

Moving Beyond Vision: Eadweard Muybridge in Philadelphia

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Introduction

In Eadweard Muybridge's "Woman Disrobing Another," a female model is stripped bare (Figure 1). She stands still, head bowed, as the photographs track the exposure of her body frame by frame. In the final images, she covers her face with her arm as though in shame.

Muybridge's motion study reenacts the French orientalist artist Jean-Léon Gérôme's *Phryne Before the Areopagus* (Figure 2). Gérôme's painting tells the tale of an ancient Greek courtesan who was wrongly accused of impiety. When an unfavorable verdict seemed inevitable, the orator defending Phryne ripped off her robe. The council immediately found her innocent of all charges. In the eyes of her judges, a body so ideally beautiful and unblemished could never be guilty.¹

Muybridge photographed these modern-day Grecians in his outdoor studio on the grounds of the University of Pennsylvania's new Veterinary Department. The University had agreed to sponsor Muybridge's "new and elaborate work upon the attitudes of man, the horse and other animals in motion" in 1883.² Muybridge obsessively photographed bipeds and quadrupeds of every variety for the next three years. The results were published in 1887 under the title *Animal Locomotion, An Electrophotographic Investigation of Consecutive Phases of Animal Movements, 1872-1885*. Comprised of eleven volumes, 781 collotype plates, and representing nearly 300 discrete motions,

¹ The similarity between these works is briefly discussed in Janine A. Mileaf, "Poses for the Camera: Eadweard Muybridge's Studies of the Human Figure," *American Art* 16, no. 3 (2002), 30-53.

² E.J. Muybridge, *Prospectus of a New and Elaborate Work Upon the Attitudes of Man, the Horse and Other Animals in Motion*. New York: Scovill Manufacturing, 1883.

Animal Locomotion was hailed as a revolutionary contribution to both the arts and sciences, and is now considered a landmark in the history of photography.³

In her 1984 article “Muybridge’s Scientific Fictions,” Marta Braun questions how, for nearly a hundred years, sequences like “Woman Disrobing Another” could have been read, almost universally and unquestioningly, as scientific documents.⁴ Braun contends that the uniform presentation of the motion studies acts to conceal many inconsistencies, including miscalculated or insufficiently recorded time lapses between the individual photographs, missing or distorted images caused by malfunctioning cameras, and cropped or reordered frames. She concludes that Muybridge was more concerned with narrative and aesthetics than with recording the scientific facts of locomotion; “Woman Disrobing Another,” she notes, was originally titled “Examining a Slave, White.”⁵ Here and in her many subsequent publications, Braun has urged scholars to reexamine *Animal Locomotion* as a treasure trove of figurative imagery and a compendium of social, cultural, and scientific history.⁶

The next generation of Muybridge scholars answered Braun’s call. Authors have, for instance, discussed the relationship between Muybridge’s motion studies and the

³ Eadweard Muybridge, *Animal Locomotion: An Electrophotographic Investigation of Consecutive Phases of Animal Movement* (Philadelphia: University of Pennsylvania, 1887b).

⁴ Marta Braun, “Muybridge’s Scientific Fictions,” *Studies in Visual Communication* 10, no. 3 (Summer 1984), 2-22.

⁵ Braun (1884), 17-18.

⁶ Braun has written extensively about Muybridge; see for instance “Animal Locomotion,” in *Helios: Eadweard Muybridge in a Time of Change*, ed. Philip Brookman (Göttingen: Steidl/Washington: Corcoran Gallery of Art, 2010), 74-76; Marta Braun, “Muybridge/Technology,” in *Zeitschrift für Medien und Kulturforschung*, ed., Lorenz Engell and Bernhard Siegert (Hamburg: Felix Meiner, 2010), 51-62; “The Expanded Present: Photographing Movement,” in *Beauty of Another Order: Photography in Science*, ed. Ann Thomas (New Haven: Yale University Press, 1997), 150-184; “Fragmentation as Narration: The Case of Animal Locomotion,” in *Stop Motion, Fragmentation of Time: Exploring the Roots of Modern Visual Culture*, ed. François Albera, Marta Braun, and André Gaudreault (Lausanne: Editions Payot, 2002), 151-170. *Picturing time: The work of Etienne-Jules Marey (1830-1904)* (Chicago: University of Chicago Press, 1992). “Chronophotography: Leaving Traces,” in *Moving Pictures: American Art and Early Film, 1880-1910*, ed. Nancy Mowll Mathews (Manchester: Hudson Hills Press/Williams College Museum of Art, 2005), 95-99.

paintings and photographic practice of Thomas Eakins, who was the director of the Pennsylvania Academy of Fine Arts and who briefly collaborated with Muybridge during the summer of 1884. Janine A. Mileaf has discussed the production and reception of Muybridge's studies in relation to Eakins's nude photographs. Mileaf posits that, while Eakins's so-called "Naked Series" so flouted the puritanical mores of the late nineteenth century that he was forced to resign from the Pennsylvania Academy in 1886, Muybridge's images of naked models escaped censure by strategically employing the conventions of both art and science.⁷ Allan Braddock traces a shared "period-specific ethnographic interest in Otherness" through Muybridge's motion studies and Eakins' paintings and photographs.⁸ Finally, Sarah Gordon has examined the question of how and why, in the conservative climate of late nineteenth-century America, Muybridge's photographs of nude men and women were not only accepted but lauded. She concludes that the "involvement of a group of respectable, upper class, highly educated Philadelphian professionals sanctioned the publication of Muybridge's thousands of nude photographs, while the publication of those very photographs emphasized the authority and prestige of these individuals."⁹

⁷ Mileaf, 30-53. For further discussions of Eakins and Muybridge's collaboration, see Amy Worbel, *Thomas Eakins: Art, Medicine and Sexuality in Nineteenth-Century Philadelphia* (New Haven: Yale University Press, 2007), 114-123; Susan Danly and Cheryl Leibold, eds., *Eakins and the Photograph: Works by Thomas Eakins and his Circle in the Collection of the Pennsylvania Academy of the Fine Arts* (Washington: Published for the Pennsylvania Academy of the Fine Arts by the Smithsonian Institution, 1994); William I. Homer, "Eakins, Muybridge and the Motion Picture Process," *Art Quarterly* 26 no. 2 (Summer 1963), 194-216. Gordon Hendricks, *The Photographs of Thomas Eakins* (New York, Grossman Publishers, 1972); Kathleen A. Foster, *Thomas Eakins Rediscovered: Charles Bregler's Thomas Eakins Collection at the Pennsylvania Academy of the Fine Arts* (New Haven: Yale University Press; Philadelphia: Pennsylvania Academy of the Fine Arts, 1997), 106-120.

⁸ Alan C. Braddock, "Eakins, Race, and Ethnographic Ambivalence," *Winterthur Portfolio* 33, no. 2-3 (Summer-Autumn 1998), 160..

⁹ Sarah Gordon, *Sanctioning the Nude: Production and Reception of Eadweard Muybridge's Animal Locomotion, 1887*, PhD Dissertation, Northwestern University, 2006, 111.

Likewise, several scholars have examined Muybridge's motion studies against the background of late nineteenth-century anthropology or ethnography, science, and medicine. Elspeth H. Brown relates Muybridge's studies to contemporary anthropometric theories and evolutionary race science, academic fields that, she demonstrates, were widely studied at the University.¹⁰ Similarly, Jayne Morgan considers the motion studies in the context of nineteenth-century medical discourse by comparing Muybridge's photographs of female models from *Animal Locomotion* to the British physician W.S. Playfair's photographic records of patients afflicted with neurasthenia.¹¹ Darwin Marable also draws connections between Muybridge's project and photography's instrumental use in continental medicine. In particular, he examines the motion studies alongside photographs taken by Hugh W. Diamond, the superintendant of at the Surrey County Asylum, and by Albert Londe, assistant to the French neurologist Jean-Martin Charcot and the chief operator of the Salpêtrière Hospital's photography studio.¹² Similarly, Marta Braun and Elizabeth Whitcombe have investigated the clinical applications of instantaneous photography by comparing Muybridge's images of models afflicted with movement disorders to photographs of clinical subjects by Londe and the French physiologist and photographer Étienne-Jules Marey. Braun and Whitcombe argue that Muybridge's photographs, ultimately, had little scientific utility.¹³

Yet, these scholars have largely left unexplored a problem that greatly vexed Muybridge's viewers in the late 1880s: the relationship between the *Animal Locomotion*

¹⁰ Elspeth H. Brown, "Racialising the Virile Body: Eadweard Muybridge's Locomotion Studies 1883-1887," *Gender & History* 17, no. 3 (2005), 627-656.

¹¹ Jayne Morgan, "Eadweard Muybridge and W. S. Playfair: An Aesthetics of *Neurasthenia*," *History of Photography* 23, no. 2 (1999), 225-231.

¹² Darwin Marable, "Photography and Human Behaviour in the Nineteenth Century," *History of Photography* 9 (April/June 1985), 141-47.

¹³ Marta Braun and Elizabeth Whitcombe, "Marey, Muybridge and Londe: The Photography of Pathological Locomotion," *History of Photography* 23, no. 3 (Autumn 1999), 218-224.

photographs and vision. Several authors have, however, situated Muybridge's first motion study investigations within a larger history of vision and visuality in the nineteenth century. As chapter one will explain in greater detail, Muybridge executed these photographs at the behest of Leland Stanford, the president of the Central Pacific Railroad, between 1872 and 1878. Muybridge's photographs play a prominent role in the genealogy of the modern observer that Jonathan Crary charts in *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* and *Suspensions of Perception: Attention, Spectacle and Modern Culture*. In his first work, Crary argues that, in the 1820s and 1830s, vision was reconceived as subjective and the observer as an active producer of perceptual experience. Thus, he argues, photography and modernist painting did not lead to the late nineteenth-century "remaking of perception," but developed simultaneously and in tandem with it. His later work focuses on the problem of "attention" as a central concern of psychological and aesthetic practices in the second half of the nineteenth century. Crary situates Muybridge's work within a larger family of late nineteenth-century visual technologies that demonstrated the instability of both perception and the observing subject by forcing the viewer to synthesize a fragmentary progression of images. "What Muybridge achieved," he writes, "was a reorganization and dispersal of perception that exposed not the naturalness of vision but...its systematic and constructed character."¹⁴ Crary's work is an important methodological guide for reconsidering the connection between representational practices and the observing subject as reciprocal rather than causal. Yet, he pays little attention to the context of the motion studies' creation or how they were received by period viewers.

¹⁴ *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge: MIT Press, 1990); Jonathan Crary, *Suspensions of Perception: Attention, Spectacle, and Modern Culture* (Cambridge: MIT Press, 2001), 140.

John Ott's recent book *Manufacturing the Modern Patron: Cultural Philanthropy, Industrial Capital, and Social Authority* is a useful counterpoint to Crary's work.¹⁵ He argues that Muybridge's studies both naturalized the new industrial order and embodied the superhuman, automated gaze of the industrial manager. While Stanford and his supporters claimed that Muybridge's photographs could be used to "train the eye" to see more and faster, critics—and, in particular, artists—contested the encroachment of this new, mechanized optics. Ott convincingly argues that this debate was intensified by larger cultural anxieties about technology and mechanization. While Crary's history of perception charts the gradual metamorphosis of the observing subject over centuries, Ott's account considers how conflicting models of viewership were used to substantiate and defend conflicting claims to social authority during a single historical moment.

With Crary and Ott's arguments in mind, I would like to return to Muybridge's "Woman Disrobing Another." To capture his motion studies, Muybridge used three batteries of twelve cameras arranged around a gridded backdrop. As the model performed his or her action, the cameras fired in tandem with the moving subject, thus capturing simultaneous photographs from three different vantage points, resulting in a 270-degree view (Figure 3).

Thus, for "Woman Disrobing Another," Muybridge has, in effect, substituted cameras for the eyes of the Roman councilmen who, in Gérôme's *Phryne Before the Areopagus*, sit in a semicircle gaping at Phryne's exposed body. Gérôme paints both spectacle and spectators and implicates the viewer by placing him within the crowd of lecherous judges. In contrast, Muybridge's "instantaneous photographs" have no

¹⁵ John Ott, *Manufacturing the Modern Patron in Victorian California: Cultural Philanthropy, Industrial Capital, and Social Authority* (Burlington: Ashgate, 2014).

analogue in perceptual experience. Captured in a fraction of a second with high-speed lenses, they reveal bodily positions normally inaccessible to the human eye. As one contemporary commentator wrote, in Muybridge's photographs "we have the naked, absolute fact: here, for the first time, human eyes may see just how the human body moves in the performance of its functions." "Woman Disrobing Another" therefore both evokes a painting that is fundamentally concerned with the act of looking, and challenges the authority and adequacy of vision. Muybridge's images give the viewer access to sights that Phryne's judges could never see, no matter how hard or long they stared. There is also a more obvious visual joke at the center of Muybridge's sequence. In recreating Gérôme's painting, Muybridge contrasts Phryne's perfect, painted beauty against his model's all-too-real, flesh-and-blood body. By extension, he plays with the limits and identities of the two media, opposing painting's power to idealize its subjects against photography's capacity for capturing only "the naked, absolute fact."

