Muybridge in Motion: Travels in Art, Psychology and Neurology

Arthur P. Shimamura

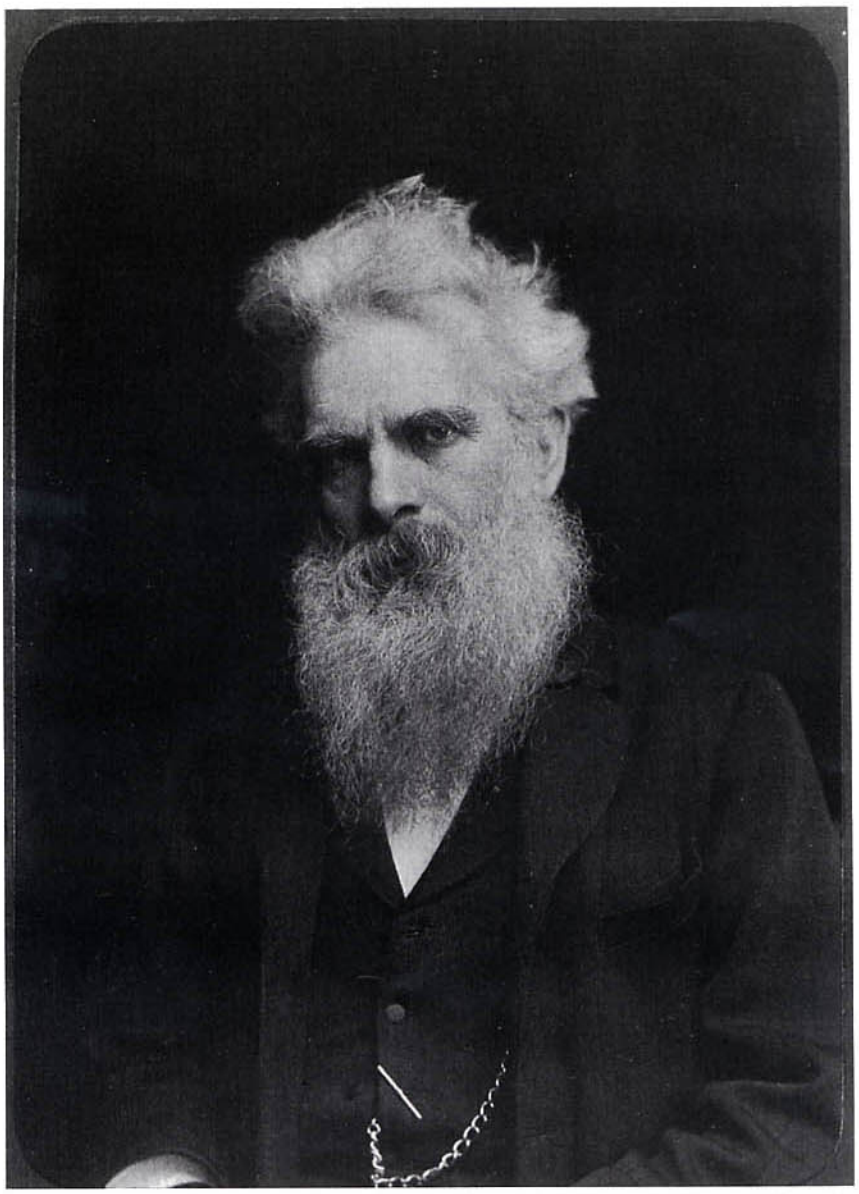

Figure 1. *Portrait of Muybridge*, Wm. Vick Studio, *c.* 1881. Bancroft Library, University of California, Berkeley, California.

ISSN 0308-7298

Eadweard J. Muybridge (1830–1904) stands as a leading figure of nineteenth-century photography.[1] Best known for his artistic and scientific application of photography to capture animals in motion, Muybridge is also recognized as an ingenious inventor and one of the finest landscape photographers of the West.[2] Most formidable amongst his landscape photography is his interpretation of Yosemite Valley. He, along with Charles Weed and Carleton Watkins, was one of the first to venture into Yosemite, capture its magnificence, and bring it back to the general public. With respect to his inventive genius, Muybridge submitted patents for many of his innovations, including the shutter system to capture motion and one of the earliest motion picture projectors, which he called the zoöpraxiscope. This device consisted of a lamp, lens and glass disk. To animate his images, Muybridge mounted on the disk impressions of his sequential shots of a trotting horse. When Muybridge rotated the disk in the device, observers could actually watch the horse in motion.

Those aware of more sordid tales in the history of photography know that in 1874 Muybridge murdered his wife's lover after discovering that the baby his wife bore was most probably not his. Reports about the murder and trial were widely published in newspapers, as by this time Muybridge was an internationally recognized photographer. What has never been fully appreciated is that Muybridge's life was significantly altered by a neurological injury that he had sustained earlier, in 1860. In a stage-coach accident, Muybridge was thrown out of the coach, hit his head against a boulder and was knocked unconscious. Long-term effects of this accident were described in some detail during the murder trial, because one aspect of the defence was to suggest insanity as a result of his brain injury. During the trial, friends and colleagues testified that Muybridge exhibited significant personality abnormalities. Prior to his accident Muybridge was a good businessman, genial and pleasant in nature; but after the accident he was irritable, eccentric, a risk-taker and subject to emotional outbursts.

