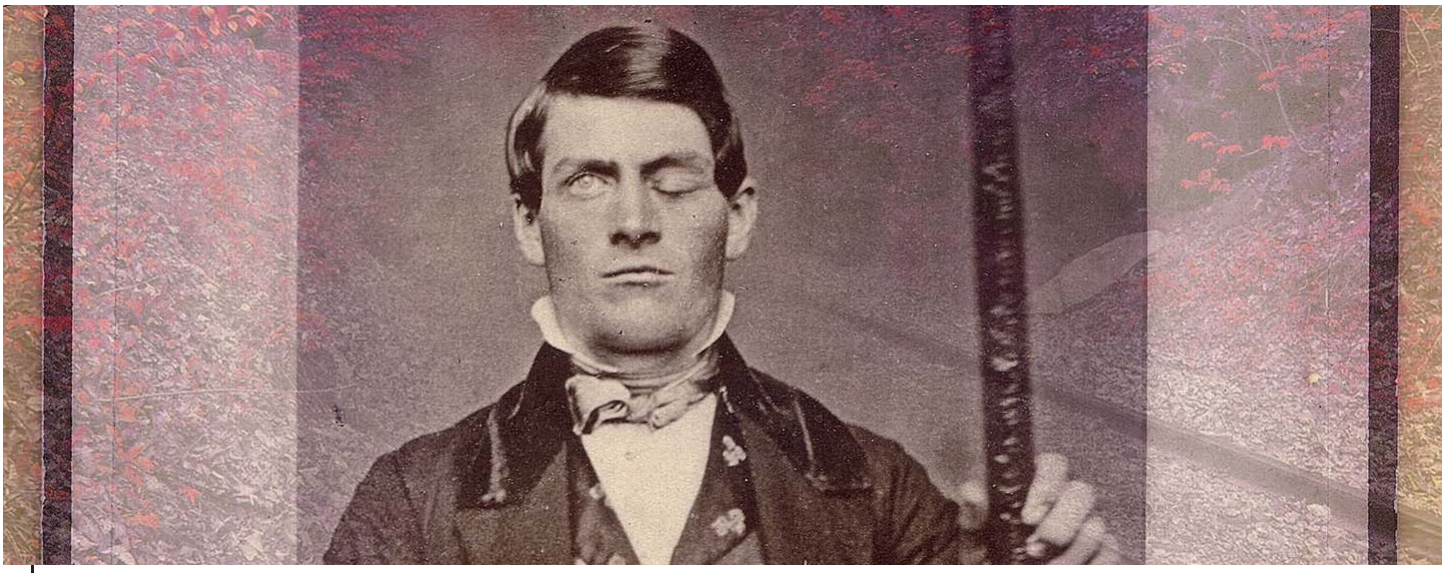



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# Phineas Gage, Neuroscience's Most Famous Patient

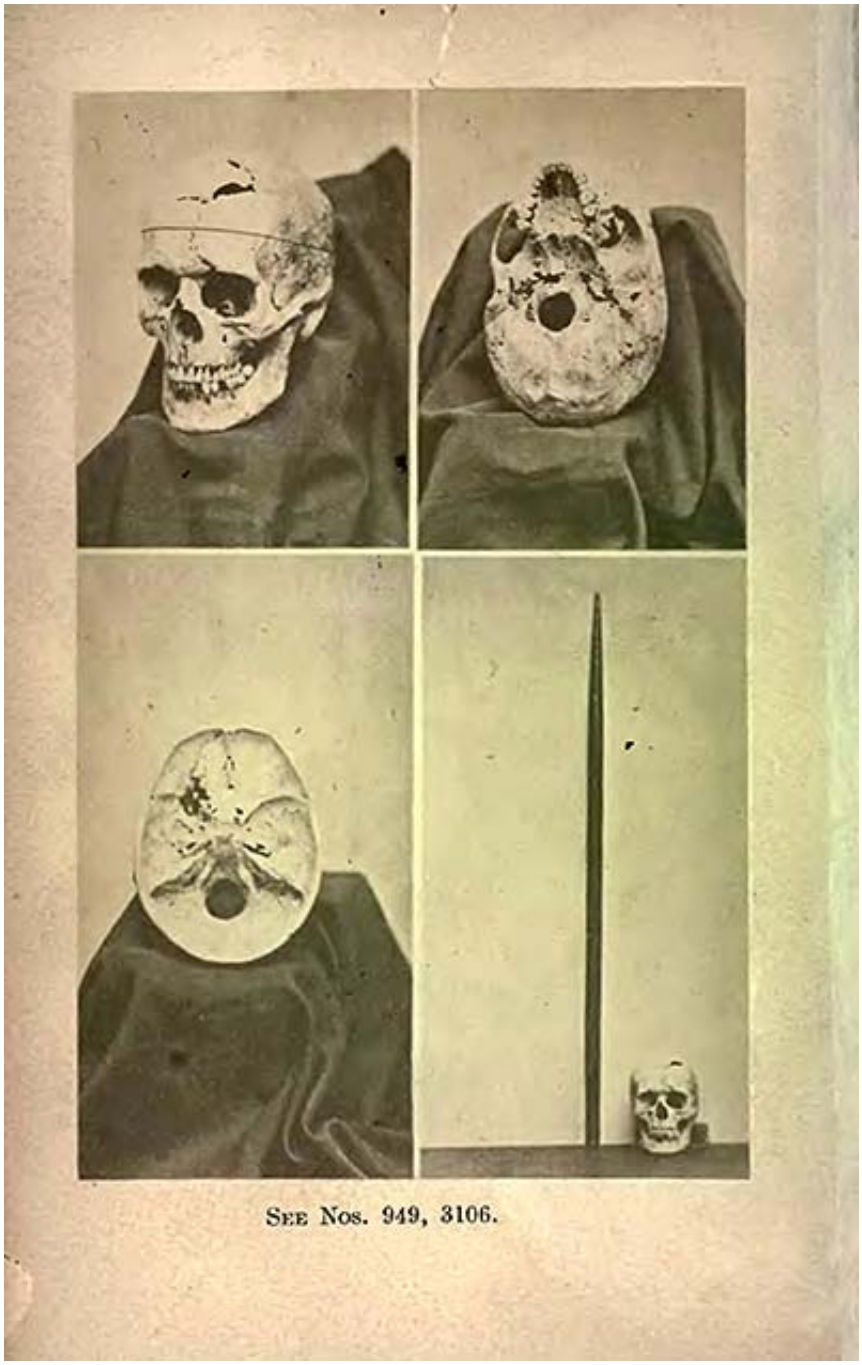
Each generation revises his myth. Here's the true story.