But the interplay between these two works is even more nuanced. Viewed alongside Gérôme's painting, Muybridge's photographic sequence seems to collapse inward in an endless *mise en abyme*. For the action captured in these photographs also reenacts the mechanism of their creation. In other words, the sequence figures Phryne's exposure as a photographic exposure, an analogy only strengthened by the fact that Muybridge's shutter—or "electro-photographic exposor [sic]"—was in fact a sheet of black rubber, or as Muybridge terms it, an "endless curtain," that was drawn rapidly in front of the lenses.¹⁶ And it then follows that Phryne's body is itself akin to a

¹⁶ Muybridge describes this mechanism in Eadweard Muybridge, *Descriptive Zoopraxography, or the Science of Animal Locomotion Made Popular* (Chicago: The Lakeside Press, 1893), 15-17. He writes that within the "electro-photographic exposor...is a continuous band of thin rubber cloth impervious to light the edges of which are bound with strong tape, and arranged to run in a groove, and over two rollers...which

photographic plate, a surface that is nakedly, absolutely and self-evidently truthful.

Muybridge's sequence therefore poses a series of comparisons and oppositions—between Muybridge's lightening-fast cameras and human eyes blinded by physiological limitations or bias; between the different representational capabilities of photography and painting; and, finally, between Muybridge's objective and unmediated “instantaneous photographs” and the body as a medium, a legible signifier of the inner workings of the mind and moral character.

This study explores the reciprocal influence of Muybridge's photographic motion studies from *Animal Locomotion* and the intellectual and artistic concerns of the knowledge community in and around the University of Pennsylvania. As I will show, the artists and scientists who collaborated with Muybridge influenced the direction and objects of his investigations. However, they also addressed the very same epistemological questions raised by Muybridge's project in their own practices. They incorporated the motion studies into their researches and used Muybridge's photographs to help them think through the complex relationships between visual technologies, perception, and the mind that are dramatized so succinctly in Muybridge's “Woman disrobing another” sequence. Often, as in *Animal Locomotion*, these epistemological considerations intersected with studies of the human body and were informed by medical and social understandings of gender. More broadly, this study reassesses how users and viewers of

are attached to a frame. In this endless band are two apertures...of suitable size, and so arranged that their full openings as they pass each other shall simultaneously take place in front of the center of the lens...To prepare a series of photographic exposures...the front of the endless curtain is drawn rapidly downward; the apertures meet in the center of the lens, form a gradually expanding and then contracting diaphragm, and the exposure is made.” William Denis Marks provides a similar description in “The Mechanism of Instantaneous Photography,” in *Animal Locomotion: The Muybridge Work at the University of Pennsylvania. The Method and the Result* (Philadelphia: J.B. Lippincott Company, 1888), 18-20.

photographs negotiated the limits and identity of the medium in the late nineteenth century.

Chapter 1 provides a brief overview of Muybridge's life and career before he arrived at the University of Pennsylvania in 1883. It also establishes the broad intellectual terrain of this study, focusing on the rise of the modern university and the professionalization and institutionalization of the sciences, and how these changes both shaped and responded to epistemological changes in American science and medicine.

Chapter 2 contends that Muybridge's photographs both exemplified a specific ideal of trained and unbiased vision that by the late 1880s had become closely associated with the modern scientific enterprise and, importantly, the newly conceived figure of the professional scientist. To do so, I examine how this ideal of vision was characterized through scientists' responses to three controversial topics: the "Classics question," which pitted scientists against classicists, modern spiritualism, and, finally, Muybridge's *Animal Locomotion*. As I demonstrate, these debates encompassed epistemological questions about the scope of knowledge and the best methods for obtaining it, as well as disciplinary questions about which academic fields were most important in and to the modern world. While I examine how the terms of these debates were established nationally, I focus on how Muybridge's scientific collaborators used the motion studies in particular and optical technologies in general as analogues for the visual skill and acuity that, they claimed, defined their professional identities and their practices.

Chapter 3 argues that Muybridge's studies reflect and were informed by a late nineteenth-century discourse of manliness that shaped not only the identities of white, middle- and upper-class men, but also their bodies. In the 1880s, masculinity, which had

previously been defined as an inner virtue, was redefined as external and legible: bulging muscles evidenced the moral fortitude and strength of character that had created them. This ideal of masculinity was inculcated in new homosocial spaces and through the new viewing practices these spaces encouraged and structured. Furthermore, as the gymnasium and the playing field made the male body into a spectacle, texts devoted to physical culture naturalized the close scrutiny of the body. I focus on the development of the University of Pennsylvania's Department of Physical Education, which was established during Muybridge's tenure, and its adoption of anthropometry to make the male body fully visible and quantifiable. I explore how Muybridge's photographs, which borrow the tools of anthropometric photography, were incorporated into this visual economy, participate in the discourse of embodied masculinity, and express the ambiguities and contradictions about gender, race and class that existed within this discourse.

Like chapter 3, chapter 4 focuses on the intersection of photography and the body by analyzing the semiotic status of the blur in relation to Muybridge's studies of subjects with movement disorders and within the larger context of photographically illustrated medical texts, many of which were written by doctors who collaborated with Muybridge. I argue that these physicians attempted to make the tremors and spasms of medical subjects legible with and in still photographs by using the artifact of the blur as a symbol for pathological locomotion. These photographs often accompanied another form of graphic evidence of the patients' underlying pathology: examples of "blurred" handwriting. As I argue, in the late nineteenth century locomotion was closely connected to self-representation. While every normal movement was considered an index of the

self's essential character, abnormal movements were thought to be unwilling and therefore nonrepresentational. Movement disorders therefore disrupted the body's ability to signify. The patient's very failure to imprint a clear likeness on the photographic plate was thus proof of his pathology. These studies, then, presented the camera as a tool for testing and diagnosing the "disordered" body.

As a brief epilogue and conclusion, I explore how these Muybridge's motion studies shaped and challenged the thought of two practitioners in the emergent field of experimental psychology, Sir Francis Galton and James McKeen Cattell. The ways in which respected scientists like Galton and Cattell struggled with the implications of Muybridge's project points to its larger influence on visual culture and modern thought and a reordering of photography's relationship to the objective "reality" it was presumed to capture.

Chapter 1

Eadweard Muybridge and the University of Pennsylvania

In 1872, Leland Stanford, the former governor of California and president of the Central Pacific Railroad, hired the photographer Eadweard Muybridge to answer a seemingly irresolvable question: whether, when a horse gallops at full speed, there is an instant when all four hooves leave the ground.¹⁷ This commission marked a turning point in Muybridge's career. Born Edward Muggeridge in 1830, Muybridge emigrated from England to New York in 1850. He worked as a book dealer and purchasing agent before relocating himself and his business to San Francisco five years later. After a near-fatal stagecoach accident in 1860, he left the States to recuperate in Europe, returning to San Francisco in 1867 with a new name—Eadweard Muybridge, appropriated from a Saxon king—and a new profession: “artist-photographer.”¹⁸

Shortly thereafter, Muybridge adopted “Helios” as his nom-de-camera and established his reputation as a photographer of the California landscape. His first views of

¹⁷ As Philip Prodger notes, the story that Stanford hired Muybridge to solve a bet about “unsupported transit” is probably apocryphal. Phillip Prodger, *Time Stands Still: Muybridge and the Instantaneous Photography Movement* (New York: The Iris & B. Gerald Cantor Center for Visual Arts at Stanford University in association with Oxford University Press, 2003), 11. The best account of Muybridge's work with Stanford is Anita Ventura Mozley, *Eadweard Muybridge: The Stanford years, 1872-1882* (Stanford: Stanford University Department of Art and Architecture, 1972).

¹⁸ Anita Ventura Mozley, “Introduction to the Dover Edition,” in *Muybridge's Complete Human and Animal Locomotion*, vol. 1 (New York: Dover, 1979), viii. The best bibliographic accounts of Muybridge's life and career are Philip Brookman, “Helios: Eadweard Muybridge in a Time of Change,” in *Helios: Eadweard Muybridge in a Time of Change*, ed. Philip Brookman (Göttingen: Steidl/Washington: Corcoran Gallery of Art, 2010), 23-109; Marta Braun, *Eadweard Muybridge* (London: Reaktion Books, 2010); Brian Clegg, *The Man Who Stopped Time: The Illuminating Story of Eadweard Muybridge—Pioneer Photographer, Father of the Motion Picture, Murdered* (Washington: Joseph Henry Press, 2007); Rebecca Solnit, *River of Shadows: Eadweard Muybridge and the Technological Wild West* (New York: Viking Press, 2003); Robert Bartlett Haas, *Muybridge: Man in Motion* (Berkeley: University of California Press, 1976); Gordon Hendricks, *Eadweard Muybridge: The Father of the Motion Picture* (New York: Grossman Publishers, 1975). The psychologist Arthur Shimamura has argued that Muybridge sustained an injury to the anterior part of his brain's frontal lobe, an injury which could account for the erratic behavior Muybridge displayed upon his return to the United States, as well as his obsessive recording of animal movements. Arthur Shimamura, “Muybridge in Motion: Travels in Art, Emotion, and Neurology,” *History of Photography* 26 no. 4 (Winter 2002), 341-350.

Yosemite were taken in 1867 and included the following year in *Yosemite: its Wonders and its Beauties*, a guidebook to the Yosemite Valley published by John S. Hittell.¹⁹ In 1872, Muybridge ventured into Yosemite again, this time with a mammoth plate camera instead of the half-plate view camera and stereo cameras he had used on his previous trip.²⁰ The resulting landscapes picture the Yosemite Valley as an unexplored and dramatic terrain. As in “Valley of the Yosemite, from Rocky Ford,” Muybridge often juxtaposes the sublime landscape in the distance with a clutter of debris and natural detail in the foreground, a composition that, in stereo views, heightened the effect of depth (Figure 4).²¹ “Pi-Wi-Ack (Shower of Stars),” which Muybridge captures from a vertiginous, death-defying vantage point, evidences his fascination with natural processes that cannot quite be stilled by the camera—waterfalls and shimmering water are reoccurring subjects (Figure 5).

Muybridge’s singular artistic vision was matched by his unparalleled technical mastery of the medium. It was likely this aspect of Muybridge’s photographic practice that attracted Stanford’s attention. Initially, Muybridge attempted to photograph Stanford’s trotters with spring-mounted, hand-released shutters.²² While none of these early photographs survive, in recounting the story of his experiments with Stanford, Muybridge himself reported that he initially succeeded in producing only “a shadowy and

¹⁹ John S. Hittell, *Yosemite: Its Wonders and its Beauties* (San Francisco: H.H. Bancroft, 1868).

²⁰ Robert Bartlett Haas, “Muybridge and the Yosemite Valley,” in Robert Bartlett Haas and Joel Snyder, *Yosemite Photographs, 1872* (Chicago: Chicago Albumen Works, 1977); Mary V. Jessup Hood and Robert Bartlett Haas, “Edward Muybridge’s Yosemite Valley Photographs, 1867-1872,” *California Historical Society Quarterly* 42 (March 1963), 5-26.

²¹ Richard M. Masteller, “Western Views in Eastern Parlors: The Contribution of the Stereograph Photographer to the Conquest of the West,” *Prospects* 6 (1981), 61-66. For discussions of this compositional device, see Jonathan Crary, *Techniques of the Observer*, 125; Rosalind Krauss, “Photography’s Discursive Spaces,” *Art Journal* 42 no. 4 (Winter 1982), 314.

²² Clegg, *The Man Who Stopped Time*, 124-125.

indistinct picture of Occident at a trot.”²³ Indeed, the “automatic electro-photograph” Muybridge published in 1877 is not truly a photograph, but a re-photographed collage combining a gouache and watercolor painting of Occident with a photograph of the rider’s head grafted onto his painted body.²⁴ Muybridge photographed Stanford’s horses intermittently for five years with little success, interrupting this work with extended trips to Northeastern California, where he photographed the Modoc War for the U.S. War Department in 1873, and, in 1875, to Central America to document coastal villages and coffee plantations for the Pacific Mail Steamship Company.²⁵

With the help of new “fast” Dallmeyer stereo lenses and an electrical shutter release mechanism, Muybridge finally succeeded in capturing serial photographs of the horse in motion in 1878. For these experiments, Muybridge used a series of wires strung underneath the track. When carriage wheels rolled across the wires, they tripped the shutters of Muybridge’s twelve cameras in succession. For unencumbered horses, Muybridge strung threads across the track, each of which would release a different shutter as the horse broke them one after the other.²⁶ The results of these experiments were published as a set of six cabinet cards titled *The Horse in Motion*.²⁷ One of the

²³ Eadweard Muybridge, “Leland Stanford’s Gift to Art and Science, Mr. Muybridge’s Invention of Instant Photography and the Marvelous Zoögyroscope,” *San Francisco Examiner*, 6 February 1881, reprinted in Mozley, *Eadweard Muybridge: The Stanford years*, 121.

²⁴ Prodger, *Time Stands Still*, 143-147. Prodger points out that Muybridge labeled this image an “Automatic Electro-Photograph” despite the fact that he, according to the photographer and other sources, was not yet using cameras with electric lenses. He suggests that Muybridge may already have been experimenting with electric shutters when the photograph was published in July of 1877, or that the prefix “electro” may have simply connoted speed and was not meant to be taken literally.