The emotional changes that followed Muybridge's head injury are familiar to neurologists. Damage to the anterior part of the frontal lobe, known as the orbitofrontal cortex, disrupts the control and regulation of emotions. In modern times, damage to this region is a common consequence of severe automobile accidents. Consider the neurological case of Samantha Fox, described in an article in the New York Times Magazine.[3] Ms Fox was on the highway riding in a truck driven by a friend when another truck attempted to enter their lane. The driver swerved to avoid this vehicle, but their truck flipped over and coursed down a concrete embankment. Fox, who was not wearing a seat belt, was ejected, head first, out of the passenger window, and landed on the concrete. Her skull was broken, and she incurred significant frontal lobe damage. In an interview, she states: 'The pre-accident Samantha was scared of people. ... The after-accident Samantha babbles away, tells anyone whatever they want to know'. The author of the article, Peter Landesman, reports: 'But the new Samantha was savagely disinhibited. Breaks in her neural web had erased all sense of social conversation. She couldn't control her desire to talk, her anger, her sexual urges'.

Detailed descriptions of personality changes associated with orbitofrontal damage, such as those incurred by

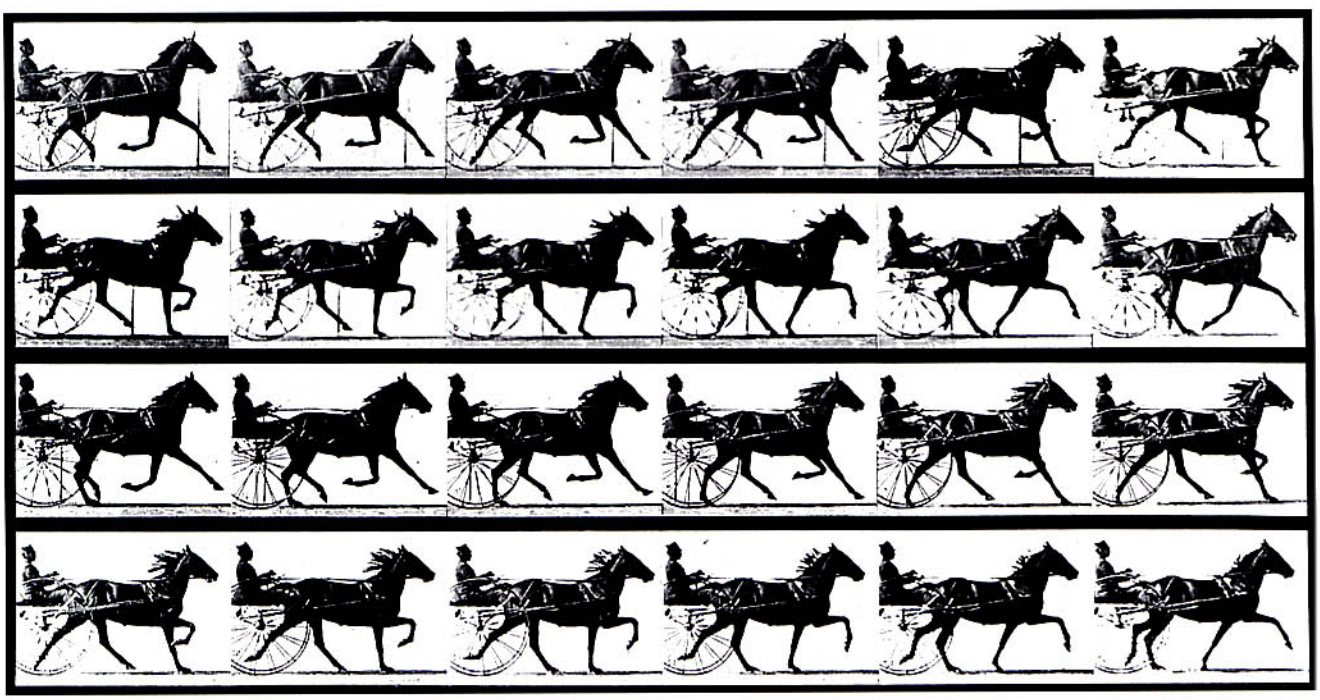

Figure 2. Eadweard J. Muybridge. *Horse in Motion* from *Animal Locomotion*, 1887. California Historical Society, San Francisco, California. FN-30239.

Muybridge and Samantha Fox, are not well documented. Thus, the sworn testimonies of individuals who described Muybridge's emotional disposition before and after his accident provide important documentation concerning the psychological nature of such injuries. With respect to Muybridge, an understanding of the consequences of his stagecoach accident offers a new historical perspective of his life. As his head injury occurred before any interest in professional photography, questions arise concerning the role it played in his art. Indeed, considering his accomplishments in art, science and technology, his injury did not appear to affect his mental abilities. Yet, as described below, Muybridge's brain damage apparently had a significant impact on his work and life experiences.

Eadweard Muybridge: The Route to Photography

Muybridge was born on 9 April 1830 and was raised in Kingston-on-Thames, near London, England. Born Edward James Muggeridge, he changed his first name to 'Eadweard' at the age of 21 in honour of a king who was crowned in Kingston during Saxon times. He emigrated to America in 1852 and settled in San Francisco, California. During the next eight years, Muybridge established himself as a successful bookseller and agent for the London Printing and Publishing Company. He adopted various transformations of his last name — from 'Muggeridge' to 'Muggridge' to 'Muygridge', perhaps as a series of simplifications. He did not take the name 'Muybridge' until years later when he became a professional photographer.

In 1860, Muybridge enlisted his brother, Thomas, to take over his rather prosperous bookshop. Muybridge then made plans for a trip to Europe to purchase antiquarian books for marketing in America upon his return. He made arrangements to sail on a ship, the *Golden Age*, which was to depart on 5 June. However, in a fateful change of plans, Muybridge missed the boat, and reserved a seat on a stagecoach operated by the Butterfield Overland Mail Company. On 2 July 1860, Muybridge, along with seven other passengers, boarded a stagecoach bound for St Louis. From St Louis, Muybridge planned to take the railroad to the east coast.