*By Sam Kean*

## 1 From a virtuous foreman to a sociopathic drifter

On Sept. 13, 1848, at around 4:30 p.m., the time of day when the mind might start wandering, a railroad foreman named Phineas Gage filled a drill hole with gunpowder and turned his head to check on his men. It was the last normal moment of his life.

Other victims in the annals of medicine are almost always referred to by initials or pseudonyms. Not Gage: His is the most famous name in neuroscience. How ironic, then, that we know so little else about the man—and that much of what we think we know, especially about his life unraveling after his accident, is probably bunk.




Gage's exhumed skull and tamping iron, 1870.

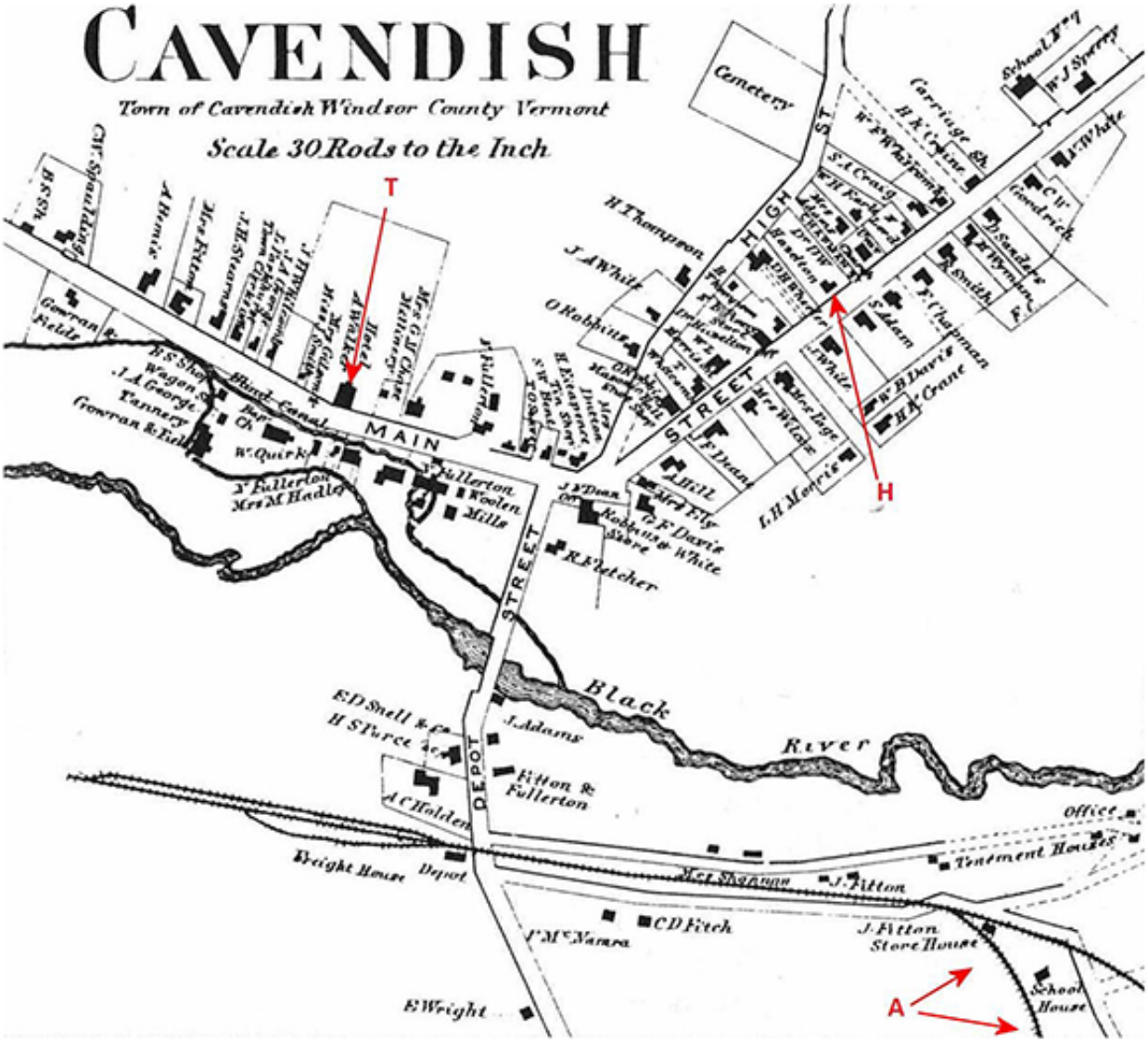
Image via J.B.S. Jackson/A Descriptive Catalog of the Warren Anatomical Museum

The Rutland and Burlington Railroad had hired Gage's crew that fall to clear away some tough black rock near Cavendish, Vermont, and it considered Gage the best foreman around. Among other tasks, a foreman sprinkled gunpowder into blasting holes, and then tamped the powder down, gently, with an iron rod. This completed, an assistant poured in sand or clay, which got tamped down hard to confine the bang to a tiny space. Gage had specially commissioned his tamping iron from a blacksmith. Sleek like a javelin, it weighed 13¼ pounds and stretched 3 feet 7 inches long. (Gage stood 5-foot-6.) At its widest, the rod had a diameter of 1¼ inches, although the last foot—the part Gage held near his head when tamping—tapered to a point.

Gage's crew members were loading some busted rock onto a cart, and they apparently distracted him. Accounts differ about what happened after Gage turned his head. One says Gage tried to tamp the gunpowder down with his head still turned, and scraped his iron against the side of the hole, creating a spark. Another says

Gage's assistant (perhaps also distracted) failed to pour the sand in, and when Gage turned back, he smashed the rod down hard, thinking he was packing inert material. Regardless, a spark shot out somewhere in the dark cavity, igniting the gunpowder, and the tamping iron rocketed upward.

The iron entered Gage's head point-first, striking below the left cheekbone. It destroyed an upper molar, passed behind his left eye, and tore into the underbelly of his brain's left frontal lobe. It then plowed through the top of his skull, exiting near the midline, just behind where his hairline started. After parabola-ing upward—one report claimed it whistled as it flew—the rod landed 25 yards away and stuck upright in the dirt, mumblety-peg-style. Witnesses described it as streaked with red and greasy to the touch, from fatty brain tissue.




An 1869 map of Cavendish, Vermont, indicates two possible accident sites: T, Joseph Adams' tavern, and H, Dr. Harlow's house.

Image courtesy EEng/Creative Commons

The rod's momentum threw Gage backward, and he landed hard. Amazingly, he claimed he never lost consciousness. He merely twitched a few times on the ground, and was talking and walking again within minutes. He felt steady enough to climb into an oxcart, and, after someone grabbed the reins and giddy-upped, he sat upright for the entire mile-long trip into Cavendish. At the hotel where he was lodging, he settled into a chair on the porch and chatted with passersby. The first doctor to arrive could see, even from his carriage, a

volcano of upturned bone jutting out of Gage's scalp. Gage greeted the doctor by angling his head and deadpanning, "Here's business enough for you." He had no idea how prophetic those words would be. The messy business of Gage continues to this day, 166 years later.