²⁵ Peter Palmquist, “Photographing the Modoc Indian War: Louis Heller versus Eadweard Muybridge,” *History of Photography* 2, no. 3 (July 1978), 187-205; E. Bradford Burns, *Eadweard Muybridge in Guatemala, 1875: The Photographer as Social Recorder* (Berkeley: University of California Press, 1986). For a brief discussion of Muybridge’s Guatemala photographs in relation to the Stanford motion studies see Crary, *Suspensions of Perception*, 138-144.

²⁶ See Prodger, *Time Stands Still*, 65-73 for an overview of the sequence of technical changes that lead to Muybridge’s final apparatus.

²⁷ Included in the set was the previously-published “automatic electro-photograph” of Occident.

earliest sequences, “Abe Edgington Trotting at a 2:24 Gait,” was taken before a crowd of journalists who had been invited by Muybridge and Stanford to witness their photographic feats (Figure 7). The series consists of three rows of four images. The carriage, horse and rider are centered in each frame and silhouetted against the backdrop, which is subdivided with equally spaced, vertical lines and marked off with sequential numbers. Although each image captures the horse in a different position, it is difficult to synthesize the sequence into motion. Instead, the reader charts the horse’s horizontal propulsion through the backdrop’s numerical progression. Muybridge appends the following information below the photographs:

The negatives of these photographs were made at intervals of about the twenty-fifth part of a second of time and twenty-one inches of distance; the exposure of each was about the two-thousandth part of a second, and illustrate one single stride of the horse. The vertical lines were placed twenty-one inches apart; the lowest horizontal line represents the level of the track, the others elevations of four, eight and twelve inches respectively. The negatives are entirely untouched.

If his repeated use of the modifier “about” makes his commitment to precision questionable, this statement at the very least indicates that Muybridge was, even at this early date, fully aware of the power of numbers and measurements to signify scientific rigor and accuracy. In these photographs, Muybridge has striped away the clutter of detail and dramatic points of view that characterized his Yosemite landscapes. However, the motion studies also have a radically different relationship to perception: while Muybridge’s landscapes brought unknown sites and dizzying perspectives before the eyes of viewers, his motion studies made phenomena beneath the threshold of perception visible for the first time.

With these first successful motion studies, what began as the answer to Stanford’s single question quickly evolved into an obsession. Muybridge completed his work with

Stanford in 1881 and published the results of their collaboration under the title *Attitudes of Animals in Motion*.²⁸ To publicize his work and, presumably, to secure funding for future investigations, Muybridge left for Europe to present a series of lectures in London and Paris. To illustrate these lectures, Muybridge projected both his own photographs and lantern slides of celebrated paintings and statues of horses, ranging from Marcus Aurelius on horseback to Rosa Bonheur's *The Horse Fair*.²⁹ He used this comparative methodology to point out the inaccuracies of conventional artistic representations of the horse in motion. But to prove the authenticity of his own photographs, Muybridge used a machine of his own invention that he called the zoöpraxiscope—an “animal motion viewer.” The zoöpraxiscope was an early ancestor of the film projector. A disc with hand-colored photographs circling the periphery was mounted behind a slotted shutter that rotated once every second (Figure 8). Behind the zoöpraxiscope was set a bright light that projected the photographs in rapid succession, giving the impression of movement.³⁰ As I will discuss later, the zoöpraxiscope was a fundamental component of Muybridge's project: by spinning the instantaneous photographs back into motion, the zoöpraxiscope incontrovertibly verified that each image was factual.³¹

²⁸ Eadweard Muybridge, *The Attitudes of Animals in Motion: A Series of Photographs Illustrating the Consecutive Positions Assumed by Animals in Performing Various Movements*, 1881. This work was handmade and self-published.

²⁹ Eadweard Muybridge, “The Attitudes of Animals in Motion,” *Journal of the Society for Arts* 30, no. 1544 (June 23, 1882), 838.

³⁰ For a full description of the mechanics of Muybridge's zoöpraxiscope, see Prodger, *Time Stands Still*, 154-61; Clegg, *The Man Who Stopped Time*, 149-154. Muybridge's first zoöpraxiscope demonstration occurred nearly six years after his experiments with Stanford began. Yet, photo-historian and Muybridge scholar Anita Ventura Mozley has speculated that Muybridge may have initially decided to use a battery of twelve cameras because the zoöetrope, the early nineteenth-century “philosophical toy” that served as the model for Muybridge's zoöpraxiscope, typically employed strips with twelve images.

³¹ Anita Ventura Mozley has speculated that Muybridge may have initially decided to use a battery of twelve cameras because the zoöetrope, the early nineteenth-century “philosophical toy” that served as the model for Muybridge's zoöpraxiscope, typically employed strips with twelve images. Mozley, *Eadweard Muybridge: The Stanford years*, 72.

Although Muybridge's zoöpraxiscope had awed many of Europe's most eminent scientists and artists, he failed to find a patron for the "future and more exhaustive experiments" that he described at the end of each lecture.³² Stanford and J.D.B. Stillman's 1882 publication *The Horse in Motion*, which barely mentioned Muybridge, had further stymied his search for a European benefactor.³³ Muybridge thus left Europe to continue his tour in the United States, where he addressed audiences in New York, Boston, and Newport. This final lecture was attended by Fairman Rogers, a former Professor of Civil engineering at the University of Pennsylvania and member of its board of trustees. Rogers's true passions, however, were horses—in particular, coaching—and art. As the chairman of the Pennsylvania Academy of Fine Arts' Committee on Instruction, Rogers had influenced the Academy to appoint Thomas Eakins as its Director that spring. Rogers was also an amateur photographer who, several years before Muybridge's Palo Alto experiments, had attempted to photograph his trotters with a rapid shutter of his own design.³⁴ Muybridge's work, therefore, fell at the precise intersection of Rogers' vocational and avocational interests—a convergence that also informed the style and content of "A May Morning in the Park (The Fairman Rogers Four-in-Hand)," which Rogers commissioned Eakins to paint in 1879 (Figure 9).³⁵ Eakins and Muybridge had struck up a correspondence soon before Eakins began this commission; a surviving

³² Quoted in Mozley, "Introduction to the Dover Edition," xxiv.

³³ J. D. B. Stillman, *The Horse in Motion as Shown by Instantaneous Photography, With a Study on Animal Mechanics Founded on Anatomy and the Revelations of the Camera in which is Demonstrated the Theory of Quadrupedal Locomotion* (Boston: J.R. Osgood and Company, 1882).

³⁴ Anne McCauley provides a succinct biographical sketch of Rogers in "'The Most Beautiful of Nature's Works': Thomas Eakins's Photographic Nudes in their French and American Contexts," in Susan Danly and Cheryl Leibold, eds., *Eakins and the Photograph: Works by Thomas Eakins and his Circle in the Collection of the Pennsylvania Academy of the Fine Arts* (Washington: Published for the Pennsylvania Academy of the Fine Arts by the Smithsonian Institution, 1994), 36-38.

³⁵ Foster, *Thomas Eakins Rediscovered*, 151-162; Gordon Hendricks, "A May Morning in the Park," *Philadelphia Museum of Art Bulletin* 60, no. 285 (Spring 1965), 48-64.

letter from Muybridge suggests that Muybridge and Rogers were also in communication during this period.³⁶ Rogers also praised Muybridge's photographs in a July 9, 1879 article published in *Art Exchange*.³⁷

In February of 1883, Rogers invited Muybridge to give a series of four lectures in Philadelphia at the Academy of Fine Arts, the Franklin Institute, and the Academy of Music. Through these lectures, Muybridge introduced Philadelphia's scientific and artistic communities to "The Attitudes of Animals in Motion." Rogers must have also introduced Muybridge to members of Philadelphia's intellectual and cultural elite. Perhaps sensing that he had finally found an amenable institutional patron, Muybridge produced a prospectus for "a new and elaborate work upon the attitudes of man, the horse and other animals in motion" in March. According to this prospectus, the work would be produced in conjunction with the French academic painter Meissonier. It would include not only Muybridge's photographs, but also "photographs of actors performing their respective parts" and "works of art from the Museums, Picture Galleries and Libraries of Europe"—presumably to illustrate depictions of movement that Muybridge's photographs had proved incorrect. Marey and the art critic Walter Armstrong would contribute essays on "Zoopraxiology, or The Science of Animal Mechanism" and "Movement in the Plastic Arts" respectively.³⁸

Impressed by either his Philadelphia lectures or his promised affiliation with such an august collection of Europeans, a group of wealthy Philadelphia investors soon agreed to sponsor Muybridge's "new and elaborate work." On August 7, 1883, they met with Dr.

³⁶ Hendricks, *Eadweard Muybridge*, 113-114.

³⁷ This article was reprinted in *Scientific American Supplement* the following month. Fairman Rogers, "The Zootrope: Action of Animals in Motion," *Scientific American Supplement* 7 no. 188 (August 9, 1879), 2991; cited in Hendricks, *Eadweard Muybridge*, 114.

³⁸ Eadweard Muybridge, *Prospectus of a New and Elaborate Work*, [unpaginated].

William Pepper, Provost of the University, and resolved to allow Muybridge to use the veterinary grounds “for the prosecution of his work on the investigation of animal motion.”³⁹ They also agreed to the following stipulations: that Muybridge’s investigation would be completed in the spring and summer of 1884; that the University’s advance of \$5,000 was to be returned through subscriptions secured before his investigations were published; and that the work was to be made and published “under the auspices of the University of Pennsylvania.”⁴⁰ Of these conditions, only the last was met; Muybridge’s investigations would run more than a year over schedule and nearly \$40,000 over budget.⁴¹

The University also appointed a commission to oversee his work. Of the nine members of the Muybridge Commission, seven were members of the university faculty. William Pepper was joined by Joseph Leidy, Professor of Anatomy, George F. Barker, Professor of Physics, Rush Shippen Huidekoper, Professor of Veterinary Anatomy and Pathology, William D. Marks, Whitney Professor of Dynamical Engineering, Harrison Allen, Emeritus Professor of Physiology, and Lewis M. Haupt, Professor of Civil Engineering. Thomas Eakins and Edward D. Coates, who had recently succeeded Rogers as the Chairman of the Pennsylvania Academy’s Instructional Committee, were also appointed to the Commission. The “Muybridge Commission” met for the first time the

³⁹ Quoted in Hendricks, *Eadweard Muybridge*, 154.

⁴⁰ These are the conditions that Muybridge lists in his response to the letter Pepper set outlining the University’s terms (now lost). Eadweard Muybridge to William Pepper, September 3, 1883. William Pepper Papers, vol. 2, 348-350, Kislack Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania.

⁴¹ Funding for the motion studies came from a patchwork of sources, including Pepper, J.B. Lippincott, Samuel Dickson and Charles C. Harrison. Lippincott donated money for Muybridge’s original lenses, Harrison supplied further funds for another set of improved lenses, Dickson partially funded the publication, and Pepper compensated the University and the other guarantors after *Animal Locomotion* failed to recoup its costs.

following month—the only meeting on record.⁴² While there is little evidence that the Muybridge Commission members supervised his work in any official capacity, as the following chapters explore, Muybridge's photographic investigations were a collaborative project: as the artists and scientists who worked with Muybridge influenced the methods and objects of Muybridge's work, so too did the motion studies shape and challenge their own researches.

But Muybridge was also working at the behest of the university, which had its own agenda for Muybridge's work and placed its own demands on his project. To understand why the University of Pennsylvania sponsored Muybridge's motion studies, his investigations must be situated within the larger context of the rise of the modern university system in the nineteenth century. Nine colleges had been chartered in the United States before the Revolutionary War. By 1860 this number had risen to 467.⁴³ Despite this proliferation, the curricula and institutional orientation of both new and old colleges remained virtually unchanged. Courses were limited to classical languages, mathematics, moral philosophy and rhetoric, while memorization, recitation and Greek and Latin composition remained the primary pedagogical cornerstones.⁴⁴ These colleges, which attracted students only from the surrounding regions, existed side by side with independent training schools that prepared students for the law, medicine and other professions.⁴⁵

⁴² Edward Coates to Jesse Burke, November 26, 188[], UPT 50 M993, Box 62 Folder 6, Eadweard Muybridge Collection, 1870-1981, University Archives and Records Center, University of Pennsylvania.

⁴³ Michael David Cohen, *Reconstructing the Campus: Higher Education and the American Civil War* (Charlottesville: University of Virginia Press, 2012), 38.

⁴⁴ Cohen, *Reconstructing the Campus*, 98.

⁴⁵ Jon H. Roberts and James Turner, *The Sacred and the Secular University* (Princeton: Princeton University Press, 2000), 5.

Historians agree that, after the Civil War, universities experienced widespread changes in organization, curriculum, and institutional ideals, and, moreover, that the primary impetus for this revolution was science.⁴⁶ Reformers argued that the classical college, with its close association with Protestantism, grounding in the classical languages, and emphasis on mental discipline, instilled a slavish devotion to tradition at the cost of preparing students to meet the challenges of the modern world. After the Civil War, “which both disrupted the research activities of scientists and drew attention to the importance of scientific expertise,” the perceived inferiority of American scientific education and the conservatism of American scientists took on a new urgency.⁴⁷ In an 1868 letter to Silas Weir Mitchell, Louis Agassiz, the Harvard naturalist and geologist, described the state of scientific practice in the United States. Agassiz attributed Mitchell’s recent failure to secure the Chair of Physiology at Jefferson Medical College to the “deep struggle...going on in scientific circles among us.” Scientific practitioners, he explains, belong to one of two camps: those “whose attainments are chiefly based upon the study of books and whose chief claim to success lies in their familiarity with what others have done to advance science to its present condition,” and those who “by original independent research contribute to the advancement of science” and “upon whose effort in reality rests the progress of knowledge.” According to Agassiz, although

⁴⁶ Works that express this general viewpoint include: Andrew Jewett, *Science, Democracy and the American University: From the Civil War to the Cold War* (New York: Cambridge University Press, 2012); Cohen, *Reconstructing the Campus*; Julie A. Reuben. *The Making of the Modern University: Intellectual Transformation and the Marginalization of Morality* (Chicago: University of Chicago Press, 1996); Burton J. Bledstein. *The Culture of Professionalism: The Middle Class and the Development of Higher Education in America* (New York: W.W. Norton, 1976); Robert V. Bruce. *The Launching of American Science, 1846-1876* (New York: Knopf, 1987).

