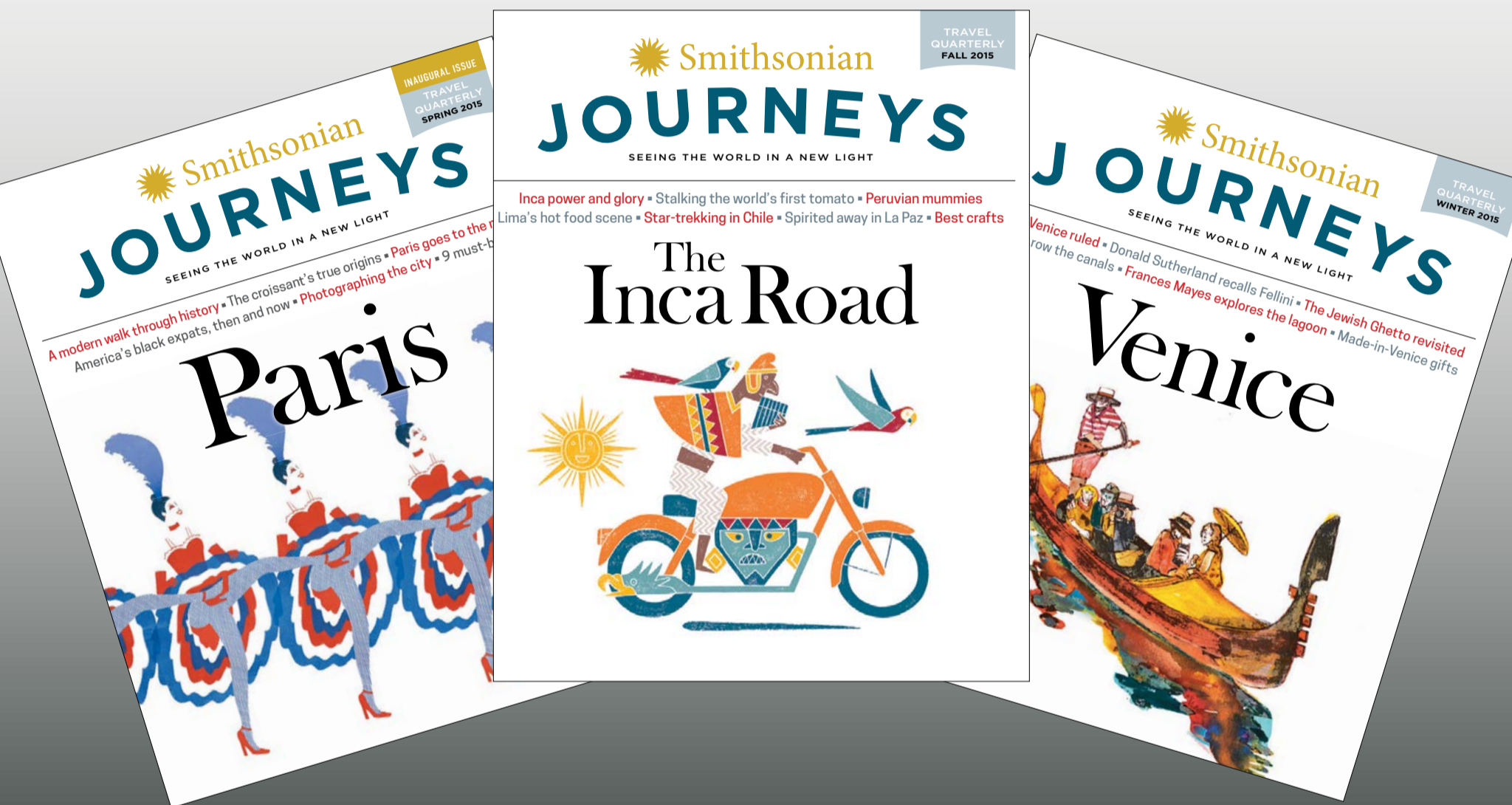
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