En route, in north-eastern Texas, the driver lost control of the horses, and the coach sped down a mountainside and crashed. A telegraph message about the accident was dispatched on 22 July and published in the *San Francisco Daily Evening Bulletin* (7 August 1860):

> The stage left Mountain Station with several passengers, besides the driver and Mr. Stout, a roadmaster, in the employ of the Overland Company, who was acting as conductor. On leaving the stable, the driver cracked his whip and the horses immediately started on a run. When they arrived at the brow of the mountain the brakes were applied, but were found to be useless. In his efforts to stop the horses, the driver drove out off the road, and they came in collision with a tree, literally smashing the coach in pieces, killing one man … and injuring every other person on the stage to a greater or less extent.

Muybridge had no personal recollection of the accident but made the following statement during his murder trial (*San Francisco Chronicle*, 6 February 1875):

> A fellow passenger told me after I had recovered consciousness that after leaving that station we had traveled for probably half an hour — we were then just entering the Texas Cross-Timbers. The mustangs ran away. The driver was unable to control them. Just as we were getting to the Timbers I remarked that the best plan would be for us to get out of the back of the stage, because I saw that an accident would take place. He told me that I took out my knife to cut the canvas back of the stage, and was preparing to leave when the stage ran against either a rock or a stump and threw me out against my head.

Muybridge reported that his first recollection following the accident was lying in bed with a 'small wound on the top of my head' at Fort Smith, Arkansas, about 150 miles away from the accident. He managed to continue on another stagecoach to St Louis and took a train to New York where he consulted Dr Parker, a prominent East Coast physician and president of the New York Academy of Medicine. It was reported that Dr Parker told Muybridge that that he was permanently injured. After two months on the east coast, Muybridge travelled to England where he consulted Sir William Gull, who was Queen Victoria's physician and treated patients at Guy's Hospital in London. Muybridge stayed in England for five or six years, recuperating from his accident. Little is known about this time in his life, except that he took out two British patents: one for 'an improved method of and apparatus for plate printing', which related to his interest in book publishing, and another for 'machinery or apparatus for washing clothes and other textile articles'. It has been claimed that Gull suggested photography to Muybridge as a new profession.

Returning to San Francisco in 1866, Muybridge began working with an old friend, Silas Selleck, who was already in the photography business. It is likely that Selleck introduced Muybridge to photography earlier, in the 1850s, when he was a bookseller. He also may have dabbled in photography during his recuperation in England after his accident. His first photographs of Yosemite Valley were taken during the summer of 1867, and at that time these images were considered to be some of the finest ever taken of the Yosemite Valley. For the next five years, Muybridge's celebrity increased with panoramic photographs of San Francisco, more images of Yosemite, and scenes from an Alaskan trip. He also invented the 'sky shade', a mechanical device for the camera that would cover the upper part of the lens during an exposure so that brighter parts of a scene, such as the sky, would not appear overexposed.[4] With the sky shade, details in a landscape could be captured along with details in the sky, such as dramatic cloud formations Today, landscape photographers still contend with this issue by attaching graduated neutral density filters to lenses for scenes that

Figure 3. *Muybridge in front of tree in Yosemite*, photographer unknown, 1872. Bancroft Library, University of California, Berkeley, California.

vary widely in brightness. Indeed, the sky shade was probably the first mechanical device that enabled graduated filtering.

In 1872, Muybridge began his relationship with Leland Stanford, former governor of California and president of the Central Pacific Railroad Company. The two first met when Muybridge was asked to photograph Stanford's opulent home in Sacramento, California. Some time later, Stanford telegraphed Muybridge and suggested a project in which he would photograph his horse, Occident, in motion. Muybridge accepted the offer and was commissioned by Stanford to travel to Sacramento and photograph Occident at various gaits. These initial photographs were not meant to be published and have not been found. However, success in freezing Occident's gait was noted in a newspaper article in 1873 (Alta California, 7 April 1873). Unfortunately, these experiments were halted as a result of the murder of Harry Larkyns.

Love and Murder

In 1872, Muybridge married Flora Shallcross Stone, who was 21 years younger than he and had worked in his studio retouching photographs. As Muybridge's profession often led him away on photographic assignments, Flora was escorted to the theatre by Harry Larkyns, who was considered to be 'gay, dashing and handsome' (*San Francisco Daily Morning Call*, 4 February 1875). On 15 April 1874, Flora gave birth to a baby boy, Florado Helios Muybridge. Although Muybridge had some suspicions about the depth

of Larkyns's relationship with Flora, confirmation that the relationship was more than just escort service surfaced on 16 October 1874. On that morning, Muybridge visited Flora's midwife, Susan Smith, at her home to settle a bill for her services. On the table was a photograph of the baby. Turning the photograph over, Muybridge read the inscription, 'Little Harry', written in his wife's handwriting. Realizing the connection Muybridge 'stamped on the floor and exhibited the wildest excitement. His appearance was that of a madman; he was haggard and pale and his eyes glassy … he trembled from head to foot and gasped for breath' (*San Francisco Chronicle*, 6 February 1875). Muybridge demanded Smith to divulge all she knew. Smith, being aware of Muybridge's unstable disposition and fearing for her own well-being, revealed love letters from Flora to Larkyns.