⁴⁷ Reuben, *The Making of the Modern University*, 29.

the first group far outnumbered the second, only the labors of original investigators like Mitchell could place the United States “on a level with the most progressive nations.”⁴⁸

Foremost among the “most progressive nations” was Germany. As Agassiz was bemoaning the sad state of American science, reformers began to look to the German system of higher education as an aspirational model. With its focus on graduate and professorial research and dedication to pure rather than applied sciences, the German university epitomized “the ideal of pure learning, the disinterested pursuit of truth, knowledge for its own sake.”⁴⁹ Because opportunities for post-graduate work were limited in the United States, in the 1860s and 1870s, many Americans went abroad for advanced training in Germany. In the following decades, these newly-minted PhDs imported the German university model to the United States; Johns Hopkins University, founded in 1876 as an explicitly science-based institution devoted to post-graduate and professorial research, is the paradigmatic—but by no means the only—example.⁵⁰ During this period universities both old and new restructured their schools and curricula by incorporating existing professional schools or founding new scientific schools and departments. Long relegated to a subordinate position, the sciences now assumed a prominent place in the curriculum.⁵¹ Moreover, a scientific education would be grounded in original research, rather than in the memorization and recitation of facts and theorems;

⁴⁸ Reprinted in Anna Robeson Burr, *Weir Mitchell, His Life and Letters* (New York: Duffield and Company, 1929), 119.

⁴⁹ Lenore O’Boyle. “Learning for Its Own Sake: The German University as Nineteenth-Century Model,” *Comparative Studies in Society and History* 25, no. 1 (Jan., 1983), 3. For 19th century opinions, see Josiah Royce, “Present Ideals of American University Life,” *Scribner’s Magazine* 10 (September 1891); John W. Burgess, *The American University. When Shall It Be? Where Shall It Be? What Shall It Be? An Essay* (Boston: Ginn, Heath and Company, 1884).

⁵⁰ For a short history of the founding of Johns Hopkins University, see John S. Brubacher and Willis Rudy, *Higher Education in Transition: a History of American Colleges and Universities* (New Brunswick: Transaction Publishers, 2004), 178-182.

⁵¹ Laurence Veysey, *The Emergence of the American University* (Chicago: University of Chicago Press, 1965), 142-143.

“students were encouraged to engage in research projects and were taught not to accept findings on authority, but to question them and seek new evidence.”⁵² American universities also began to inaugurate programs of graduate study culminating in the PhD. Awarded only for the discovery of new knowledge rather than the recapitulation of old, the PhD was both symbol and symptom of this reformist zeal and new commitment to research.

But this reconceptualization of the goals and means of education also reflected larger debates about the nature of scientific inquiry. Since the eighteenth century, American scientists had closely identified scientific method with the taxonomical organization of and induction from empirical facts. This Baconian model comprised three related ideas: “a strenuously empiricist approach to all forms of knowledge, a declared greed for the objective fact, and a corresponding distrust of ‘hypothesis’ or imagination and indeed of reason itself.”⁵³ The American conception of Baconianism was derived from Thomas Reid and his fellow philosophers of the Scottish School of Common Sense Realism. Reid’s epistemological system posited that our minds make direct connections to the world around us, without intermediate objects such as ideas (which, for instance, in Locke’s theory of perception, are representations that stand between the mind and the material world). Because of this direct line between mind and nature, Reid believed, “the evidence of sense is a kind of evidence which we may securely rest upon.”⁵⁴ American Baconianism therefore had little to do with Bacon’s *Novum Organum*. Rather, it stood for an adaptable collection of ideas about and attitudes towards knowledge. For the

⁵² Fritz Machlup, *Knowledge: its Creation, Distribution and Economic Significance*, vol. II (Princeton: Princeton University Press, 1982), 142.

⁵³ Theodore Dwight Bozeman, *Protestants in as Age of Science: The Baconian Ideal and Antebellum American Religious Thought* (Chapel Hill: University of North Carolina Press, 1977), 3.

⁵⁴ Quoted in Bozeman, *Protestants in as Age of Science*, 11.

antebellum scientific community, this common-sense-inspired epistemology seemed to limit the proper sphere of scientific knowledge to observable phenomena. That Baconianism remained largely unchallenged for so long is partly due to the dominance of what the physicist Ernest Rutherford would later dismiss as the “stamp collecting” fields—botany, in particular, was the favorite American science well into the nineteenth century.⁵⁵

However, by mid-century new areas of investigation—especially the “imponderable” forces of electricity and magnetism—had made the inadequacies of Baconian induction clear. Charles Darwin’s evolutionary theories, which seemed to contradict Baconianism’s proscription of hypothesis and theorizing, further ignited debates about the nature and boundaries of scientific inquiry. Darwin’s American critics warned that he was ‘investigating nature, not in the interests of science properly so-called, but, consciously or unconsciously, to find facts to fit a hypothesis.’ If Darwin’s theories gained general acceptance, one critic worried, “our own Baconian mode of viewing nature will be quite reversed.”⁵⁶ American scientists who defended Darwinism, however, “affirmed that hypothesis and theories were essential to science and that progress in science involved discrediting old ideas and formulating new theories.”⁵⁷ By the mid-1880s, this new model of scientific method had largely replaced the older Baconian model. The majority of American experimenters believed that science progressed through hypothesis, experimental testing, and verification rather than the

⁵⁵ For botany’s popularity, see Elizabeth B. Keeney, *The Botanizers: Amateur Scientists in Nineteenth Century America* (Chapel Hill: University of North Carolina Press, 1992). The dominance of Baconian thought in the first half of the nineteenth century is greatly contested among historians of American science. While some critics argue that Baconianism was so ill-defined as to be meaningless, others question whether the majority of scientists ascribed to it. However, the majority of scholars allow for a general trajectory from “common sense” to “specialized knowledge” over the course of the nineteenth century.

⁵⁶ Quoted in Thurs, *Science Talk*, 75.

⁵⁷ Reuben, *The Making of the Modern University*, 36.

accumulation and organization of empirical facts. When William James wrote in 1896 that the Baconian scientist might as well expect “a weather table to sum itself up into a prediction of probabilities, of its own accord” he was echoing the majority opinion.⁵⁸

At the same time, this methodological shift both paralleled and propelled the institutionalization and professionalization of the sciences in the last third of the nineteenth century. As Burton Bledsoe has observed, “Americans after 1870 committed themselves to a culture of professionalism.”⁵⁹ Baconianism implied a democratic vision of science. The common sense theory of science “described all minds as essentially alike, and thus insisted that every mind would reach the same conclusions from a given body of experimental evidence.”⁶⁰ Because anyone would make the same induction from the same evidence, anyone could, in effect, be a scientist. However, the new model of experimental science worked hand in hand with processes of professionalization and institutionalization to radically restrict who could participate in the scientific endeavor. Universities, along with the many museums, scientific institutions and professional associations founded after the Civil War, not only set scientists apart as a professional class, but also defined and delimited the boundaries of scientific research and method by permitting particular kinds of knowledge as “real science” and proscribing others. By the end of the nineteenth century, the “trained specialist—the professional whose sole source

⁵⁸ William James, “Great Men and Their Environment,” in *The Will to Believe and Other Essays in Popular Philosophy* (New York: Longmans, Green and Company, 1897), 249.

⁵⁹ Burton J. Bledstein. *The Culture of Professionalism*, 80. The literature on professionalization is vast; for a concise summary of the historiography, see Paul Lucier, “The Professional and the Scientist in Nineteenth-Century America,” *Isis* 100, no. 4 (December 2009), 699-705.

⁶⁰ Jewett, *Science, Democracy and the American University*, 56.

of support was his scientific employment” had replaced the gentleman amateur—the prototype of the eighteenth-century “man of science.”⁶¹

Within this climate of scientific professionalization, medicine held a tenuous position.

Throughout the first decades of the nineteenth century, “regular” (or university-trained) medical practitioners had campaigned for new licensing legislation that would limit the practice of medicine to physicians who had received a University medical education, thereby closing the ranks of the medical profession to both doctors who had been trained through apprenticeships and “irregular” physicians—the “medical sects” of hydropaths, practitioners of eclecticism or Thomsonian medicine (schools which centered on botanical remedies), and homeopaths who populated the antebellum medical landscape. At the same time, the “regular” physicians formed organizations that not only bolstered the prestige of the profession, but also ensured the standardization of medicine.⁶² With the rapid expansion of medical schools in the post-war period, medical knowledge became increasingly institutionalized; while only four medical schools were founded before 1800, by 1877 this number had increased to 81.⁶³ These schools taught a highly invasive form of medicine that consisted of bloodletting, blistering, the administration of

⁶¹ George Daniels, *American Science in the Age of Jackson* (New York: Columbia University Press, 1968), 34. Daniels, one of the first scholars to assay the complex problem of professionalization, sought to explain the process through a four-stage framework, beginning with “preemption,” or the formation of a body of esoteric knowledge accessible only to particular group, and ending with “autonomy,” the establishment of the profession as a self-perpetuating system. See also George H. Daniels, “The Process of Professionalization in American Science: The Emergent Period, 1820-1860,” *Isis* 58 (1967), 151-166.

⁶² William G. Rothstein, *American Physicians in the Nineteenth Century: from Sects to Science* (Baltimore: Johns Hopkins University Press, 1972), 63-84, esp. 72-81 for medical licensing; Paul Starr, *The Social Transformation of American Medicine* (New York: Basic Books, 1982), 30-60.

⁶³ S.E.D Shortt, “Physicians, Science, and Status: Issues in the Professionalization of Anglo-American Medicine in the Nineteenth Century,” *Medical History* 27 (1983), 53.

emetics, and other treatments that “produced demonstrable and consistent physiological changes” but often had detrimental long-term effects.⁶⁴

When coupled with the growing public opposition to “heroic” therapeutics, the movement to institutionalize “regular” medical practice, and attempts to develop a system of medical credentialing only resulted in an increase in the number of and popular approval for “irregular” physicians who defined themselves and their practice in opposition to the “regulars.”⁶⁵ In turn, the “regulars” tightened their ranks, forming the American Medical Association in 1847 “to promote the science and art of medicine and the betterment of public health”—not to mention the “heroic” therapeutics learned in medical schools and practiced by university-trained physicians.⁶⁶ In an 1858 valedictory address Joseph Leidy, who would, nearly 30 years later, be appointed to the Muybridge commission, warned the medical graduates in the audience about the “competition of unscientific pretenders” that they would soon encounter and the “false systems...which hang like parasites upon the regular practice of medicine, including homeopathy, hydropathy, Thomsonianism, eclecticism, mesmerism, and the pseudo-therapeutics of some of the disciples of modern spiritualism.”⁶⁷ The point is not that these mesmerists and spiritualists were any less legitimate—or any less “scientific”—than the “regular” physicians, but that each group defined themselves in opposition to the other. Professionalization was as much a process of disassociation as it was a project of association.

⁶⁴ Rothstein, *American physicians in the Nineteenth Century*, 64.

⁶⁵ Rothstein, *American Physicians in the Nineteenth Century*, 125-146.

⁶⁶ Rothstein, *American Physicians in the Nineteenth Century*, 170-173;

⁶⁷ Joseph Leidy, *Valedictory Address to the Class of Medical Graduates of the University of Pennsylvania, Delivered at the Commencement, March 27, 1858* (Philadelphia: Collins, 1858), 13.

However, this process of professionalization also went hand in hand with epistemological reform. Before the Civil War, many aspiring American physicians left behind the crowded and ill-equipped medical schools common in the United States for the clinics of Paris.⁶⁸ There they were schooled in an anatomo-clinical method founded on the systematic correlation of anatomical signs and symptoms observed at the bedside with organic lesions discovered at autopsy. Throughout the first two-thirds of the century, American physicians had conceived of the body as an interconnected whole and attributed disease to a systemic imbalance (which could be restored through treatments like bloodletting and emetics).⁶⁹ The anatomo-clinical paradigm, however, necessitated a radical reconceptualization of the body as a collection of discrete organs or organ systems, each with its own particular pathologies and corresponding diagnostic and therapeutic methods.⁷⁰ What has come to be known as the Paris Clinical School was characterized by the disciplined and all-seeing “clinical gaze,” which, extended by new technologies like the stethoscope and the microscope, indiscriminately claimed the living and dead body alike as its object of knowledge. As Michel Foucault relates in *The Birth of the Clinic*, the radical empiricism that characterized Parisian clinical medicine represented not simply a teleological or natural progression of medical knowledge, but an epistemic rift that made possible “a scientifically structured discourse about an individual” for the first time.⁷¹

⁶⁸ John Harley Warner has chronicled the rise and fall of French medicine in the United States. John Harley Warner, *Against the Spirit of System: The French Impulse in Nineteenth-Century American Medicine* (Princeton: Princeton University Press, 1998).