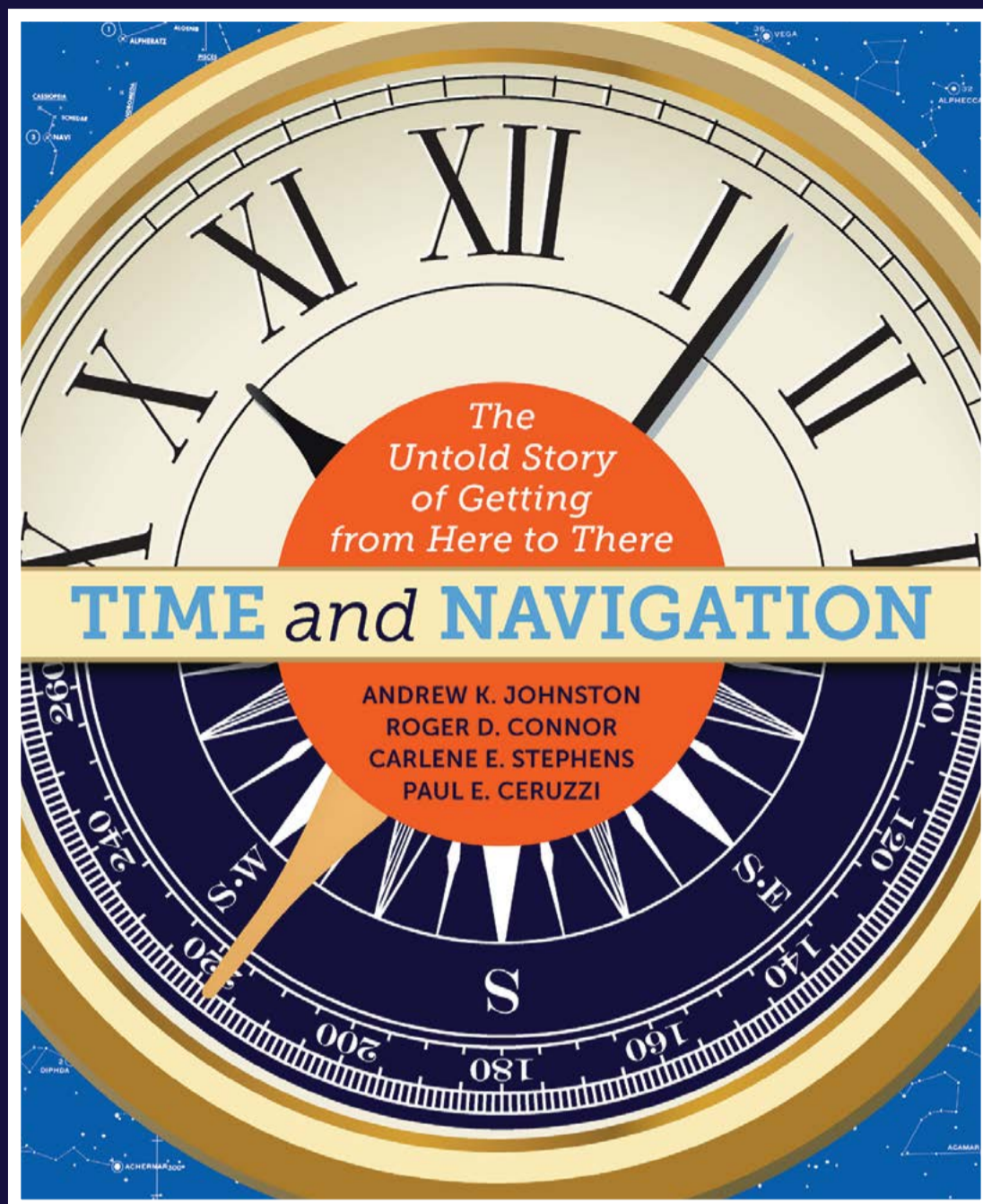
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