On the next day Muybridge settled his affairs with his business associate, William H. Rulofson, and with knowledge that Larkyns was working in Calistoga, took a ferry to Vallejo and proceeded by train to Calistoga in Napa Valley. Upon his arrival, he was told that Larkyns was staying at the Yellow Jacket Ranch, eight miles west of the town. Muybridge took a horse and buggy to the ranch, proceeded to the back door, knocked, and asked for Larkyns. Larkyns came to the door, and Muybridge declared, 'I am Muybridge and this is a message from my wife' (*San Francisco Chronicle*, 4 February 1875). Muybridge then raised his Smith & Wesson No. 2 six-shooter, fired once, and killed Harry Larkyns.

The murder trial began on 3 February 1875 in Vallejo. Muybridge's counsel included C. H. King and W. W. Pendegast. King made the opening speech for the defence: 'We claim a verdict both on the ground of justifiable homicide and insanity. We shall prove that years ago, the prisoner was thrown from a stage, receiving a concussion of the brain, which turned his hair from black to gray in three days, and has never been the same since'. The midwife, Susan Smith, gave testimony about Muybridge's visit the day before the murder and about the relationship between Flora and Larkyns. Various witnesses described Muybridge's journey to the Yellow Jacket Ranch and the shooting. It was established that on the day of the murder Muybridge had announced to several individuals that he intended to kill Larkyns. Indeed, on the buggy ride to the ranch he had tested his gun to make sure it was operational. After the shooting, Muybridge was disarmed, and his demeanour was calm.

The trial lasted three days. Muybridge took the stand under the condition that he would not discuss the murder incident and only describe the nature of his stagecoach accident. Long-time friends and associates described Muybridge's personality quirks following his accident. A witness for the prosecution, Dr G. A. Shurtliff, Superintendent of the Stockton Insane Asylum, testified that if a man were calm after a murder, it suggested that the man was not insane. He considered Muybridge's actions

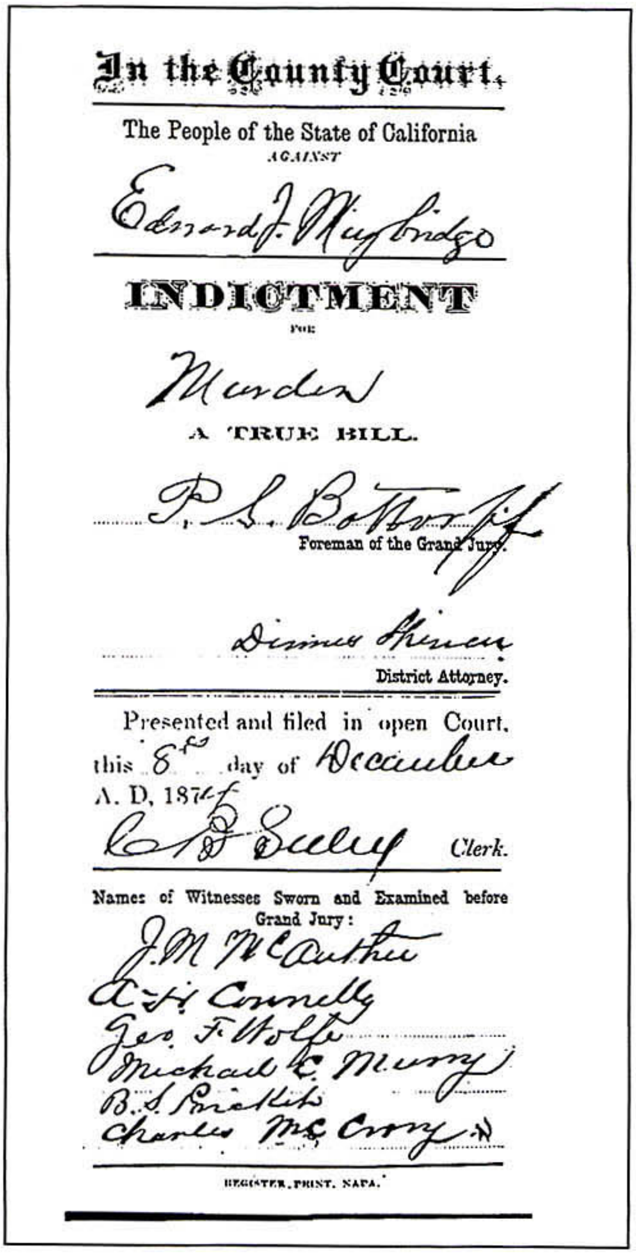
In the County Court.
The People of the State of California
AGAINST
Edward J. Muybridge
INDICTMENT
FOR
Murder
A TRUE BILL.
P. L. Bottorff
Foreman of the Grand Jury.
Dimmer Spencer
District Attorney.
Presented and filed in open Court,
this 8th day of December
A. D, 1874
C. B. Seeley Clerk.
Names of Witnesses Sworn and Examined before Grand Jury:
J. M. McArthur
A. H. Connelly
Geo. F. Wolfe
Michael C. Murry
B. S. Pricklit
Charles McCrory
REGISTER, PRINT, NAPA.

Figure 4. *Indictment Document from Napa County Superior Court*, 1874. Napa Historical Society, Napa, California.

to be sane and premeditated. Indeed, even Muybridge discounted the insanity plea, as he indicated that his actions were deliberate and intentional.