⁶⁹ John Harley Warner, *The Therapeutic Perspective: Medical Practice, Knowledge, and Identity in America, 1820-1885* (Princeton: Princeton University Press, 1997), 85-91.

⁷⁰ Starr, *The Social Transformation of American Medicine*, 54-55.

⁷¹ Michel Foucault, *Birth of the Clinic*, trans. Alan M. Sheridan (New York: Routledge, 1973), xv.

Upon their return, these Paris-trained American physicians translated the epistemological and technical innovations of the Paris Clinical School into the loosely defined “cluster of commitments” associated with Baconianism.⁷² Their program to reform American medicine in the years directly before the Civil War was characterized by “animus against speculation and for the empirical pursuit of truth, against rationalistic systems and for knowledge rooted in the collection of observed facts.”⁷³ But, as John Harley Warner explains, “regular” physicians also claimed empiricism—“the direct observation of fact open for all to see, an egalitarian foundation for knowledge not shrouded as a professional mystery”—as the fundamental tenet of medical practice and the hallmark of professional identity because it effectively countered “radical democratic assaults on the orthodox profession and its putative trickery of the public through mystification of medical knowledge.”⁷⁴ Thus, “having undermined the attack on orthodox medicine, regular reformers would go on to use the ideals of empiricism and antirationalism to discredit their irregular competitors, thereby affirming the superiority of regular medicine in ways consonant with American values.”⁷⁵

As this process of professionalization continued after the interruption of the Civil War, specialization, once seen as a dangerous tendency, became the norm. Medical historians have attributed the rise of specialization to the rapid proliferation of medical knowledge in the late nineteenth century, as well as to socio-economic changes in the United States, including urbanization and immigration. Physicians thus turned to “specialism” because the glut of medical knowledge had rendered the body as a gestalt

⁷² Warner, *Against the Spirit of System*, 165-172.

⁷³ Warner, *Against the Spirit of System*, 165.

⁷⁴ Warner, *Against the Spirit of System*, 9.

⁷⁵ Warner, *Against the Spirit of System*, 232.

unknowable.⁷⁶ However, this epistemological shift also coincided with an unprecedented density of urban populations that drove physicians, like workers in other occupations, “to organize markets by gaining the exclusive right to exercise certain skills and to perform certain tasks.”⁷⁷ In this way, specialization and professionalization were, many scholars agree, interdependent processes.

Furthermore, it was the specialists, rather than the generalists, who disavowed the “art” of medicine and instead allied themselves with experimental science. By the 1880s, specialization was closely associated with German medicine, which emphasized laboratory work and microscopical and chemical diagnostic techniques. Although this model had eclipsed the empiricism of the French school, Warner explains that “the kinds of knowledge produced and employed in these two sites, far from being in competition with one another, were mutually reinforcing.” Physicians who proselytized for the German medical model tended to identify it with “a broader ethos characterized by a valuation of precision, exactness, thoroughness, and rigor that drew together rather than polarized the cultures of the laboratory and the clinic.”⁷⁸ The instruments of precision that were the hallmark of German laboratory research were equated with instruments such as the ophthalmoscope that were used at the bedside. As Philadelphia ophthalmologist George M. Gould argued in 1889, the “reproach that medicine has not kept step with the

⁷⁶ George Rosen attributes the rise of specialism to the greater motility afforded by cities, as well as to the expansion of medical knowledge and, in particular, the rise of pathological anatomy and organic localization, as well as the new technologies that developed along with this epistemological reorientation. George Rosen, *The Specialization of Medicine with Particular Reference to Ophthalmology* (New York: Froben Press, 1944). George Weisz has challenged Rosen’s account, arguing that the rise of surgery, rather than organic localization, encouraged specialization, and that, by the 1870s, physicians had collectively come to believe that the most expedient way to both classify large patient populations and observe a statistically significant number of patients was through specialization. George Weisz, “The Emergence of Medical Specialization in the Nineteenth Century,” *Bulletin of the History of Medicine* 77 (2003), 536-575.

⁷⁷ Glenn Gritzer and Arnold Arluke, *The Making of Rehabilitation: A Political Economy of Medical Specialization, 1890-1980* (Berkeley: The University of California, 1985), 7.

⁷⁸ Warner, *Against the Spirit of System*, 334.

general scientific progress of the age” was readily answered by looking not at “the undifferentiated part, called general or internal medicine” but rather at the “the specialties, which have almost reached the limit of possible scientific extension and accuracy.” The growth and advancement of these specialties, Gould concludes, are “proof of that systematization and accuracy which we call scientific.”⁷⁹ However, the accuracy and systematization of German laboratory medicine were incompatible with the empiricism that had defined professional medical practice in America for decades. As advocates of the German model dismissed clinical empiricism as insufficiently exact, the valuation of specialized knowledge gave medical specialization and the experimental laboratory cultural legitimacy. Thus, specialism became both the symbol of scientific medicine and the means for making medicine into a science.

Between the early 1880s and the publication of *Animal Locomotion* in 1887, the University of Pennsylvania experienced many of the institutional and epistemological developments outlined in the previous section. Under Provost Charles Janway Stillé, the sciences, which had long been relegated to a subordinate role and limited to electives in the School of Arts, became more fully incorporated into the curriculum. The Scientific School of the University of Pennsylvania was established in 1872 as the University’s fifth Faculty. The objective of the undergraduate course was to combine a liberal education with technical training. During their first two years, students in the School of Arts and in the School of Science alike studied ancient languages, history and mathematics. In years three and four, students in the scientific course could choose to specialize in a course ranging from analytical and applied chemistry and mineralogy to mechanical

⁷⁹ George M. Gould, “Is Medicine a Science?” *Forum* (December, 1889). 417.

engineering.⁸⁰ In 1873, the first year that the new scientific school accepted students, 45 freshmen enrolled. In comparison, only 16 students matriculated in the school of arts.⁸¹ Although it is tempting to attribute this disparity to the institution's desire to bolster a fledgling program, the fact that the University continued to enroll more science than art students for the next decade suggests a sustained institutional commitment to the sciences. This commitment only increased after a large bequest in 1875 allowed the University to further expand what was now named the Towne Scientific School. In 1883, 91 sciences students were admitted in comparison to 46 freshmen in the school of the arts.⁸²

The establishment of the Towne School paved the way for the large-scale restructuring of University departments and curricula carried out by Dr. William Pepper, who assumed the provostship in 1881. Pepper inherited an institution in dire financial straits. In 1872, Stillé had relocated the University to West Philadelphia and greatly increased its footprint. However, to fund this expansion and the construction of new buildings, the University had mortgaged its real estate holdings and, lacking a stable endowment, had plunged deeper and deeper into debt.⁸³ Despite several sizeable donations, "the debt, in 1880, was about \$450,000 and the future gave promise of its increase."⁸⁴

⁸⁰ University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1872-1873* (Philadelphia: Collins, 1873), 39-40.

⁸¹ University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1872-1873*, 10-13.

⁸² University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1883-1884* (Philadelphia: Collins, 1884), 65.

⁸³ For the University's relocation into West Philadelphia, see Martin Meyerson and Dilys Pegler Winegrad, *Gladly Learn and Gladly Teach: Franklin and His Heirs at the University of Pennsylvania, 1740-1976* (Philadelphia: University of Pennsylvania Press, 1978), 105; Francis Newton Thorpe, *William Pepper, M.D., LL.D* (Philadelphia: J.B. Lippincott Company, 1904), 177.

⁸⁴ Thorpe, *William Pepper*, 169.

Unlike Stillé, Pepper was a life-long Philadelphian. He had received both a Bachelors and a medical degree from the University and was a respected physician and member of the University Faculty. Moreover, Pepper was the scion of a prominent Philadelphia family.⁸⁵ His personal connections to the city's elite proved invaluable. According to the renowned Shakespeare scholar Horace Howard Furness, Pepper knew “the exact location in every rich man's body of the pocket-book nerve—that nerve of the keenest sensibility in the whole system...and how to touch this nerve so as to excite the largest reflex action.”⁸⁶ Pepper began applying pressure to this “pocket-book nerve” even before he assumed office. On the day of his inauguration as Provost Pepper was able to announce that he had received a contribution of \$100,000 for the founding of the Wharton School of Finance and Economy.⁸⁷ Within six months, the publisher J.B. Lippincott donated \$10,000 towards the founding of a Veterinary School, which would also become the site of Muybridge's photographic investigations.⁸⁸ With Henry Seybert's 1883 bequest of \$60,000 for the endowment of a Chair of Philosophy—plus an additional \$20,000 to fund the mandated investigation of spiritualism—the University was well on its way to solvency.

However, Pepper not only filled the University's coffers, but also effectively reoriented the University away from its sole focus on the liberal education of undergraduates. Despite his institution of the Towne School, under Stille's provostship, the University continued to be, in Furness' words, “sedate, conservative, respectable;

⁸⁵ Edward Digby Baltzell, *Philadelphia Gentlemen: The Making of a National Upper Class* (New York: Free Press, 1958), esp. 323-324.

⁸⁶ Horace Howard Furness, “Address at the Commencement Exercises of the University of Pennsylvania,” *University Medical Magazine* 6 (August, 1894), 738.

⁸⁷ Joshua Lawrence Chamberlain. *The University of Pennsylvania: its History, Influence, Equipment and Characteristics*. Vol. 1 (Boston: R. Herndon Company, 1902), 136.

⁸⁸ Chamberlain, *The University of Pennsylvania*, 138.

quiescent in the belief that the methods of education which were wholesome for the fathers must be wholesome and all-sufficient for the sons and grandsons.”⁸⁹ Pepper, in contrast, remade his alma mater in the image of a German research university. One of the first and most important reforms Pepper instituted was the organization of the Department of Philosophy in 1882.⁹⁰ The 1882-1883 University catalog explained that the Department “has recently been organized for the supervision of advanced studies in the several departments of literature and science.”⁹¹ With a faculty composed of professors selected from the other university departments, the Department of Philosophy began granting PhDs in subjects ranging from zoology to intellectual and moral philosophy. In the next five years, the addition of a Biological School and the erection of Biological Hall, which more than doubled the available laboratory space, further strengthened the University’s institutional commitment to both scientific education and original research.⁹² The Provost Report for 1885-1887 clarified that the degree of Doctor of Philosophy “is not given for proficiency in miscellaneous branches or merely for the faithful performance of a prescribed course of study. It is conferred only on the ground of detailed investigation and high attainments in some special department.” The conferral of the degree, the report adds, recognizes that the “candidate is qualified to give advanced instruction in the department which he has chosen as his major subject.”⁹³ The Department of Philosophy therefore fostered not only advanced study, but also a new

⁸⁹ Furness, “Address at the Commencement Exercises of the University of Pennsylvania,” 737.

⁹⁰ Although there had been tentative plans to found a Department of Philosophy under Stillé, the previous provost had little interest in expanding the University to include Graduate education.

⁹¹ University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1882-1883* (Philadelphia: Collins, 1883), 39-40.

⁹² Chamberlain. *The University of Pennsylvania*, 140.

⁹³ University of Pennsylvania, *Annual Report of the Provost of the University of Pennsylvania including Reports of Departments and Abstract of the Treasurer’s Report for the Year ending October 1, 1887* (Philadelphia: Collins Printing House, 1887), 78.

class of professionals who would ensure that scientific knowledge remained within the walls of the University.⁹⁴

At same time, the Medical School of the University of Pennsylvania established new clinical chairs, professorships and lectureships devoted to specific specialties. Under Stille's provostship, the Medical Department had greatly expanded. After its move to West Philadelphia in 1872, the University began construction on its new Medical Hall and University Hospital and established clinical lectureships in ophthalmology, dermatology and laryngology.⁹⁵ Yet, the University did not fully embrace specialization. Even as an 1874 article in the *Philadelphia Medical Times and Register* defended Philadelphia's rightful place as the center of American medical science, it also allowed that "New York is...decidedly ahead of this city in the cultivation as well as in the literature of specialities: this we freely acknowledge; and it seems to us the only danger...of our city losing its medical preeminence."⁹⁶ After Pepper's assumption of the provostship, however, the University, like Philadelphia as a whole, adapted to the climate of specialization. By 1885, six professorships in specialized fields had been established, as well as a host of auxiliary positions devoted to specialties ranging from gynecology to otology.⁹⁷

But in the 1880s the University—and the Philadelphia medical community as a whole—was renowned for one specialty in particular: neurology. In 1875, the University

⁹⁴ See also William Pepper, *The Relation of Undergraduate to Post-Graduate Curricula: an address read before the*

National Educational Association at Saratoga, July 12, 1892 (Philadelphia: Allen, Lane and Scott, 1892).

⁹⁵ University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1871-1872* (Philadelphia: Collins, 1872), 46.

⁹⁶ "The Asserted Decadence of Philadelphia as a Medical Centre," *Medical Times*, November 28, 1874, 134-135.