Most of us first encountered Gage in a neuroscience or psychology course, and the lesson of his story was both straightforward and stark: The frontal lobes house our highest faculties; they're the essence of our humanity, the physical incarnation of our highest cognitive powers. So when Gage's frontal lobes got pulped, he transformed from a clean-cut, virtuous foreman into a dirty, scary, sociopathic drifter. Simple as that. This story has had a huge influence on the scientific and popular understanding of the brain. Most uncomfortably, it implies that whenever people suffer grave damage to the frontal lobes—as soldiers might, or victims of strokes or Alzheimer's disease—something essentially human can vanish.

Recent historical work, however, suggests that much of the canonical Gage story is hogwash, a mélange of scientific prejudice, artistic license, and outright fabrication. In truth each generation seems to remake Gage in its own image, and we know very few hard facts about his post-accident life and behavior. Some scientists now even argue that, far from turning toward the dark side, Gage recovered after his accident and resumed something like a normal life—a possibility that, if true, could transform our understanding of the brain's ability to heal itself.

## 2 Gage "was no longer Gage"

The first story that appeared about Gage contained a mistake. The day after his accident, a local newspaper misstated the diameter of the rod. A small error, but an omen of much worse to come.

Psychologist and historian Malcolm Macmillan, currently at the University of Melbourne, has been chronicling mistakes about Gage for 40 years. He has had a peripatetic career: Among other topics, he has studied disabled children, Scientology, hypnosis, and fascism. In the 1970s, he got interested in Gage and decided to track down original material about the case. He turned up alarmingly little, and realized just how rickety the evidence was for most of the science about Gage.

Macmillan has been sifting fact from fiction ever since, and he eventually published a scholarly book about Gage's story and its afterlife, ***An Odd Kind of Fame***. Although slowed by a faulty hip replacement—he has trouble reaching books on the bottom shelves at libraries now—Macmillan continues to fight for Gage's reputation, and he has gotten so involved with his subject that he now refers to him, familiarly, as Phineas. Above all, Macmillan stresses the mismatch between what we actually know about Gage and the popular understanding of him: "Despite there being no more than a couple hundred words attesting to how he changed, he came to dominate thinking about the function of the frontal lobes."

The most important firsthand information comes from John Harlow, a self-described "obscure country physician" who was the second doctor to reach Gage the day of the accident, arriving around 6 p.m. Harlow watched Gage lumber upstairs to his hotel room and lie down on the bed—which pretty much ruined the linens,

since Gage's body was one big bloody mess. As for what happened next, readers with queasy stomachs should probably skip to the next paragraph. Harlow shaved Gage's scalp and peeled off the dried blood and brains. He then extracted skull fragments from the wound by sticking his fingers in from both ends, Chinese-finger-trap-style. Throughout this all, Gage was retching every 20 minutes, because blood and greasy bits of brain reportedly kept slipping down the back of his throat and gagging him. Incredibly, Gage never got ruffled, remaining conscious and rational throughout. He even claimed he'd be back blasting rocks in two days.

American physician John M. Harlow.

Photo courtesy Creative Commons

The bleeding stopped around 11 p.m., and Gage rested that night. The next morning his head was heavily bandaged and his left eyeball was still protruding a good half-inch, but Harlow allowed him visitors, and Gage recognized his mother and uncle, a good sign. Within a few days, however, his health deteriorated. His face puffed up, his brain swelled, and he started raving, at one point demanding that someone find his pants so he could go outside. His brain developed a fungal infection and he lapsed into a coma. A local cabinet-maker measured him for a coffin.

Fourteen days into the crisis, Harlow performed emergency surgery, puncturing the tissue inside Gage's nose to drain the wound. Things were touch-and-go for weeks, and Gage did lose sight in his left eye, which remained sewn shut the rest of his life. But he eventually stabilized, and in late November he returned home to Lebanon, New Hampshire—along with his tamping iron, which he started carrying around with him everywhere. In his case report, Harlow modestly downplayed his role in the recovery: "I dressed him," he wrote, "God healed him."

During his convalescence, stories about Gage started circulating in newspapers, with varying degrees of accuracy. Most gave Gage the tabloid treatment, emphasizing the sheer improbability of his survival. Doctors gabbed about the case, too—albeit with a dose of skepticism. One physician dismissed Gage as “a Yankee invention,” and Harlow said that others, like St. Thomas with Jesus, “refused to believe that the man had risen until they had thrust their fingers into the hole of his head.”

Dr. Henry Bigelow brought Gage to Harvard Medical School for a formal evaluation in 1849. Although Bigelow treated Gage like a curiosity—he once presented Gage at a meeting along with a stalagmite “remarkable for its singular resemblance to a petrified penis”—the visit resulted in the only other detailed, firsthand account of Gage and his accident besides Harlow’s. Surprisingly, Bigelow’s report pronounced Gage “quite recovered in his faculties of body and mind.” However, as was common in neurological exams then, Bigelow probably only tested Gage for sensory and motor deficits. And because Gage could still walk, talk, see, and hear, Bigelow concluded that his brain must be fine.

Daguerreotype of Henry Jacob Bigelow.

Photo courtesy Harvard Art Museum/Fogg Museum

Bigelow’s assessment meshed well with the medical consensus at the time, which held that the frontal lobes didn’t do much—in part because people could suffer grave injuries to them and walk away. Scientists now know that parts of the frontal lobes contribute to nearly every activity inside the brain. The forefront of the lobes, called the prefrontal area, plays an especially important role in impulse control and planning.

But even today scientists have only a vague idea of how the prefrontal lobes exercise that control. And victims of prefrontal injuries can still pass most neurological exams with flying colors. Pretty much anything you can measure in the lab—memory, language, motor skills, reasoning, intelligence—seems intact in these people. It's only the lab that problems emerge. In particular, personalities might change, and people with prefrontal damage often betray a lack of ambition, foresight, empathy, and other ineffable traits. These aren't the kind of deficits a stranger would notice in a short conversation. But family and friends are acutely aware that something is off.