Mr Pendegast made the closing statement for the defence. According to the *San Francisco Chronicle* (6 February 1875): 'The speech was one of the most eloquent forensic efforts ever heard in the State. The peroration carried the audience away, and at the close they broke into a storm of applause …'. Just before the Judge retired the jury for deliberation, he instructed them to reach one of four verdicts: (1) guilty in the first degree with the death penalty, (2) guilty in the first degree with life imprisonment, (3) not guilty, or (4) not guilty by reason of insanity. The Judge explicitly stated that knowledge about an adulterous relationship was not an acceptable reason for taking the law into one's own hands and thus insufficient grounds

for the jury to yield a not guilty verdict. The jury retired at 10:45 pm. The initial jury ballot was 5 for murder in the first degree and 7 for acquittal. At midnight, the Judge adjourned the Court until the morning as the jury had not reached a unanimous verdict. In the morning, a second ballot was taken with the same result as the first. Interestingly, the primary contention was the issue of insanity. The jury members preferred acquittal, but they did not believe Muybridge to be insane and considered his actions premeditated. By the Judge's order, Muybridge was guilty of murder.

By noon the next day, the jury reached a verdict. Muybridge was acquitted for the murder of Harry Larkyns. In the end, the jury ignored the Judge's order. As described by the *San Francisco Chronicle* (7 February 1875):

> The jury discarded entirely the theory of insanity, and meeting the case on the bare issue left, acquitted the defendant on the ground that he was justified in killing Larkyns for seducing his wife. This was directly contrary to the charge of the Judge, but the jury do not mince the matter, or attempt to excuse the verdict. They say that if their verdict was not in accord with the law of the books, it is with the law of human nature; that, in short, under similar circumstances they would have done as Muybridge did, and they could not conscientiously punish him for doing what they would have done themselves.

It is believed that this case was the last one in California in which a murder charge was acquitted on the jury's explicit pronouncement of justifiable homicide. Following the verdict, Muybridge's emotional reaction was overwhelming (*San Francisco Chronicle*, 7 February 1875):

> At the sound of the last momentous words a convulsive gasp escaped the prisoner's lips, and he sank forward from his chair. The mental and nervous tension that had sustained him for days of uncertain fate was removed in an instant; and he became as helpless as a new-born babe. Mr. Pendegast caught him in his arms and thus prevented his falling to the floor, but his body was limp as a wet cloth. His emotion became convulsive and frightful. His eyes were glassy, his jaws set and his face livid. The veins of his hands and forehead swelled out like whipcord. He moaned and wept convulsively, but uttered no word of pain or rejoicing. Such a display of overpowering emotion has seldom, if ever, been witnessed in a Court of justice. ... He rocked to and fro in his chair. His face was absolutely horrifying in its contortions as convulsion succeeded convulsion. ... Pendegast begged Muybridge to control himself and thank the jurymen for their verdict. He arose to his feet, and tried to speak, but sank back in another convulsion. He was carried out of the room by Pendegast and laid on a lounge in the latter's office.

Within 30 minutes, Muybridge regained his composure, stepped out of the courtroom, and was greeted by an excited and cheerful crowd.

Life Afterwards

Soon after the trial, Muybridge set off to Central America for a nine-month photography assignment, which had been planned during the previous year but was delayed because of the trial. Flora, who had divorced Muybridge, took ill and died five months after the trial, and Florado was sent to an orphanage. On Muybridge's return, his professional success flourished with stunning photographs from Central America and a series of panoramic images of San Francisco.

Muybridge also returned to his project with Stanford. In 1877, at the recently bought stock farm in Palo Alto, which is now the site of Stanford University, Muybridge placed up to twelve cameras along a horse track, so he could photograph a continuous series of Stanford's horse in motion. Each camera included an electromagnetic shutter with a speed of 1/1000th second. The shutters were held cocked by a thread strung across the track; as the horse ran by, the threads were broken, tripping each shutter in quick succession. Muybridge secured a patent for this ingenious mechanism. Fame followed these photographs, as it clearly showed all four legs of the horse off the ground during one part of its gait. Various newspapers published articles about the feat. By 1879, Muybridge increased the number of cameras to twenty-four and photographed other animals — including a dog, cow, deer, goat, seagull and humans. These photographs became representative of Muybridge's most famous work. It was this time period that Muybridge also invented his motion picture projector, the zoöpraxiscope, as a way to display his animals in motion.

In 1881, Muybridge published his photographs from the series taken at Stanford's farm in a book entitled *The Attitudes of Animals in Motion*. He then set out for Europe to discuss his extraordinary photographs. He used his zoöpraxiscope to portray the animal's movement. During this trip a rather embarrassing incident occurred that caused a falling out between Stanford and Muybridge. Muybridge was invited to prepare a monograph about his findings for the Proceedings of the Royal Society of London. Just before he was to submit his manuscript, Muybridge was asked to meet the President and the Society Council to discuss a book entitled, *The Horse in Motion: As Shown by Instantaneous Photography by J. D. B. Stillman*, published in 1882 'under the auspices of Leland Stanford'. Muybridge had known that Stillman, a physician and friend of Stanford, was planning to write a book on animal motion, perhaps in collaboration with Muybridge. Yet, Muybridge was shocked to find in the book drawings taken from his photographs, without any acknowledgement except for a passing reference about his contribution in a preface written by Stanford. With Stillman's book in hand, the Royal Society accused Muybridge of plagiarism and refused to publish the monograph. The incident marred Muybridge's reputation in his native country. Upon his return to America, Muybridge sued the publishers of *The Horse in Motion* and Leland Stanford. He lost both suits.