⁹⁷ University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1884-1885* (Philadelphia: Collins, 1884), 60-61.

of Pennsylvania became one of the first universities in the country to establish a clinical professorship in nervous diseases.⁹⁸ Horatio C Wood, who was a Clinical Lecturer in Nervous Diseases, was promoted to fill the position. As a lecturer, Wood had established the University Hospital's dispensary and clinic for nervous diseases in 1871.⁹⁹ With the appointment of the nerve specialists Charles K. Mills and Francis X. Dercum in 1881 and 1883 respectively, the University's Medical Department became "the strongest neurological center in the country."¹⁰⁰ In addition to the large number of neurologists within the Medical Department and the University Hospital, other medical institutions in and around Philadelphia, including the Philadelphia Polyclinic and the Philadelphia Hospital, also had eminent specialists in nervous diseases on staff.¹⁰¹ The Philadelphia neurological community was close-knit and collaborative, a spirit of collegiality that gave rise to the Philadelphia Neurological Society in 1883. Founded by Mills, Dercum, and Wharton Sinkler, an attending physician in the Philadelphia Orthopaedic Hospital's Infirmary for Nervous Diseases, the society elected Silas Weir Mitchell, arguably the country's most eminent nervous disease specialist, as its first president soon thereafter.¹⁰²

⁹⁸ The University of Pennsylvania was preceded only by Harvard and the Bellevue Hospital Medical School. Christopher G. Goetz and Eric J. Pappert, "Early Professorships in Neurology," *Annals of Neurology* 40 no. 2 (August 1996), 258-63.

⁹⁹ Charles K. Mills, "A History of the Department of Neurology of the Medical School of the University of Pennsylvania," in *Contributions from the Department of Neurology and the Laboratory of Neuropathology for the Years 1911 and 1912*. vol. VI (Philadelphia: University of Pennsylvania, 1912), 2. See also Goetz and Pappert, "Early Professorships in Neurology," 258-261.

¹⁰⁰ Francis G. Gosling, "Neurasthenia in Pennsylvania: a Perspective on the Origins of American Psychotherapy, 1870-1910," *Journal of the History of Medicine and Allied Sciences* 40 no. 2 (Spring 1985), 189.

¹⁰¹ In particular, after the Infirmary for Nervous Diseases was added to the Philadelphia Orthopaedic Hospital in 1870, the hospital attracted several prominent neurologists. Although there was no formal affiliation among these institutions, there was, as Goetz and Pappert explain, a "close working relation" among them. Many members of the medical staff at the Infirmary for Nervous Diseases also maintained clinics or had academic or clinical appointments at the University of Pennsylvania or the Philadelphia Polyclinic.

¹⁰² T.H. Weisenburg, "The Founders and Work of the Philadelphia Neurological Society," *Journal of Nervous and Mental Disease* 42 no. 6 (June 1915), 421.

During this period of institutional expansion, Muybridge's project exemplified the kind of long-term investigation that Pepper believed to be critical to the University's development and success. In the introduction to a volume of essays published as a companion to *Animal Locomotion*, Pepper provides a succinct explanation for "the connection of the University with [Muybridge's] work, and the motives which led its authorities to assume the supervision of it." He explains that the University's functions should not be limited to the teaching of its students. Rather, "researches and original investigations conducted by the mature scholars composing its faculties are an important part of its work, and in a larger conception of its duty should be included the aid which it can extend to investigators engaged in researches too costly or elaborate to be accomplished by private means."¹⁰³

Reflecting upon the history of Muybridge's project in 1896, Pepper clarified—and slightly modified—his reasons for sponsoring Muybridge's project. He wrote, "I undertook the patronage of Muybridge believing that it would promote the general recognition of the University. I believed also that it would lead to an important piece of useful work being done under scientific control." Pepper therefore not only considered Muybridge's photographic investigations an important contribution to science, but also trusted that his project would attract the public's attention to the University. It would also, he hoped, attract donations. Pepper added, "I feel that it may help the university to

¹⁰³ William Pepper, "Note," in William Dennis Marks, Harrison Allen, and Francis X. Dercum, *Animal Locomotion: The Muybridge Work at the University of Pennsylvania. The Method and the Result* (Philadelphia: J.B. Lippincott Company, 1888). 5.

be able to send presentation copies of these plates to important people from whom we seek concessions.”¹⁰⁴

In other words, in sponsoring Muybridge’s project, the University was motivated not only by a selfless desire to contribute a “useful work” to the common weal, but also by the need for good PR. Muybridge’s motion studies played two roles: they were both spectacle and science, both a publicity stunt and a demonstration of the kind of long-term and capital-intensive investigations the University, newly re-fashioned as a center for research, hoped to support in the future.

¹⁰⁴ William Pepper to H. Galbraith Ward, June 15, 1896. William Pepper Papers, vol. 7, 1438-40, Kislack Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania.

Chapter 2

Scientific Sight, Second Sight, and Artistic Sight: *Animal Locomotion* and Contested Vision

In the 1887 University of Pennsylvania Provost Report, William Pepper detailed three long-term productions that had recently been brought to a close. The first was the University-funded Seybert Commission for Investigating Modern Spiritualism, which had, after an inquiry of nearly three years, finally published its preliminary findings. Second, Pepper announced “the successful completion of another interesting investigation”: Muybridge’s photographic analysis of animal movements.¹⁰⁵ Lastly, University students performed the *Acharnians* of Aristophanes to great acclaim in Philadelphia and New York.

How might the relations among these seemingly divergent projects be described or explained? The most obvious answer lies with Pepper himself. A member of both the Seybert and the Muybridge Commissions, as well as the “Joint Committee to Produce a Greek Play,” Pepper was the hub that connected and drove all three projects. As chapter one explained, the structural and curricular developments at the University of Pennsylvania were indicative of a national movement to reform American higher education that, in the last quarter of the nineteenth century, both paralleled and propelled the professionalization of the sciences. Under Pepper’s leadership, the University evolved from a provincial college that provided a Classical education to the sons of Philadelphia’s elite, to a research university with a thriving scientific school and a graduate program that fostered and encouraged original research.

¹⁰⁵ University of Pennsylvania, *Annual Report of the Provost of the University of Pennsylvania* (1887), 7.

The three projects Pepper discussed in his report are emblematic of this institutional expansion and reorientation. The Seybert Commission was formed to fulfill the condition of a sizeable bequest, one of many that made the University's evolution possible. Muybridge's investigations, in turn, exemplified the kind of long-term investigation that, Pepper believed, was critical to the University's development. Finally, the University's explicit motivation for staging the *Acharnians* was to renew students' interest in the classical languages and literature that had, only decades before, formed the foundation of the college curriculum.

This chapter argues that modern spiritualism, Muybridge's motion studies, and the Classics were all sites where a national discussion about the production, control, and dissemination of knowledge was waged. In the 1880s, the "university revolution," the related drive towards scientific professionalization, and the growing cultural capital of the sciences gave new vitality to an old epistemological debate. Questions about the nature and scope of knowledge and the best methods for obtaining it had, of course, been posed and argued in American universities long before the Civil War. Yet, as knowledge was divided between disciplines, and disciplines were institutionalized within academic departments, this debate was reorganized along disciplinary lines. What had once been the stuff of abstract philosophizing had, by the time Muybridge began his photographic investigations, become a dispute over which fields of knowledge were most important in and to the rapidly changing modern world.

This chapter examines how Muybridge's project participated in—and was enlisted into—the larger battle over intellectual territory and authority by considering one side of this contentious and multi-vocal exchange: the burgeoning class of professional

scientists. In particular, it examines what sociologist Thomas Gieryn has termed the “boundary work” performed by these scientific advocates. Gieryn defines boundary work as the “attribution of selected characteristics to the institution of science (i.e. to its practitioners, methods, stock of knowledge, values and work organization) for purposes of constructing a social boundary that distinguishes some intellectual activities as ‘non-science.’”¹⁰⁶ Gieryn argues that the characteristics that demarcate science from other intellectual endeavors are neither innate nor essential, but rhetorical—that is, they are found not in scientific practices, methodologies, or texts, but “in their representations.”¹⁰⁷ Boundary work thus exists on the level of discourse: it describes the ideological rhetoric used both to differentiate science from other intellectual pursuits and to claim intellectual or cultural authority for science “in situations where answers to the question ‘what is science’ move from tacit assumption to explicit articulation.” In Gieryn’s formulation, “science” becomes less a defined field than a spatial marker, “empty until its insides get filled and its borders drawn amidst context-bound negotiations over who and what is ‘scientific.’”¹⁰⁸

With Gieryn’s schema in mind, this chapter argues that, as institutions in the late nineteenth century defined and delimited the boundaries of science by sanctioning particular kinds of knowledge and proscribing others, scientific “professionalizers” claimed a specific ideal of trained and objective vision—what the neurologist George Miller Beard termed the “scientific sense”—as a defining attribute of both the modern

¹⁰⁶ Thomas Gieryn, “Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists,” *American Sociological Review* 48, no. 6 (1983), 782.

¹⁰⁷ Thomas Gieryn, “Boundaries of Science,” in *Handbook of Science and Technology Studies*, ed. Sheila Jasanoff et al. (Thousand Oaks: Sage Publications, 1995), 406.

¹⁰⁸ Gieryn, “Boundaries of Science,” 405.

scientific enterprise and the modern scientist.¹⁰⁹ Furthermore, professionalizers presented the new figure of the professional scientist as not simply a more objective observer, but as an observer who, through training and expertise, had evolved to see more and better—to, in short, surpass the normal limits of the human sensorium. As I show, the growing conviction—substantiated by Muybridge’s images—that perception was both suspect and unstable only widened the gulf between typical vision and the “scientific sense.”

This chapter begins with a brief examination of how Beard and other professionalizers presented the “scientific sense” in books and articles specifically devoted to explicating the methods and objects of science. Yet, as Gieryn argues, scientists and their supporters discussed the “scientific sense” more frequently and defined it more precisely when they were forced to specify how science differed from other intellectual endeavors.¹¹⁰ I focus on three such situations, each of which is exemplified by one of the projects described in Provost Pepper’s report.

In the 1880s, proselytizers of the sciences used the “scientific sense” to defend and differentiate the sciences from other academic fields that had long dominated the intellectual landscape of the United States, in particular, classical languages and literature. By doing so, they posed a challenge to the cognitive and cultural authority of classical studies. The university’s staging of the *Acharnians* points to both the continued place of Greek and Roman literature within the college curriculum and the incursion of, as one commentator wrote, the new “scientific spirit” into even the sacred territory of the classics. At the same time, through the rhetorical deployment of the “scientific sense,” professionalizers differentiated themselves from “pseudo-scientists,” a term that entered

¹⁰⁹ George Miller Beard, “The Scientific Study of Human Testimony,” part III, *Popular Science Monthly* 13 (July 1878), 329.

¹¹⁰ Gieryn, “Boundaries of Science,” 405.

the lexicon through these debates.¹¹¹ Spiritualists, who often allied themselves, their objects, and their methods with scientific practitioners and practices, posed an especially imminent threat to “the rapid progress of the sciences and the intellectual edifice on which the scientific profession based its claims for professional authority.”¹¹² The object of the Seybert Commission was not so much to investigate modern spiritualism as to differentiate between scientists and spiritualists and science and spiritualism.

Finally, analyzing how professionalizers used scientific perception as a rhetorical tool reveals another explanation for the university’s sponsorship of Muybridge’s project. Upon *Animal Locomotion*’s publication, viewers understood and received Muybridge’s photographs as both models and metaphors for the kind of trained, scientific vision that, professionalizers argued, was integral to both scientific practice and scientific self-identity. As I show, after the publication of *Animal Locomotion*, critics speculated about the effect of Muybridge’s photographs on artistic depiction and framed this question in terms of vision. While some viewers anticipated that artists should mimic the perfected perception of Muybridge’s cameras, others defended the integrity and authority of artistic vision. I thus contend that it was this easy commutability between Muybridge’s photographs and the “scientific sense” that made the motion studies compelling as

¹¹¹ Daniel Patrick Thurs, *Science Talk: Changing Notions of Science in American Popular Culture* (New Brunswick: Rutgers University Press, 2007), 65. Thurs comments, “though talk about pseudo-science was still rare by twentieth-century standards, its appearance in magazine articles was increasingly common during the last quarter of the nineteenth century.”

¹¹² Robert Noakes, “Natural Causes? Spiritualism, Science, and the Supernatural in Mid-Victorian Britain,” in *The Victorian Supernatural*, eds. Nicola Bown, Carolyn Burdett, and Pamela Thurschwell (Cambridge: Cambridge University Press, 2009), 24.

scientific documents, and that Muybridge's instantaneous photographs were useful to the university specifically because they exemplified and objectified this new optic.¹¹³

For viewers in the late 1880s, Muybridge's motion studies made visible the gaps and fissures between seeing and knowing and reality and its representation. Muybridge's photographs not only made the invisible visible for the first time, but also proved unaided sight suspect. In this way, Muybridge's studies substantiated the findings of contemporary experiments in sensory physiology and experimental psychology: that the eye is an insensitive mechanism and human bias is inevitable. For many scientific professionalizers, these researches had profound implications not only for the sciences, but also for the education and authority of the scientist. In a series of articles on "the Scientific Study of Human Testimony," George Miller Beard, one of the nation's most vocal advocates for the professionalization of neurology, argues that these "experiments of authorities" exposed a dangerous contradiction: that the majority of scientists assumed that vision and, by extension, facts derived empirically were trustworthy even though they knew that vision was, at best, limited, and human testimony all but worthless. "It must be allowed that the senses bring us into direct relation with only an infinitesimal fraction of the natural," Beard writes. "We are practically shut out of knowledge of nature, of which we are a part."¹¹⁴

However, for Beard and other promoters of scientific professionalization, only one conclusion could be drawn from this recognition of the essentially biased nature of

¹¹³ John Ott has made a similar argument about Muybridge's first body of motion studies and the "industrial gaze" of Leland Stanford, who sponsored Muybridge's first project. This chapter is indebted to his work, and should be read as a continuation of it. Ott, *Manufacturing the Modern Patron*.