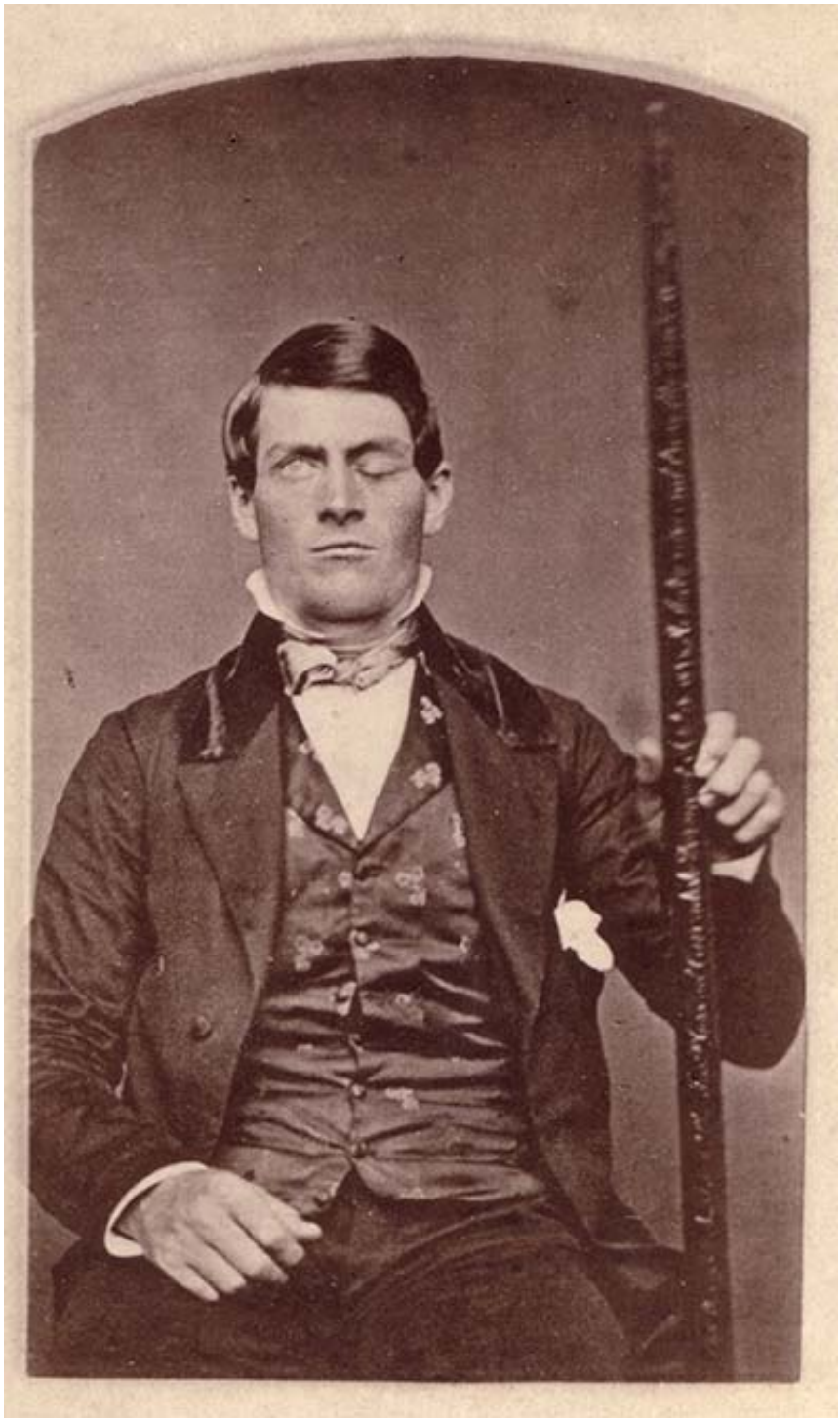
Frustratingly, Harlow limited his discussion of Gage's mental status to a few hundred words, but he does make it clear that Gage changed—somehow. Although resolute before the accident, Harlow says Gage was now capricious, and no sooner made a plan than dropped it for another scheme. Although deferential to people's wishes before, Gage now chafed at any restraint on his desires. Although a "smart, shrewd businessman" before, Gage now lacked money sense. And although courteous and reverent before, Gage was now "fitful [and] irreverent, indulging at times in the grossest profanity." Harlow summed up Gage's personality changes by saying, "the equilibrium ... between his intellectual faculties and his animal propensities seems to have been destroyed." More pithily, friends said that Gage "was no longer Gage."

As a result of this change, the railroad refused to reinstate Gage as foreman. He began traveling around New England instead, displaying himself and his tamping iron for money. This included a stint in P.T. Barnum's museum in New York— Barnum's traveling circus, as some sources claim. For an extra dime, skeptical viewers could "part Gage's hair and see his brain ... pulsating" beneath his scalp. Gage finally found steady work driving a horse coach in New Hampshire.

Beyond that sketch of his activities, there's no record of what Gage did in the months after the accident—and we know even less about what his conduct was like. Harlow's case report fails to include any sort of timeline explaining when Gage's psychological symptoms emerged and whether any of them got better or worse over time. Even the specific details of Gage's behavior seem, on a closer reading, ambiguous, even cryptic. For instance, Harlow mentions Gage's sudden "animal propensities" and, later, "animal passions." Sounds impressive, but what does that mean? An excessive appetite, strong sexual urges, howling at the moon? Harlow says that Gage cursed "at times," but how often is that? And was this a saucy "hell" or "damn" here and there, or something more dastardly? Harlow notes that Gage started telling his nieces and nephews wild stories about his supposed adventures. Was he confabulating here, a symptom of frontal lobe damage, or simply indulging a love of tall tales? Even the conclusion that Gage "was no longer Gage" could mean almost anything.

Indeed, it has come to mean almost anything. One reason it's hard to diagnose frontal lobe damage is that people vary quite a bit in their baseline behavior: Some of us are rude, crude, cruel, flighty, or whatever naturally. To judge whether a person changed after an accident, you have to have known him beforehand. Unfortunately, no one who knew Gage intimately left any sort of statement. And with so few hard facts to constrain people's imaginations in later years, rumors began to swirl about Gage's life, until a wholly new Phineas emerged.

Macmillan summarizes this caricature of Gage as “an unstable, impatient, foul-mouthed, work-shy drunken wastrel, who drifted around circuses and fairgrounds, unable to look after himself and dying penniless.” Sometimes his new traits contradicted one another: Some sources describe Gage as sexually apathetic, others as promiscuous; some as hot-tempered, others as emotionally void, as if lobotomized. And some anecdotes seem like outright fabrications. In one, Gage sold the exclusive, posthumous rights to his skeleton to a certain medical school—then sold the same rights to another school, and another, skipping town and pocketing the cash each time. In another tale, a real howler, Gage lived for 20 years with the iron rod still impaled in his skull.



Portrait of Gage holding the tamping iron that injured him.

