[1] The newsletter title has been changed from **Aphasia Insights** to **Plasticity Insights** to encompass brain function and plasticity as the foundation of all learning as well as recovery.

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"The iron passes through [Phineas] head at a very steep angle. That's both his salvation and his ruin. It misses a number of key areas on the side and top of the brain. On the left side, it misses Broca's area for speech. On top, it misses two key sections of the cortex, the motor and somatosensory strips. These areas integrate your sensory input and muscle actions so you keep oriented in space and in motion. Thus, Phineas is left with the ability to keep his balance, to focus his attention, and to remember both old and new events." pg 70.

Fleischman J. Phineas Gage, A Gruesome but True Story About Brain Science (2002). Houghton Mifflin Company, New York.

Aphasia Nation, Inc. is committed to educating the wider public about stroke and aphasia and the "*Aim High for Aphasia!"* international Aphasia Awareness campaign.

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Plasticity Insights![1]

Phineas Gage: Neuroscience's Most Famous Patient, the American Crowbar Case.

By Tom Broussard, Ph.D.

This is the next in a series of articles about the science and scientists behind the brain, stroke, aphasia, plasticity and recovery.

Phineas Gage
1823 - 1860

Phineas P. Gage (1823–1860) was an American railroad construction foreman remembered for his amazing survival of an accident on September 13, 1848, in which a large iron rod was driven completely through his head, destroying much of his brain's left frontal lobe. His injury was reported to have changed his personality and behavior drastically but that remained somewhat in doubt (Wikipedia).

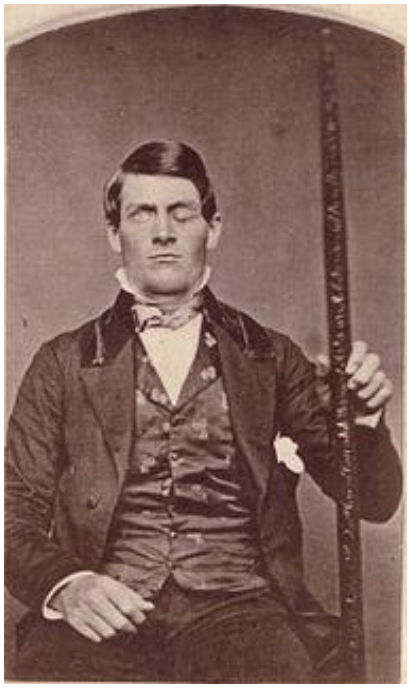
His "horrible accident in Vermont" (Fleischman, 2002) was known as the "American Crowbar Case" although it was a straight tamping iron, not a crowbar with a bend. His case influenced the medical world about the mind, brain, and controversy over cerebral localization, and the damage to specific parts of the brain that might induce specific mental and personality changes (Wikipedia).

In Gage's case, it had been reported that most of his behavioral changes were temporary. He recovered and was highly functional and social, and he adapted well in the years following his accident. Historically, published accounts of Gage (including scientific ones) have almost always exaggerated and distorted his behavioral changes, and was frequently at odds with the known facts at the time (Damasio, 1994). He worked as a stagecoach driver in Chile for eight years after his accident, and did well there (Wikipedia).

Before his accident, his physician described him as perfectly healthy, strong and active, twenty-five years of age, five feet six inches, and an average weight one hundred and fifty pounds. At the time of his accident, Gage was blasting rock for the Rutland & Burlington Railroad in Cavendish, Vermont. He and his team were drilling a hole deep in the rock, added blasting powder and a fuse, and then used a tamping iron to pack ("tamp") the sand, clay, or other inert material into the hole on top of the powder to contain the explosion directly into the surrounding rock (Wikipedia).

As reported by Gage's doctor, "It appears from his own account, and that of the by-standers, that he was engaged in

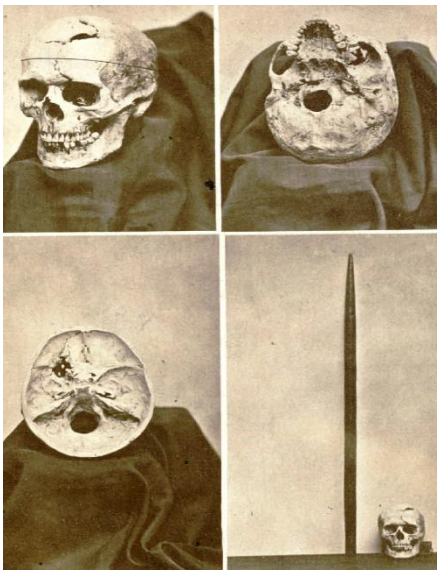
charging a hole, preparatory to blasting. He had turned in the powder, and was in the act of tamping it slightly before pouring on the sand. He had struck the powder, and while about to strike it again, turned his head to look after his men (who were working within a few feet of him), when the tamping iron came in contact with the rock, and the powder exploded, driving the iron against the left side of [his] face…" (Harlow, 1848). (Video animation, https://youtu.be/F_-Xol6v3Ok)