Despite this failure in his legal battles, Muybridge prevailed. Stillman's book was a business flop, and Muybridge was able to secure funding from the University of Pennsylvania to continue his work. Indeed, under the auspices of the University of Pennsylvania, Muybridge took over 20 000 photographs of animals performing a variety of actions. His two widely popular books describing

this body of work, *Animals in Motion* (1899) and *The Human Figure in Motion* (1901) enlightened both artists and scientists in the nature of animal physiology and movement. Muybridge spent his remaining years promoting his photography in both America and Europe. He died in England at the age of seventy-four.

Brain Injury and Emotional Control

Ever since Darwin's treatise on the evolution of emotions, scientists have struggled to define the biological underpinnings of emotional behaviour.[5] Feelings and emotions are often viewed as too personal, complex or difficult to analyse scientifically. Yet, some aspects of emotions have been studied.[6] For example, electrical stimulation of a subcortical brain structure called the amygdala can induce a fear response in animals, whereas a lesion of the same structure produces unusual tameness. These and other findings suggest that the amygdala is involved in the induction of basic emotional responses, such as rage, glee and sexual excitement.

The regulation of emotions appears to be controlled by the orbitofrontal cortex. Patients with damage to this brain region exhibit heightened or disinhibited emotional responses. Damage to the orbitofrontal cortex is particularly frequent in cases of head trauma because this area is adjacent to sharp bony ridges that make up the skull's openings for the eyes. Elsewhere, the skull's inner surface is smooth. During severe head trauma, shearing against these bony ridges produces contusions in the orbitofrontal cortex along with damage to nearby areas in the anterior temporal lobe.[7]

In patients with orbitofrontal damage, the loss of emotional control is often characterized as a 'personality' change by relatives and friends. That is, the demeanour of an individual changes — often from stable, responsible and friendly to fitful, argumentative and aggressive. Uncontrollable emotional outbursts, inappropriate sexual advances and sudden changes in emotional state create a sense that the patient is a different person altogether. Thus, unlike other forms of brain damage — where intelligence, memory or language are disrupted — orbitofrontal damage impairs one's emotional control and reactivity. The difficulty in evaluating such dispositional changes is that impulsivity, aggressiveness and emotional outbursts are not uncommon characteristics among individuals who are (presumably) not brain injured. As such, it is difficult to attribute the cause of inappropriate emotions to brain damage, unless one is familiar with the same individual before and after the injury.

Another interesting symptom of orbitofrontal damage is heightened risk-taking behaviour. Patients with orbitofrontal damage fail to appreciate the consequences of their actions. Thus, they follow the immediate hedonic value of the present situation. In several investigations, Antonio Damasio and colleagues have assessed risk-taking behaviour in patients with orbitofrontal damage.[8] Subjects play a gambling game in which they select cards from four decks. Each card has a win or loss value (e.g. WIN $100). Some decks are set up so that they yield occasional high wins, though in the long run the losses are substantial. Patients with orbitofrontal lesions key on decks with the occasional big wins and fail to appreciate that they are losing money. That is, these individuals opt for risky situations. It is as if these patients cannot overcome or regulate the emotional rush that occurs in high-risk gambles. Interestingly, Rule, Shimamura and Knight used electroencephalgraphy (EEG) to study brain activity in response to emotional stimuli.[9] They found that patients with orbitofrontal damage elicit abnormally heightened brain activity to emotional stimuli. These findings are consistent with behavioural findings which indicate that such patients have problems in regulating emotions and suppressing the excitement of an emotional state, such as a high gamble.

Among the various neurological cases studied in the annals of medical research, one individual, Phineas Gage, has gained notoriety as a result of a bizarre accident.[10] Phineas Gage — a railroad foreman for the Rutland and Burlington Railroad — was known to be an even-tempered, smart business man and a favourite among co-workers. His job involved the creation of railroad routes through rocky areas in Vermont. Explosives were used to form these routes. First, a hole was drilled into rock, then explosive powder and a fuse were placed into the hole. To insulate the explosive powder, sand was poured on top of it. The compound was then compressed or tamped into the hole with a heavy iron rod. On 13 September 1848, Phineas started tamping the explosive powder before sand was poured. The iron rod hit the side of the hole, caused a spark and ignited the powder, thus causing an explosive charge that sent the rod, harpoon-like, up through Gage's cheekbone, through his orbitofrontal cortex, and out of his skull. The rod landed 80 feet behind him, and evidence of blood and brain tissue was found near the iron rod. Despite this horrendous brain insult, witnesses stated that Gage did not lose consciousness, was helped to a cart and sent to the nearby town of Cavendish to be treated.

Amazingly, Gage survived the accident and lived for another $11\frac{1}{2}$ years. What is known about Gage's accident comes from the physician who treated him, John Martyn Harlow. Harlow published accounts of the case,[11] as it was rather remarkable that an individual could sustain such a serious insult to the brain. Although Gage did not appear to exhibit much intellectual decline, his personality changed — with remarkable similarities to Muybridge's condition. As described by Harlow (1868):

> He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom), manifesting but little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillating, devising many plans of future operation, which are sooner arranged than that are abandoned in turn for others appearing more feasible. ... In

> this regard his mind was radically changed, so decidedly that his friends and acquaintances said he was 'no longer Gage'. (Harlow, 1868)

Following his injury, Gage's emotional instability prevented him from continuing his employment as a railroad foreman. He took on various jobs, travelled to South America, and ended up in San Francisco, where his sister lived. He died on 21 May 1860. About seven years later, Harlow made a request to Gage's relatives to examine Gage's skull. His request was granted, and Gage's body was exhumed from a grave in San Francisco in the presence of David Dustin Shattuck (Gage's brother in law), Dr Henri Perrin Coon (the Mayor of San Francisco), and Dr J. D. B. Stillman (coincidentally the same man who wrote the infamous 'The Horse in Motion'!). Gage's skull was given to Harlow, who had also secured the tamping iron — both are now the property of the Warren Anatomical Museum of Harvard University. With Gage's skull, Harlow was able to estimate the trajectory of the iron rod and determine the likely extent of brain damage. Based on these findings — and on more recent findings using MRI analyses of Gage's skull by Hanna Damasio and colleagues[12] — damage to the orbitofrontal cortex was confirmed.