Phyllis Gage Hartley/Creative Commons

More uncomfortably, some scientists have questioned Gage's humanity. ***Descartes' Error***, a popular book from 1994, trotted out many familiar tropes: that women couldn't stand to be in Gage's presence, that he started "drinking and brawling in questionable places," that he was a braggart and a liar and a sociopath. The neuroscientist author then got metaphysical. He speculated that Gage's free will had been compromised, and raised the possibility that "his soul was diminished, or that he had lost his soul."

People butcher history all the time, of course, for various reasons. But something distinct seems to have happened with Gage. Macmillan calls it "scientific license." "When you look at the stories told about Phineas," he says, "you get the impression that [scientists] are indulging in something like poetic license—to make the story more vivid, to make it fit in with their preconceptions." Science historian Douglas Allchin has noted the power of preconceptions as well: "While the stories [in science] are all about history—events that happened," Allchin writes, "they sometimes drift into stories of what 'should' have happened."

With Gage, what scientists think "should" have happened is colored by their knowledge of modern patients. Prefrontal lobe damage is associated with a subsequent slightly higher rate of criminal and antisocial behavior. Even if people don't sink that low, many do change in unnerving ways: They urinate in public now, blow stop signs, mock people's deformities to their faces, or abandon a baby to watch television. It's probably inevitable, Macmillan says, that such powerful anecdotes influence how scientists view Gage in retrospect: "They do see a patient and say, 'Ah, he's like what Phineas Gage was supposed to be like.' " To be clear, Harlow never reports anything criminal or blatantly unhinged about Gage's conduct. But if you're an expert on brain damage, scientific license might tempt you to read between the lines and extrapolate from "gross profanity" and "animal passions" to seedier behavior.

If repeated often enough, such stories acquire an air of truthiness. "And once you have a myth of any kind, scientific or otherwise," Macmillan says, "it's damn near impossible to get it destroyed." Macmillan especially bemoans "the degree of rigor mortis in textbooks," which reach a large, impressionable audience and repeat the same anecdotes about Gage in edition after edition. "Textbook writers are a lazy lot," he says.

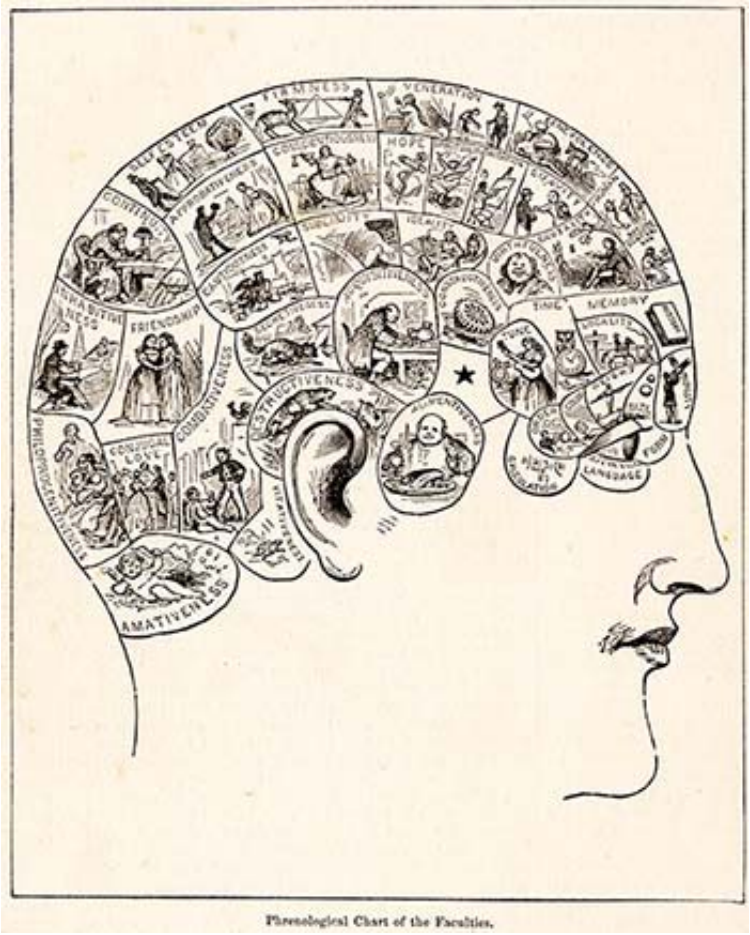
Historians have also noticed, not surprisingly, that myths have more staying power when they're good stories—and Gage's is truly sensational. Once upon a time, a man with a funny name really did survive having an iron rod explode through his skull. It's tragic, macabre, bewildering—and even comes with the imprimatur of a science lesson. In contrast to other scientific fables, Gage's has an intriguing twist as well. Most other scientific myths depart from reality by inflating the heroes (usually scientists) into godlike creatures, wholly pure and wholly virtuous. Gage, meanwhile, gets demonized. He's Lucifer, fallen. Gage's myth has proved so tenacious in part because it's fascinating to watch someone break bad.

## 3 The journey of the tamping iron

With the development of new scanning and computer technologies, a new chapter in Gage studies has opened in the past quarter century. Unfortunately, no one preserved Gage's brain when he died, so scientists are left examining the few remaining relics from his life instead, especially his

skull and tamping iron, which are on display at the Warren Anatomical Museum at Harvard Medical School.

In six years as museum curator, Dominic Hall has become an expert on Gageanalia. He often shows the skull and tamping iron to student groups, and he finds that people don't mind hearing even graphic details about Gage's injury. "There's just something about him," Hall says.




A 19th-century phrenological diagram cropped to show "organs" at top and front of head.

People's Cyclopedia of Universal Knowledge

Gage's skull and tamping iron are basically the only reason the Warren Museum still exists, says Hall, although calling it a "museum" seems generous. It's really just two rows of 8-foot-tall wooden cabinets; one sits on either side of an atrium on the fifth floor of Harvard's medical library. Surrounding the Gage artifacts are head sculptures with phrenology labels, a life mask of Samuel Taylor Coleridge, and stillborn Siamese twins, among other curios.

The left eye socket of Gage's skull, near the entry wound, looks jagged. The exit wound on top consists of two irregular holes with a patch of bone stuck between them, like a flattened wad of white gum. The tamping iron rests one shelf below the skull. Hall describes the rod as heavy, but struggles beyond that. "It's not like a baseball bat or shovel," he says, "because the weight is distributed throughout." He finally just says, "it feels  ." The tip of the iron looks blunted, like a slightly used crayon, and the shaft contains an inscription, in white calligraphic script, explaining Gage's case.  is misspelled twice.

The skull's obvious entry and exit wounds have tempted several scientists to digitally recreate the journey of the tamping iron. They hope to determine what parts of the brain were destroyed, which might make Gage's deficits clearer. The sophisticated computer modeling helps scientists study normal brain function as well, but there's something undeniably splashy about recreating the most famous accident in medical history.