The tamping iron landed some 80 feet away, "smeared with blood and brain". Gage was thrown onto his back and gave some brief convulsions of the arms and legs, but spoke within a few minutes, walked with little assistance, and sat upright in an oxcart for the ¾-mile ride to his lodgings in town. About 30 minutes after the accident, physician Edward H. Williams found Gage sitting in a chair outside the hotel and was greeted with "one of the great understatements of medical history"(Wikipedia).

Gage's doctor was John Harlow, M.D. who arrived soon after and took charge of the patient. "Assisted by my friend, Dr. Williams, who was first called to the patient in my absence, we proceeded to examine and dress his wound … the brain protruding from the opening and hanging in shreds upon the hair … having very much the shape of an inverted funnel … and the frontal bone extensively fractured … leaving an irregular oblong opening in the skull of two by three and one-half inches (Harlow, 1868).

This was another chapter in the continuing medical mystery of the brain, which, in Gage's case, "has been cited as one of complete recovery, it being often said that a very considerable portion of the left cerebrum was lost, without an impairment to the intellect" (Harlow, 1868).



"[T]he mother and friends, waiving the claims of personal and private affection, with a magnanimity more than praiseworthy, at my request have cheerfully placed this skull in my hands, for the benefit of science." Gage's skull (sawed to show interior) and iron, photographed for Harlow in 1868 (Harlow, 1868).

There have been other famous brain injury patients too, each with their own unique brain injury and similarly distinctive healing. One such patient included Eadweard Muybridge who suffered serious head injuries as a result of a stagecoach crash in Texas in 1860 which resulted in severe mental changes, and secondly, Henry Molaison (known as Patient H.M.) who became the most famous memory patient and "the most studied individual in the history of neuroscience" (Dittrich, 2016) (Broussard, 2023).

Just like snowflakes, all brain injuries are somewhat the same but completely different. Injuries like Gage's was "the leading feature" in his case, as "its improbability" and the "beautiful display of the recuperative powers of nature" (Harlow, 1868).

"Nature is certainty greater than art. Someone has wisely said, that vain is learning without wit. So may we say, vain is art without nature" (Harlow, 1868). Gage was walking in town again on his fifty-sixth day since the accident, and Harlow had no idea how he recovered. As Harlow said, "I can only say, in conclusion, with good old Ambrose Pare (a fifteen-century surgeon), I dressed him, God healed him" (Harlow, 1868).

Signed: *The Johnny Appleseed of Aphasia Awareness*

The author is a three-time stroke survivor and has aphasia as a result of the strokes. His language skills continue to improve.

He is Founder and President, Aphasia Nation, Inc., a non-profit organization whose mission is educating the wider public, national and international, about aphasia and plasticity, the foundation of all learning.

1. Broussard T. August 2023 Vol 5 Issue 16 Brenda Milner, Aphasia, Patient H.M. and a Hero of the Engram (8-29-2023).
2. Damasio H, Grabowski T, Frank R, Galaburda AM, Damasio AR. The Return of Phineas Gage: Clues About the Brain from The Skull of a Famous Patient. Science. New Series, Vol. 264, No. 5262 (May 20, 1994), 1102-1105.
3. Dittrich, Luke. Patient H.M., A Story of Memory, Madness, and Family Secrets. Random House, New York (2016).
4. Fleischman J. Phineas Gage, A Gruesome but True Story About Brain Science (2002). Houghton Mifflin Company, New York.
5. Harlow, John Martyn (1848). "Passage of an iron rod through the head". Boston Medical and Surgical Journal. 39 (20): 389–393. doi:10.1056/nejm184812130392001. (also issued as an offprint, vide Cordasco, 60-0808).
6. Harlow, John Martyn (1868). "Recovery from the Passage of an Iron Bar through the Head". Publications of the Massachusetts Medical Society. 2 (3): 327–47. Reprinted: David Clapp & Son (1869) [scan] open access.
7. Video animation of Gage's head, https://youtu.be/F_-Xol6v3Ok)