¹¹⁴ George Miller Beard, "The Scientific Study of Human Testimony," part II, *Popular Science Monthly* 13 (June 1878), 174.

observation: the need for scientists trained to overcome, as far as possible, the innate limits of the human sensorium. For Beard, the “reform of logic” that he envisioned for the sciences would be brought about by and depended wholly upon “those who are endowed with, or by discipline have acquired, what I am accustomed to call the scientific sense, by which phrase I mean the power of seeking truth through the intellect alone, uninfluenced by the emotions.”¹¹⁵ The “scientific sense” was, according to Beard, a corrective for the inherent inexactitude, biases, and limitations of the human sensorium. Experts, he explains, distrust their senses, avoid all sources of error in observation, experiment, or reasoning, and are able to differentiate between subjective and objective visions, reality and its semblance; non-experts trust their senses implicitly and are incapable of correcting errors in observation. Thus, “the corner-stone of the reconstructed edifice of the principles of evidence must be the recognition of the necessity of the testimony of experts in all matters of science, and consequently absolute rejection of all testimony of non-experts without reference to their number or the unanimity of their testimony.”¹¹⁶ Beard’s exposé of the fallacies of human testimony was, in the end, both a rejection of Baconianism’s democratization of scientific inquiry and an argument for the importance and necessity of professional scientists.

While Beard defined the “scientific sense” as a combination of self-awareness and self-monitoring, other scientists attributed to experts even more specialized observational knowledge and skills. In an 1891 speech entitled “The Early History of Instrumental Precision in Medicine,” Silas Weir Mitchell argues that, while at the beginning of the century physicians were driven to use the imagination as a compensatory tool “to assist

¹¹⁵ Beard, “The Scientific Study of Human Testimony,” part III, 329.

¹¹⁶ Beard, “The Scientific Study of Human Testimony,” part III, 329.

intellect beyond the boundaries of the possible in observation,” modern optical devices such as the sphygmograph and the microscope had made the imagination obsolete by rendering all phenomena immediately, wholly, and equally visible to the eye.¹¹⁷

Moreover, he claims that precision instruments had not only made post-mortem analyses or the diagnosis of patients more accurate, but also—and more importantly—“tended to lift the general level of acuteness of observation.” The increased use of instruments of precision had, in other words, improved physicians. “The instrument trains the man; it exacts accuracy and teaches care; it creates a wholesome appetite for precision which, at last, becomes habitual.” Mitchell concludes that “the microscope, the balance, the thermometer, the chronograph have given birth to new standards in observation, by which we live.”¹¹⁸

In the end, Mitchell’s “History of Instrumental Precision in Medicine” is the story of the emergence of the modern, professional scientist. In his account, precision instruments are less prosthetics that compensate for the many failures of human sensation than they are a means to improve the senses. Through the practiced use of these devices, physicians, according to Mitchell’s logic, could overcome—at least in part, and by habit—the limitations of their perceptual faculties. That is, by using precision instruments, physicians would begin to take on the visual acuity of the instruments—to see like a sphygmograph, for example. Mitchell even maintains that the senses of the present-day physician had been so sharpened by these precision tools that, if he should be

¹¹⁷ Silas Weir Mitchell, *The Early History of Instrumental Precision in Medicine: An Address Delivered before the Second Congress of American Physicians and Surgeons* (New Haven: Tuttle, Morehouse and Taylor, Printers, 1892), 8. The sphygmograph was a device used to measure blood pressure.

¹¹⁸ Mitchell, *The Early History of Instrumental Precision in Medicine*, 8.

forced to rely on his unaided senses alone, he would still be more visually acute than his medical forefathers.

Mitchell, like Beard, framed acute observation as the special province and privilege of the modern scientist. But this “scientific sense,” born from professional training and the use of specialized devices, not only defined who belonged to the new class of professional scientists, but—and equally importantly—who did not. As Douglas J. Lanska emphasizes, within the burgeoning American neurological community, the many instruments of precision invented in the late nineteenth century were important markers of professional authority.¹¹⁹ The technical expertise needed to originate and put these tools to use lent legitimacy to neurology and differentiated it from other specialties, while the exchange of these technologies further strengthened professional ties and bound together the neurological confraternity. Both Mitchell and Beard, for instance, invented their own precision instruments. Charles K. Mills, another neurologist within the Philadelphia Medical community, widely promoted Mitchell’s “sway meter.”¹²⁰

Both Beard and Mitchell emphasized the vagaries of human perception and the consequent need for scientific experts endowed with a trained “scientific sense.” The characteristics of the modern scientist that emerge from their writings—objectivity, self-discipline and super-human perceptual acuity—were further elaborated by scientific professionalizers in a very different context: debates about the relative merits and

¹¹⁹ Douglas J. Lanska, “The Role of Technology in Neurologic Specialization in America,” *Neurology* 48 (1997), 1722-1727.

¹²⁰ With Alphonso David Rockwell, Beard invented “a modification of Eulenberg’s ‘baresthesiometer’ or ‘piesmeter’ to assess the sense of weight.” In addition to the “sway meter,” Mitchell also invented a “knee-jerk meter.” Lanska (1997). See also, Douglas J. Lanska, “Nineteenth-Century Contributions to the Mechanical Recording of Postural Sway,” *Archives of Neurology* 58 no. 7 (July 2001), 1147. Mitchell’s “Sway meter” made a graphic recording of the uncontrolled movements of neurological patients’ heads as they attempted to stand still.

importance of a scientific education and a classical education and the place of each within the university curriculum that reached a fever pitch in the 1880s.¹²¹

Despite the reforms in institutional structure and the introduction of new academic disciplines outlined in chapter one, the classics remained the bedrock of a liberal education. In the 1880s, the curricula and requirements of the nine “colonial colleges” were based almost entirely on the study of Greek and Latin, just as they had been upon their establishment before the American Revolution.¹²² A student at the University of Pennsylvania in 1791 would have devoted the majority of his studies to Greek and Latin grammar and to the translation, memorization and recitation of ancient literature.¹²³ Over a century later, the course of study had changed very little; in 1902, the university began to require that students in the College of Arts take Greek or Latin, rather than both.¹²⁴

The university’s staging of Aristophanes’s the *Acharnians* in 1886 attests to the lasting importance of the Classics.¹²⁵ The production involved the majority of Penn’s undergraduates, not to mention a year’s worth of rehearsals and historically accurate costumes, weaponry, sets, and music commissioned for the occasion. Muybridge, who was at the time busily assembling his photographic sequences for publication,

¹²¹ Jewett discusses the antebellum origins of the “Classics Question” debate. Jewett, *Science, Democracy and the American University*, 29-34.

¹²² Caroline Winterer, *The Culture of Classicism: Ancient Greece and Rome in American Intellectual Life, 1780-1910* (New York: The Johns Hopkins University Press, 2002), 9-13.

¹²³ According to a course schedule from 1791, a typical Monday consisted of Latin exercise and a lecture on Natural Philosophy, Higher Greek and Latin, a lecture on Moral Philosophy, Euclid and Practical Mathematics. The schedule also notes that “three boys in rotation in the two collegiate classes declaim every day of the week except Saturday between the hours of 11 and 12 without interfering with the other studies.” Weekly class schedule for the College, c. 1791.
<http://hdl.library.upenn.edu/1017/d/archives/20041022005>

¹²⁴ University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1902-1903*. (Philadelphia: Collins, 1903).

¹²⁵ For a history of the play’s production, see Lee T. Pearcy, “Aristophanes in Philadelphia: The “Acharnians” of 1886,” *The Classical World* 96, no. 3 (Spring, 2003), 299-313.

photographed the cast for an article published in *Harper's Weekly* (Figure 10).¹²⁶

Performed in the original Greek before sold out audiences in Philadelphia and at the New York Academy of Music, the play was a rousing success. *Harper's* concluded that when “the beau monde and haut ton flock to the performance, it does not look very much as if Greek were going out of favor.”¹²⁷

As the *Harper's* reviewer recognized, the success of the *Acharnians* evidenced the continued cultural authority of the classics. But he also suggested that this authority was in dispute—Greek's favored status among the intellectual and cultural elite could no longer be assumed. Similarly, Pepper's observation that, as a result of the Greek play, “deep interest was aroused in Greek literature, and a distinct stimulus was imparted to classical study” also hinted that the once-dominant Classics were now in need of assistance.¹²⁸ Yet, the staging of the *Acharnians*, “infused by careful attention to philological detail and archaeological accuracy,”¹²⁹ also pointed to both the incursion of the sciences into the cultural stronghold of the classics and the growing cultural authority of the sciences. In the late 1880s, classicists attempted to maintain the prized place that Greek and Latin had long held in American culture by contending that classical studies was, in fact, a “scientific” discipline. They emphasized that the classics—in particular, the specialized branches of archaeology and philology—strictly adhered to the scientific method. They thus resisted “the claims of the physical and social sciences to be sole inheritors of the prestige of science.”¹³⁰

¹²⁶ “The Acharnians' of Aristophanes at the Academy of Music,” *Harper's Weekly*, November 20, 1886.

¹²⁷ “A Greek Comedy Played,” *The New York Times*, May 15, 1886.

¹²⁸ University of Pennsylvania, *Annual Report of the Provost of the University of Pennsylvania, Including Reports of Departments and Abstract of the Treasurer's Report for the Year Ending October 1, 1887* (Philadelphia: Collins Printing House, 1887), 7.

¹²⁹ Percy, “Aristophanes in Philadelphia, 313.

¹³⁰ Winterer, *The Culture of Classicism*, 154.

This call to redefine classical studies as a science was part of a larger national debate about the relationship between the two disciplines and the relative merits of each. In the early 1880s, a wide range of scientific professionalizers—including not only practicing scientists, but also editors of scientific magazines, university administrators, and alumni—began to argue that the sciences should unseat the Classics and assume a privileged place in college academics and American culture. But the ensuing debate, which was waged in the pages of countless newspapers, journals, and books, as well as in lectures delivered before learned societies, was more than a petty squabble over the minutiae of school policy. At its center was an epistemological argument about the kinds of knowledge—and methods for acquiring knowledge—that were necessary for navigating the modern world. As Caroline Winterer has argued, in the eighteenth and early nineteenth centuries Latin and Greek were considered vocation necessities that prepared young men for the law, ministry and politics. In the late nineteenth century, however, “the emerging construct of ‘utilitarian science’ had armed a new generation of anticlassicists with a powerful new rhetorical tool...the anticlassicism of the Victorian era marched under the banner of science and utility.”¹³¹ In addressing what was popularly referred to as the “Classics Question,” professionalizers used the same characteristics identified by Beard and Mitchell—objectivity, perceptual acuity, and self-discipline—to make the case for a scientific education. However, they also argued that an education in the sciences was useful precisely because of the observational skills it cultivated.

When advancing their case, scientific professionalizers maintained that the Classics instilled a slavish deference to the ideas, beliefs, and mores of the past rather than preparing men for the demands of the modern world and marketplace. In a speech

¹³¹ Winterer, *The Culture of Classicism*, 105.

delivered before Harvard's chapter of Phi Beta Kappa in 1883, Charles Francis Adams, grandson of John Adams and a fourth generation "Harvard Man," complained that "in a utilitarian and scientific age," colleges failed "to fit their graduates for the work they have to do in life that awaits them." Adams dismissed the study of the Classics as a "modern fetish," a primitive religion "in which the real and practical is systematically sacrificed to the ideal and theoretical."¹³² Adams' address quickly became the most cited anti-classics screed amongst like-minded reformers who agreed that this classical "superstition" not only impeded progress, but also tended, as E.L. Youmans asserts, "to exalt authority, and to inculcate reverence for what is written, rather than what is true." "If any one wants to keep out 'new ideas,'" Youmans concludes acerbically, "he does well to cling to classical studies."¹³³

Thus, the modern world and the modern university alike demanded the "modern sciences" and "necessitated a rhetorical break with the past." In contrast to the regressive fetish worship of the classics, a thorough education in the sciences, professionalizers agreed, best equipped men for the demands of contemporary civilization. Yet, beyond the ill-defined but unanimously acknowledged modernity of the sciences, they offered only vague explanations for how the sciences would achieve this desired result. Youmans, the influential founder and editor of *Popular Science Monthly*, grandly pronounced that "the discipline of science is superior to lingual and literary discipline because it involves all

¹³² Charles Francis Adams, *A College Fetish: An Address Delivered before the Harvard Chapter of the Fraternity of the Phi Beta Kappa, in Sanders Theatre, Cambridge, June 28, 1883* (Boston: Lee and Shepard, 1883), 5.