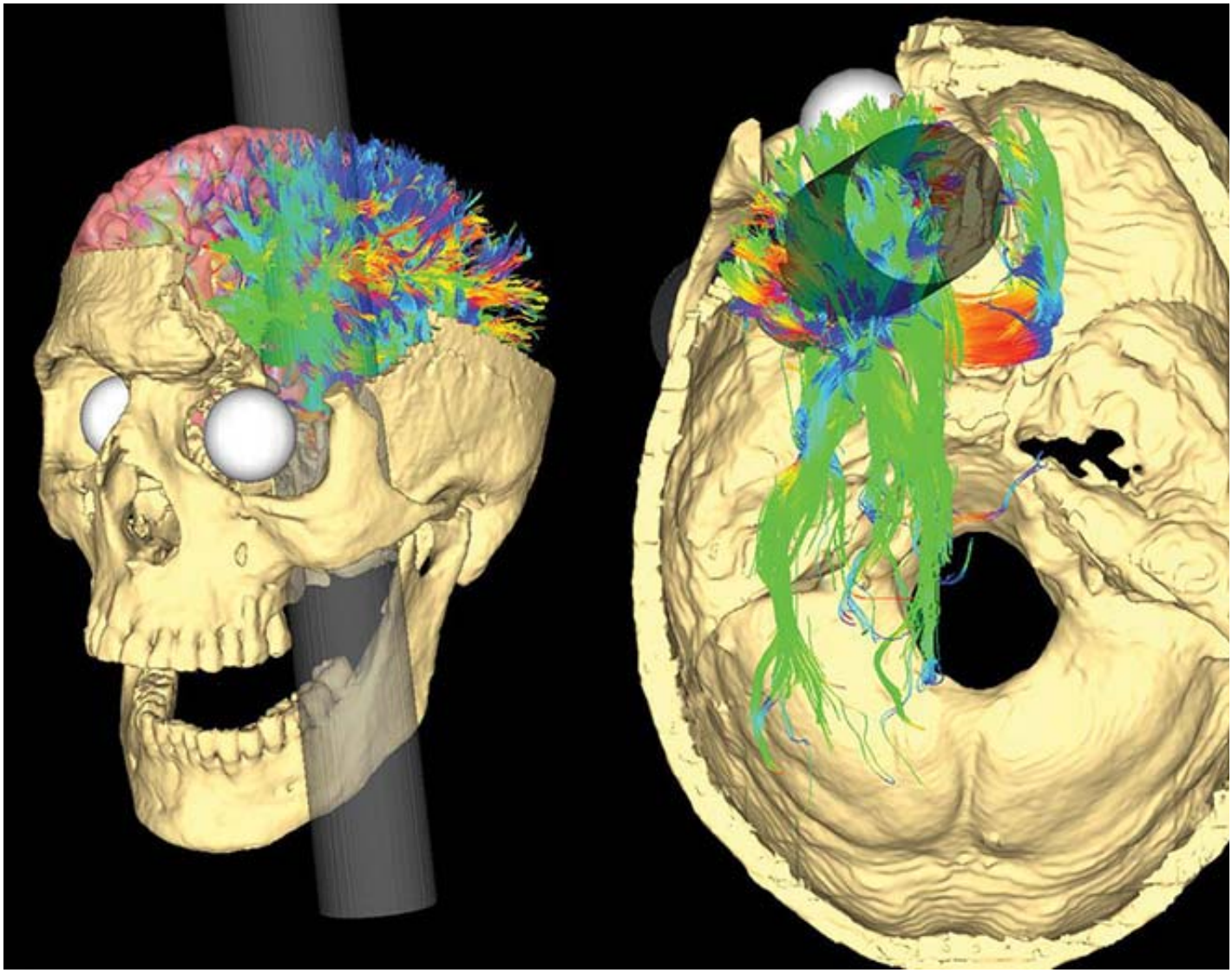
The best-known recreation of the accident was done by the husband-and-wife team of Antonio and Hanna Damasio, neuroscientists now at the University of Southern California. Antonio Damasio developed a famous theory of how emotions work, especially how they supplement and enhance our reasoning skills. To do so, he drew on a number of his own patients with frontal-lobe deficits. But he also drew on Gage. (Damasio, the author of , is the scientist who described Gage as a vagrant sociopath.) The Damasios modeled Gage's accident in part to search for evidence that he suffered damage to both his left and right hemispheres, which would make any personality changes more drastic. They found what they were looking for, and the study graced the cover of in 1994.

The Damasios still stand behind their paper. But two later studies, which took advantage of higher-horsepower computers to create more accurate models of Gage's skull, have since questioned their results. In 2004, a team led by Peter Ratiu, who was then teaching neuroanatomy at Harvard and now works as an emergency doctor in Bucharest, Romania, concluded that the rod could not have crossed over the midline and damaged Gage's right hemisphere. What's more, Ratiu determined that, based on the angle of entry and lack of a broken jawbone, Gage must have had his mouth open and been speaking at the moment of impact. Ratiu's renderings of this moment—with the iron rod piercing a gaping mouth—have an unnerving quality, reminiscent of Francis Bacon's paintings of screaming popes.

In 2012, neuroimaging expert Jack Van Horn led another study on Gage's skull. In contrast to Macmillan, Van Horn refers to Phineas as "Mr. Gage." He first delved into the case while living in New Hampshire, near the old Gage farmstead on Potato Road. Van Horn now works at USC in the same department as the Damasios.

Van Horn's study sifted through millions of possible trajectories for the iron rod, he says, and ruled out all but a few "that didn't break his jaw, didn't blow his head off, and didn't do a bunch of other things." (For comparison, the Damasio study scrutinized a half-dozen trajectories.) Overall, Van Horn's work supported Ratiu's: The rod, he argues, never crossed over to the right hemisphere.

Van Horn did introduce a new wrinkle, however. He studies brain connectivity, the emerging awareness that, while neurons are important to brain function, the between neurons are equally vital. Specifically, the patches of neurons that compute things in the brain (grey matter) reach their full potential only when networked together, via axon cables (white matter), to other centers of neural computation. And while Gage suffered damage to 4 percent of his grey matter, Van Horn concluded, 11 percent of his white matter suffered damage, including cables that led into both hemispheres. Overall, the injury "was much more profound than even we thought," he says.



A computer model of the Gage skull showing a reconstruction of the most likely trajectory taken by the tamping r (gray). The colored fibers represent white matter in the brain and show which ones would have been severed by t On the right, another view of white matter fibers that were likely injured by the rod.