Eadweard Muybridge's Brain Damage

The personality changes observed in Phineas Gage, Samantha Fox and Muybridge share a strikingly similar resemblance to each other. In sworn testimonies during Muybridge's murder trial, friends and colleagues described Muybridge's personality before and after his accident. Below are reports from various newspapers describing the testimonies.

> Silas Selleck, photographer, called and sworn — Resides in San Francisco; known Muybridge for 26 or 27 years.... Muybridge, from 1852 to 1867, was a genial, pleasant and quick business man; after his return from Europe he was very eccentric, and so very unlike his way before going; the change in his appearance was such that I could scarcely recognize him after his return. (*Sacramento Union*, 5 February 1875)
>
> Silas Selleck testified that before Muybridge's trip East he was active, energetic, strict in all his dealings, open and candid. When he came back he had changed entirely. He was eccentric, peculiar, and had the queerest of odd notions, so much so that he seemed like a different man. (*San Francisco Chronicle*, 6 February 1875)
>
> M. Gray, called and sworn — Resides in San Francisco; been there twenty years. Knew the defendant for twenty years intimately. Remember his going to Europe in 1859.... Was much less irritable than after his return; was much more careless in dress after his return; was not as good a business man.... Has not been the same man in any respect since. (*Sacramento Union*, 5 February 1875)
>
> J. G. Easland testified that he had been intimately acquainted with Muybridge for a number of years before and after his European trip. Heard of the accident to him on the trip. After his return I noticed certain eccentricities of speech, manner, and action, and my impression formed thereof. I thought the change was such that had I heard of this killing before the accident it would have surprised me, but occurring after it did not. (*San Francisco Chronicle*, 6 February 1875)

Various incidences attest to Muybridge's tendency to exhibit uncontrollable emotional outbursts. As described earlier, his reaction to the baby picture and his overwhelming outburst after his trial exceeded the bounds of normal emotional responses. Also, William H. Rulofson, Muybridge's business associate, testified 'that on the second day after the homicide he called to see Muybridge in jail. Muybridge fell upon his neck and wept bitterly, and then became suddenly calm and said, "I am calm; I am cool; I am not excited". Then when he talked about his wife, he would give way to bursts of grief; then become, by turns, suddenly greatly excited, and cool, immovable as stone. This was a temperament which I had noticed in him before' (*San Francisco Chronicle*, 6 February 1875).

Evidence of risky decision making was also described in Rulofson's testimony:

> He had seen frequent indications of unsoundedness of mind in the defendant. The witness then related strange things which Muybridge had done during the period of his acquaintance with him. One thing was, that while Muybridge was a strictly honest man, he would make a bargain or contract with one at night and next morning go back on it in tote and make a new contract. These idiosyncrasies he had noticed within two years. The witness said he could go on and fill whole volumes with the peculiar things Muybridge had done. Among the strange freaks which Muybridge had committed was to have his picture taken on a rock at Yosemite valley, where a biscuit, if slightly tilted, would have fallen down 2,000 feet. (*San Francisco Chronicle*, 6 February 1875)

If it were not for attempts to suggest a plea of insanity in the murder trial, no documentation of Muybridge's personality changes would be available. Further evidence of neurological injury was given by Muybridge during the trial. He stated that just after his accident he had double vision, loss of taste and loss of smell. All of these symptoms can occur as a result of damage to the orbitofrontal cortex or to nearby nerve fibres. The fact that Muybridge experienced a concussion and took from months to years to recover suggests that the head trauma was severe enough to cause permanent neurological damage. In all likelihood, Muybridge's brain injury included at least the orbitofrontal cortex and probably more extensive damage, such as damage to the anterior temporal lobe.

To what extent did Muybridge's head injury contribute to his life experiences? First, it appeared to have contributed to his decision to become a professional photographer. Muybridge stated that it was his physician, Sir William Gull, who suggested photography as a vocation. Although this suggestion may be more myth than fact, it is quite reasonable that Gull would have suggested a change in vocation toward an outdoor activity that would take Muybridge away from social contact, given his irascible nature and propensity to display emotional outbursts. Second, Muybridge's head injury likely contributed to his profound emotional outbursts. His failure to regulate and control his emotions strongly suggests orbitofrontal damage. As such, it is probable that Muybridge's emotional instability contributed to the act of murdering of Harry Larkyns.

Figure 5. *Muybridge on Contemplation Rock*, Bradley & Rulofson stereoview, 1872. California Historical Society, San Francisco, California. FN-18893.

Of course, not all patients with orbitofrontal damage resort to such drastic actions. However, aggressive behaviour and impulsivity are common symptoms.

It is interesting to speculate that orbitofrontal damage contributed to other peculiarities of Muybridge's behaviour. Patients with orbitofrontal damage exhibit inappropriate risk-taking behaviour, obsessive-compulsive disorder, and social disinhibition. With respect to risk-taking behaviour, orbitofrontal damage may have prompted Muybridge's decision to accept assignments in remote areas (e.g. Central America, Alaska) or his decision to photograph in dangerous or precarious situations. It is also interesting to note the rather obsessive quality (and quantity) of Muybridge's tens of thousands of photographs of animals in motion. His zeal for such images appears to border on the obsessive-compulsive side. Interestingly, neuroimaging studies show that the orbitofrontal cortex is abnormally active in individuals with obsessive-compulsive disorder.[13] Muybridge's social disinhibition is evidenced by a series of photographs taken during his time in Philadelphia, in which Muybridge himself posed nude in front of his camera set-up.