Image courtesy Van Horn JD, Irimia A, Torgerson CM, Chambers MC, Ki

How that damage affected Mr. Gage's behavior, though, is tough to predict. Van Horn has read Macmillan's work closely, and he says it scared him away from undue speculation. "I didn't want to piss [Macmillan] off," he jokes. Van Horn nevertheless did compare the destruction of Gage's white matter to the damage wrought by neurodegenerative diseases like Alzheimer's. Gage might even have displayed classic symptoms of Alzheimer's, he argues, such as moodiness and an inability to complete tasks. John Harlow's original case report did state that Gage's changes were "nothing like dementia," Van Horn acknowledges. But Harlow examined Gage shortly after his accident, Van Horn says, not months or years later, when such symptoms might have emerged.

Despite different interpretations, Damasio, Ratiu, and Van Horn all agree about one thing: Their models are basically sophisticated guesswork. Clearly, the tamping iron destroyed some brain tissue. But the flying bone shrapnel and the fungal infection would have destroyed still more tissue—and that destruction is impossible to quantify. Perhaps even more important, both the position of the brain within the skull, and the location of various

structures within the brain itself, actually vary a lot from person to person—brains differ as much as faces do. When cataloguing brain destruction, then, millimeters matter. And no one knows which exact millimeters of tissue got destroyed in Gage.

That ignorance hasn't slowed down the speculation. Phineas Gage is reborn every generation, but as a different man: Each generation reinterprets his symptoms and deficits anew. In the mid-1800s, for example, phrenologists explained Gage's profanity by noting that his "organ of veneration" had been blown to bits. Nowadays scientists cite Gage in support of theories about multiple intelligences, emotional intelligence, the social nature of the self, brain plasticity, brain connectivity—every modern neuro-obsession. Even Macmillan, after studying the end of Gage's life, has edged beyond merely debunking other people's stories, and started presenting his own theory about Phineas Gage's redemption.

## 4 "I knew there was a contradiction there"

Incredibly, after working 18 months in the horse stable in New Hampshire, Gage struck out for South America in 1852. He was seasick the whole voyage. He'd been recruited by an entrepreneur hoping to take advantage of a gold rush in Chile, and once ashore, Gage resumed driving coaches, this time along the rugged, mountainous trails between Valparaiso and Santiago. You wonder how many passengers would have climbed aboard had they known about their one-eyed driver's little accident, but he did the job for seven years.

Poor health forced Gage to quit Chile, and in 1859 he caught a steamer to San Francisco, near where his family had moved. After a few months of rest, he found work as a farm laborer and seemed to be doing better, until a punishing day of plowing in early 1860 wiped him out. He had a seizure the next night over dinner. More followed, and after one particularly intense fit, he died on May 21, age 36, having survived his accident by almost a dozen years. His family buried him two days later, possibly with his beloved tamping iron.

Phineas Gage's skull on display.

J.D. Van Horn, A.Irimia, C.M. Torgerson, M.C. Chambers, R. Kikinis, et al./Warren Anatomical Museum at Harvard Medical School

Gage's story might have ended there—an obscure small-town tragedy, little more—if not for Dr. Harlow. He had lost track of Gage years before, but he learned the address of Gage's family in 1866 (through some unspecified "good fortune") and wrote to California for news. After milking the family for details, Harlow prevailed upon Gage's sister, Phebe, to open the grave and salvage Gage's skull in 1867. The exhumation sounded like quite a to-do, with Phebe, her husband, their family doctor, the city mortician, and even San Francisco's mayor, one Dr. Coon, all present to peek inside the coffin. Gage's family then hand-delivered the skull and tamping iron to Harlow in New York a few months later. At this point Harlow finally wrote up a full case report, which included virtually everything we know about Gage's mental status and sojourn to South America.

Most accounts of Gage's life omit all mention of Chile. Even Macmillan didn't know what to make of it for decades. But in the past few years, he has become convinced that Chile holds the key to understanding Gage.

The epiphany came while, of all things, watching Queen Elizabeth's husband, Prince Philip, race coaches on television one night. Philip, an old-fashioned sportsman, drives horse coaches similar to the ones Gage did, and the intricacy of the rein-work and difficulty of the maneuvering struck Macmillan as significant. The driver controls each of his horses' reins with a different finger, for example, so even rounding a bend takes incredible dexterity. (Imagine driving a car while steering each wheel independently.) Moreover, the trails Gage drove were crowded, forcing him to make quick stops and dodges, and because he probably drove at night sometimes, he would have had to memorize their twists and drop-offs, plus watch for bandits. He also presumably cared

for the horses and collected fares. Not to mention that he likely picked up a soupçon of Español in Chile. "To have someone with impulsive behavior, uncontrolled behavior, carrying out the highly skilled task of stagecoach driving," Macmillan says, "I knew there was a contradiction there."

He pursued his hunch, and after parsing and reparsing the vague chronology in Harlow's case report, Macmillan now believes that Gage's behavioral troubles were temporary and that Gage eventually recovered some of his lost mental functions. Independent evidence also supports this idea. In 2010 a computer scientist and intellectual property consultant who sometimes collaborates with Macmillan, Matthew Lena, turned up a statement from a 19th-century doctor who lived in "Chili" and knew Gage well: "He was in the enjoyment of good health," the doctor reported, "with no impairment whatever of his mental faculties."***** To be sure, Macmillan does not believe that Gage magically recovered everything and "became Gage" again. But maybe Gage resumed something like a normal life.

Modern neuroscientific knowledge makes the idea of Gage's recovery all the more plausible. Neuroscientists once believed that brain lesions caused permanent deficits: Once lost, a faculty never returned. More and more, though, they recognize that the adult brain can relearn lost skills. This ability to change, called brain plasticity, remains somewhat mysterious, and it happens achingly slowly. But the bottom line is that the brain can recover lost functions in certain circumstances.

In particular, Macmillan suggests that Gage's highly regimented life in Chile aided his recovery. People with frontal-lobe damage often have trouble completing tasks, especially open-ended tasks, because they get distracted easily and have trouble planning. But in Chile Gage never had to plan his day: Prepping the coach involved the same steps every morning, and once he hit the road, he simply had to keep driving forward until it was time to turn around. This routine would have introduced structure into his life and kept him focused.

A similar regime could, in theory, help other victims of Gage-like brain damage. One gruesome paper from 1999 ("Transcranial Brain Injuries Caused by Metal Rods or Pipes over the Past 150 Years") chronicles a dozen such cases, including a drunken game of "William Tell." Another case occurred on a construction site in Brazil in 2012, when a metal bar fell five stories, pierced the back of a man's hardhat, and exited between his eyes. More commonly, people suffer brain damage on the battlefield or in car accidents. And according to a traditional reading of Gage, their prognosis was bleak. But according to Macmillan's reading, maybe not. Because if even Phineas Gage bounced back—that's a powerful message of hope.

## 5 Proud, well-dressed, disarmingly handsome

Phineas Gage has probably never been more popular. Several musicians have written tributes. Someone started a blog called The Phineas Gage Fan Club, and another fan **crocheted** Mr. Gage's skull. YouTube contains thousands of Gage videos, including several re-enactments of the accident. (One involves Barbie dolls, another Legos. Beneath one, somebody commented, inevitably, "**mind=blown**.")

What's more, his skull has become the modern equivalent of a medieval saint's relic: The log book at the Harvard museum has recorded pilgrims from Syria, India, Brazil, Korea, Chile, Turkey, and Australia within the past year. Comments in the book include, "An odd treat," and "Phineas Gage was on my bucket list."

Cased-daguerreotype portrait of Phineas P. Gage holding the tamping iron that injured him.

Photo courtesy the Collection of Jack and Beverly Wilgus

More importantly, new material about Gage continues to emerge. In 2008, the first-known image of Gage turned up, a sepia daguerreotype of him holding his tamping iron. (A second photo has since appeared.) The picture's owners, the collectors Jack and Beverly Wilgus, originally labeled it "the whaler," speculating that, somewhat like Ahab, the young man in it had lost his left eye to "an angry whale." But after they posted **the picture on Flickr**, whaling enthusiasts protested that the smooth tamping iron looked nothing like a harpoon. One commenter finally suggested it might be Gage. To check this possibility, the Wilguses compared their image to a life mask of Gage made in 1849 and found that the features lined up perfectly, including a scar on Gage's forehead. Although just one picture, it exploded the common image of Gage as a dirty, disheveled misfit. This Phineas was proud, well-dressed, and disarmingly handsome.

Scientifically, Gage's legacy remains more ambiguous. His story certainly captures people's imaginations and kindles their interest in neuroscience. (Whenever I'm in mixed company and mention that I've written **a book about the most fascinating injuries in neuroscience history**, someone always blurts out, "Oh, like Phineas Gage!") But his story also misleads people, at least in its traditional form. Based on interviews and citations, Macmillan's revised history does seem to be gaining traction. But it's an uphill climb. "It has occurred to me [to ask] from time to time," Macmillan sighs, "what the hell I am doing working on this?"

## Top Comment

Truly engrossing story. Stories like this make sifting through all of Slate's clickbait worthwhile. More like this, please. Then maybe I'll add a plus to my name. More...

-Laplace's Demon

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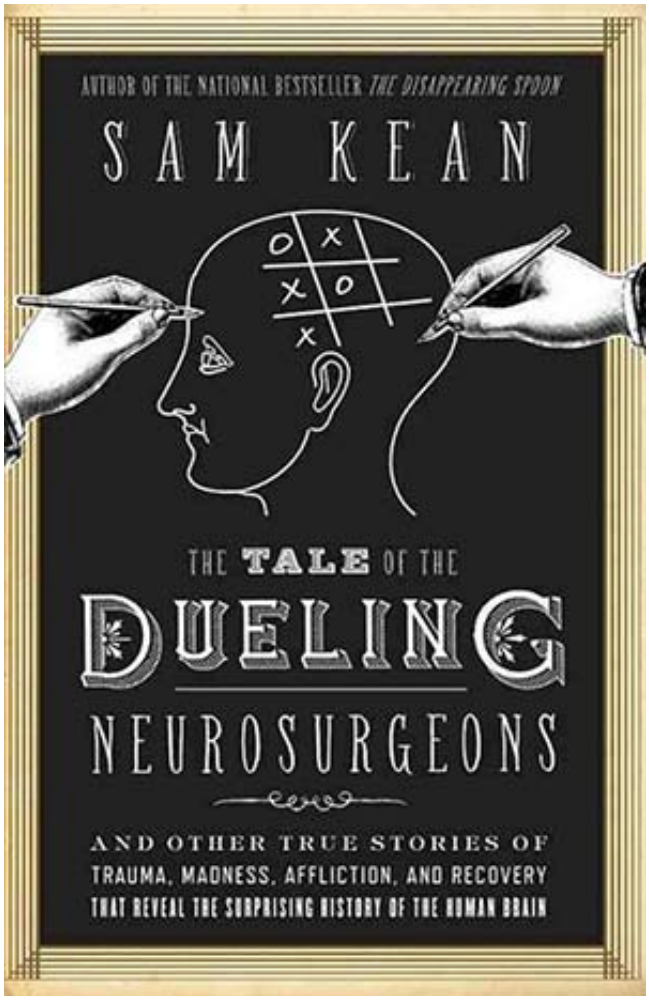
As for the latest research on Gage—especially the brain connectivity and brain plasticity work—it seems sound. But that's really for posterity to judge. Perhaps each new theory about Gage is indeed inching us closer to the truth. On the other hand, perhaps Gage is doomed to remain a historical Rorschach blot, revealing little but the passions and obsessions of each passing era.

Because of all the uncertainty, Ratiu, the Bucharest doctor, recommends that neuroscientists stop teaching Gage. "Leave this damn guy alone," he says. (Like Gage himself, people seem to indulge in "gross profanity" when discussing his case.) But this seems unlikely. Whenever teachers need an anecdote about the frontal lobes, "you just take this ace out of your sleeve," Ratiu says. "It's just like whenever you talk about the French Revolution you talk about the guillotine, because it's so cool."




If nothing else, Macmillan says, “Phineas’s story is worth remembering because it illustrates how easily a small stock of facts can be transformed into popular and scientific myth.” Indeed, the myth-making continues today. “Several people have approached me with a view to develop film scripts or plays,” he says. One involved Gage falling in love with a Chilean prostitute who rescues him from a life of dissolution. Another involved Gage returning to the United States, befriending and freeing a slave, then banding together with Abraham Lincoln to win the Civil War.

Another, deeper reason Gage will probably always be with us is that, despite all that remains murky and obscure, his life did hint at something important: The brain and mind are one. As one neuroscientist writes, “beneath the tall tales and fish stories, a basic truth embedded in Gage’s story has played a tremendous role in shaping modern neuroscience: that the brain is the physical manifestation of the personality and sense of self.” That’s a profound idea, and it was Phineas Gage who pointed us toward that truth.

***Update, May 7, 2014:***

***Correction, May 15, 2014:***

***Return***

**A SLATE PLUS SPECIAL FEATURE:**

# “I Thought About Skipping the Phineas Gage Story”

*Behind the Story:* Slate Plus members can read Sam Kean explain why he decided to write about neuroscience's most famous patient.

"There’s a lot more than just the deficit. The deficit is what makes these people important and unique to neuroscience, but if you really want to understand how the brain works, you need to look at the deficit in the context of all the other things that the brain can still do."

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