Finally, Muybridge's head injury occurred before he began his career as a professional photographer. Thus, his emotional disorder did not appear to deter his creative abilities. Moreover, his ability to create ingenious inventions suggests that his injury did not affect problem-solving or technical skills. It is interesting to speculate whether his injury actually enhanced his creative abilities. One could suppose that disinhibited emotions could act to heighten one's creative expression. Interestingly, Dr Bruce Miller, a neurologist at the University of California, San Francisco, has studied artistic abilities in patients with a neurological illness called frontotemporal dementia.[14] This disease causes atrophy in the orbitofrontal cortex. Miller *et al.* (1998) report that patients with this disorder develop interests in artistic expression. It is possible that these patients are less inclined to inhibit or suppress their emotions, and as a result become more expressive in their art. By this view, it is not as if brain injury makes an individual more creative or artistic in an aesthetic manner. Instead, it may be that individuals with orbitofrontal damage are less inhibited in expressing their emotions in art.

It is tantalizing to consider the neurological case of Eadweard J. Muybridge as an instance in which artistic and inventive genius required a bit of emotional instability or disinhibition. Thus, shutting off one's orbitofrontal cortex — from time to time — may actually enhance one's

creative expression. Of course, uncontrolled aggression, impulsivity, risky undertakings and other eccentric behaviours are also consequences of a dysfunctional orbitofrontal cortex. In Muybridge's case, orbitofrontal damage may have led to both good and bad.

Notes

NIH Grants NS17778 and DA14110 supported this research. The author wishes to thank the staff at the Napa County Historical Society, the Napa County Superior Court, and the California Historical Society for assistance. Thanks also to Helen Ettlinger for helpful comments on earlier drafts. Correspondence concerning this article can be addressed to Arthur P. Shimamura via electronic mail (aps@socrates.berkeley.edu) or standard mail, Department of Psychology (No. 1650), University of California, Berkeley, CA 94720, USA.

1. For extensive biographical reviews, see R. B. Haas, *Muybridge: Man in Motion*, University of California Press: Berkeley, CA 1976 and G. Hendricks, *Eadweard Muybridge: The Father of the Motion Picture*, New York: Grossman Publishers 1975.
2. M. Braun and E. Whitcombe, 'E. Marey, Muybridge, and Londe: The photography of pathological locomotion', *History of Photography* 23 (1999), 218–24, and D. Rossell, *Living Pictures: The Origins of the Movies*, State University of New York Press 1998.
3. P. Landesman, 'Speak, memory', *New York Times Magazine* (17 September 2000), 74–79.
4. *Eadweard Muybridge: The Stanford Years, 1872–1882*, ed. A. V. Mozley, catalogue of an exhibition at the Stanford University Museum of Art, sponsored by Board of Trustees of The Leland Stanford Junior University, 1972.
5. C. Darwin, *The Expression of the Emotions in Man and Animals*, Chicago: University of Chicago Press 1872/1965.
6. R.J. Davidson, 'Affective style and affective disorders: perspectives from affective neuroscience', *Cognition & Emotion* 12 (1998), 307–30, and J. E. LeDoux, *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*, New York: Simon & Schuster 1996.
7. *Localization and Neuroimaging in Neuropsychology*, ed. A. Kertesz, San Diego, CA: Academic Press 1994; A. J. Mattson and H. S. Levin, 'Frontal lobe dysfunction following closed head injury', *Journal of Nervous and Mental Disease* 178 (1990), 282–91; D. T. Stuss and F. Benson, *The Frontal Lobes*, New York: Raven Press 1986.
8. A. Bechara, A. R. Damasio, H. Damasio and S. W. Anderson, 'Insensitivity to future consequences following damage to human prefrontal cortex', *Cognition* (1994), 7–15.
9. R. Rule, A. P. Shimamura and R. T. Knight, 'Orbitofrontal cortex and dynamic filtering of emotional stimuli', *Cognitive, Affective, & Behavioral Neuroscience* (in press).
10. M. B. MacMillian, 'A wonderful journey through skull and brains: the travels of Mr. Gage's tamping iron', *Brain and Cognition* 5 (1986), 67–107; M. B. MacMillian, *An Odd Kind of Fame: Stories of Phineas Gage*, Cambridge, MA: MIT Press 2000; J. M. Harlow, 'Passage of an iron rod through the head', *Boston Medical and Surgical Journal* 39 (1848), 389–93.
11. J. M. Harlow, 'Recovery of an iron rod through the head', *Publications of the Massachusetts Medical Society* 2 (1868), 327–47.
12. H. Damasio, T. Grabowski, R. Frank, A. M. Galaburda and A. R. Damasio, 'The return of Phineas Gage: clues about the brain from the skull of a famous patient', *Science* 264 (1994), 1102–05.
13. T. R. Insel, 'Toward a neuroanatomy of obsessive-compulsive disorder', *Archives of General Psychiatry* 49 (1992), 739–44.
14. B. L. Miller, J. Cummings, F. Mishkin, K. Boone, F. Prince, M. Ponton and C. Cotman, 'Emergence of artistic talent in frontotemporal dementia', *Neurology* 51 (1998), 978–82.