¹³³ E.L. Youmans, "Yale Professors on College Studies," *Popular Science Monthly* 25 (October 1884), 128.

the mental processes, because it takes effect upon the realities of experience, because it is a discipline in the pursuit of truth, because it is a preparation for practical life-work.”¹³⁴

However, Youmans, like other professionalizers, also couched these abstract appeals to truth, culture and practicality in epistemological arguments that enlisted the rhetorical trope of “scientific sight.” Because words were inherently delusive, connected to their referents through the tenuous ties of convention alone, Greek and Latin were, he contended, always susceptible to manipulation and abuse. Conversely, modern science consisted “in demanding that the human mind shall no longer occupy itself in the verbal sphere, but shall break through the barriers of words and study the things they represent.”¹³⁵ The scientific investigator freed himself from “the thralldom and illusion which reign in the world of mere words” by gaining “knowledge of things, and not merely of names of things; an acquaintance with the operations and productions of Nature, as they appear to the eye, not merely an acquaintance with what has been said about them.”¹³⁶

It was by training the visual faculty—the eye disciplined to see for itself—that, professionalizers contended, the sciences best prepared men to face the challenges of modern civilization. They explained that a classical education produced men who were incapable of making concrete observations and too biased and uncritical to draw correct conclusions or to reason inductively. Josiah Parsons Cooke wrote that the “dull perceptions” and “confused impressions” that were the inevitable byproducts of years bent over Greek and Latin texts could only lead to false conclusions about the world. In contrast, through scientific study the student learned “quickness and sharpness of

¹³⁴ E.L. Youmans, “The College Fetich Once More,” *Popular Science Monthly* 25 (September 1884), 704.

¹³⁵ E.L. Youmans, “Is the Contrast Valid?” *Popular Science Monthly* 26 (November 1884), 126.

¹³⁶ Youmans, “Is the Contrast Valid?”, 126.

perception” and “accuracy in details,” observational skills necessary, he argued, not only in scientific research, but also in daily life.¹³⁷ Echoing Cooke, Adams claimed that his classical Harvard education had “systematically suppressed” his observational powers and, by doing so, left him debilitated and vulnerable in the “bustling, active, nervous” world of the late nineteenth century.¹³⁸ “In life a happy knack at quotations is in the long run an indifferent substitute for the power of close observation, and correct inference from it,” Adams wrote.¹³⁹

But, to proponents of the sciences, the acute powers of perception and deductive skills that the sciences imparted also—and perhaps most importantly—prepared young men to detect deception and trickery. Cooke, for instance, argued that science taught “truthfulness” by forcing him to be aware of his own biases. “Remember,” Cooke warned, “our observations are our data, and unless accurate, everything deduced from them must have the taint of our deception.”¹⁴⁰ Disciplining the sense of sight through a rigorous scientific education thus prepared the eye to see accurately and the mind to draw accurate conclusions. However, while a scientific education taught self-discipline, professionalizers agreed that it also readied men to navigate a modern world rife with humbug. Youmans characterized the late nineteenth century in these terms:

Certain it is that we are duped and cheated continually, and in a thousand ways. At home and on the street, in the cars, at public assemblies, and in all the relations of life, we are beset and imposed upon by designing knaves of every shade. We eat the falsified foods of the grocer, and wear the swindling textures of the dry-goods man. We are ‘done’ by unscrupulous shoemakers, and ‘sold’ by dishonest

¹³⁷ Josiah Parsons Cooke, “Scientific Culture,” in *Scientific Culture and Other Essays* (New York: D. Appleton and Company, 1881), 28.

¹³⁸ Adams, (unpaginated).

¹³⁹ Adams, (unpaginated).

¹⁴⁰ Cooke, “Scientific Culture,” 33.

hatters, while builders construct for us fraudulent houses, and upholsterers fill them with sham furniture.¹⁴¹

The only defense against “multifarious imposture” was, Youmans claimed, a rigorous scientific education.¹⁴² In contrast to the “faulty mental training” that a classical curriculum provided, men who had been put through a rigorous scientific education acquired “a skeptical state of mind.” Youmans even went so far as to assert that a comprehensive scientific education was the credulous and half-blind populace’s only protection from the dangers and duplicities of the modern world.¹⁴³

Youmans was not alone in his pessimistic appraisal of American “humbuggery.” Michael Leja, Karen Halttunen, Michael Petit, and other scholars have argued that many Americans perceived the modern world as rife with illusion and deception.¹⁴⁴ As rapid urbanization transformed city streets into hotbeds of duplicity and fraud (an anxiety embodied by the ever-lurking figure of the confidence man) and new technologies like the cinematoscope confounded the eye, the schism between reality and perception, truth and fiction seemed to grow ever wider. Michael Leja summarizes, “at one, the aspects of things in the world were recognized increasingly as deceptive; at the other, the human eye was revealing a dull tool, inadequate to its tasks. If seeing had ever been a basis for believing, it certainly was not now.”¹⁴⁵ Navigating this uncertain, modern terrain necessitated the adoption of the skeptical attitude or perspective that Youmans claimed as

¹⁴¹ E.L. Youmans, “A Foreign Lesson and a Domestic Application,” *Popular Science Monthly* 5 (May 1874), 112.

¹⁴² Youmans, “A Foreign Lesson and a Domestic Application,” 112.

¹⁴³ Youmans, “A Foreign Lesson and a Domestic Application,” 114.

¹⁴⁴ See: Michael Leja, *Looking Askance: Skepticism in American Art from Eakins to Duchamp* (Berkeley: University of California Press, 2004); James W. Cook, *The Arts of Deception: Playing with Fraud in the Age of Barnum* (Cambridge: Harvard University Press, 2001); Karen Halttunen, *Confidence Men and Painted Women: A Study of Middle Class Culture in America, 1830-1870* (New Haven: Yale University Press, 1982); Michael Petit, *The Science of Deception: Psychology and Commerce in America* (Chicago: The University of Chicago Press, 2013).

¹⁴⁵ Leja, *Looking Askance*, 1.

a product of a scientific education, and that Leja has termed “looking askance.” The debate surrounding the “Classics Question,” which framed trained, scientific observation as integrally important for success in the modern world, was therefore part of a larger history of skeptical viewership in the nineteenth century.

As the “Classics Question” demonstrates, in the last decades of the nineteenth century, scientific training, scientific practice, and the scientific expert himself were, in public discourse, all closely allied with a specific ideal vision. Professionalizers argued that, unlike the blind deference to authority and clouded perception that were the inheritance of the classics, the objectivity and perceptual acuity fostered by an education in the sciences prepared young men to meet the challenges of the modern world and to see through its many deceptions. However, scientific professionalizers also policed professional boundaries by regulating and dictating both who had the right to make empirical observations and what constituted a true scientific fact. In the 1880s, investigations of spiritualism—attempts to, as spiritualists claimed, put spiritualism on trial—became public forums for scientists to defend their autonomy and legitimacy by drawing professional boundaries along the lines of vision.

One such investigation was the Seybert Commission’s Investigation of Modern Spiritualism. Examining how the Seybert commissioners theorized, practiced and presented their work provides a glimpse into the intellectual community of the university and insight into how the commission members defined the scope and limitations of an investigation carried out in the name of science. Moreover, the commission’s investigation demonstrates how, in the 1880s, the burgeoning class of professional

scientists attempted to define the boundaries of science, defend their professional authority, and distance themselves from their spiritualist counterparts by controlling empiricist discourse.

As Robert Laurence Moore has noted, modern spiritualism “appealed not to the inward illumination of mystic experience, but to the observable and verifiable objects of empirical science.”¹⁴⁶ Adherents of “modern spiritualism” argued for the compatibility of their religion and science and sought to prove the invisible presence of spirits by marshaling “facts” derived from objective and repeatable experiences. Spiritualists and their scientific detractors thus shared what Kenneth Pimple terms the same “folk belief”: “that empiricism provides irrefutable evidence of what is, and the evidence of our senses constitutes the ultimate authority.”¹⁴⁷ Sheri Weinstein has emphasized that spiritualism and the professional sciences arose in tandem and were mutually constitutive. Therefore it is crucial to remember that “spiritualists were not the quacks in counterpart to the rational, educated men of science in the late nineteenth century.”¹⁴⁸ Rather, both spiritualists and scientists drew these boundary lines as the two fields developed and then diverged.

The Seybert Commission’s investigation was only one of many organized interrogations of spiritualism performed by scientists in Europe and the United States in the nineteenth century. Indeed, the scientific investigation of modern spiritualism began with modern spiritualism itself. Scholars usually trace the origin of modern spiritualism

¹⁴⁶ Robert Laurence Moore, *In Search of White Crows: Spiritualism, Parapsychology, and American Culture* (New York: Oxford University Press, 1977), 7.

¹⁴⁷ Kenneth D. Pimple, “Ghosts, Spirits, and Scholars: The Origins of Modern Spiritualism,” in *Out of the Ordinary: Folklore and the Supernatural*, ed. Barbara Walker (Logan: Utah State University Press, 1995), 84.

¹⁴⁸ Sheri Weinstein, “Technologies of Vision: Spiritualism and Science in Nineteenth-Century America” in *Spectral America: Phantoms and the National Imagination*, ed. Jeffrey Andrew Weinstock (Madison: University of Wisconsin Press, 2004), 131.

to 1848, when two young sisters, Catherine and Margaretta Fox, claimed to hear spirit rappings in their home near Rochester, NY. Kate and Maggie, joined by their elder sister Leah, soon began giving séances and demonstrations in New York and Boston. News of the “Rochester Rappings” quickly spread. In 1851, three physicians from the University of Buffalo carried out the first thorough investigation of the Fox sisters. After a series of controlled experiments, they concluded that the girls produced the rappings by cracking the joints of their toes, a charge the Foxes publicly denied. The “Battle in Buffalo,” as the local and national press dubbed it, ended in a stalemate.¹⁴⁹

As modern spiritualism spread throughout the United States and abroad, organized committees of scientists began investigating spiritualist phenomena. One of the most widely reported tests of spiritualism in the antebellum period was the so-called “Cambridge investigations” of 1857. The investigations pitted a committee of Harvard scientists, including Louis Agassiz and the mathematician Benjamin Peirce, against a collection of the most well-known mediums of the day, among them Kate and Leah Fox. Both Peirce and Agassiz were leading members of the so-called scientific “Lazzaroni,” a self-selected and informal group of American scientists united in the belief that “quackery and charlatanism were the twin evils that lowered the character of American science.”¹⁵⁰ They therefore sought to formalize and reform science in America by promoting professionalization and the adoption of modern scientific methods pioneered in Europe, and by organizing and controlling professional societies, in particular the

¹⁴⁹ For the Fox sisters, see: Moore; Barbara Weisberg, *Talking to the Dead: Kate and Maggie Fox and the Rose of Spiritualism* (San Francisco: HarperSanFrancisco, 2004); Ann Braude, *Radical Spirits: Spiritualism and Women’s Rights in Nineteenth Century America* (Boston: Beacon University Press, 1989); Nancy Rubin Stuart, *The Reluctant Spiritualist: The Life of Maggie Fox* (Orlando: Harcourt, 2005).

¹⁵⁰ Lucier, “The Professional and the Scientist in Nineteenth-Century America,” 709.

National Academy of Sciences.¹⁵¹ Through the “Cambridge investigations,” the Harvard scientists hoped to expose as frauds spiritualists who often claimed to have successfully reconciled science and spiritual phenomena. The Committee never published a report on its investigations. However, it did issue a statement to the *Boston Courier* announcing that the mediums had failed to produce “any phenomenon which required for its production, or in any manner indicated a force which could technically be denominated spiritual, or which was hitherto unknown to science.” After reviewing details of the sham séances, it concluded, “it is the opinion of the committee, derived from observation, that any connection with spiritualistic circles, so called, corrupts the morals and degrades the intellect.”¹⁵²

By 1883, the question of spiritualism had, if anything, grown more pressing. Just as the Civil War had revitalized interest in the sciences, so too had it inspired a second wave of spiritualist converts. Before his death in 1883, Henry Seybert, Provost William Pepper’s cousin, member of one of the “founding families” of Philadelphia, and a devotee of spiritualism, donated funds to the university for the endowment of a chair of philosophy. The endowment came with one condition: that a commission be appointed to investigate “all systems of Morals, Religion, or Philosophy which assume to represent the Truth, and particularly of Modern Spiritualism.”¹⁵³ In July of that year, a month before the University of Pennsylvania agreed to sponsor Muybridge’s photographic

¹⁵¹ Historians of American Science disagree over how united the objectives of the Lazzaroni truly were. For instance, although the Lazzaroni were, on the whole, invested in promoting the quantitative studies of natural phenomena, Louis Agassiz, one of the group’s principle members, was a naturalist and geologist, fields far removed from the “pure science” ideal propagated by the Lazzaroni. See Lucier, 710; also Mark Beach, “Was There a Scientific Lazzaroni?” in *Nineteenth-Century American Science: A Reappraisal*, ed. George H. Daniels (Evanston: Northwestern University Press, 1972), 115-32; Bruce. *The Launching of American Science*, 217-24.

¹⁵² *Boston Courier*, June 29, 1857.

¹⁵³ Seybert Commission, *Preliminary Report of the Commission Appointed by the University of Pennsylvania to Investigate Modern Spiritualism* (Philadelphia: J.B. Lippincott Company, 1887), 5.

investigations, the Board of Trustees of the University appointed a commission to carry out Seybert's request.¹⁵⁴

The majority of the members of the Seybert Commission were drawn from the University Faculty. The commission's primary and most active members were Provost William Pepper; Dr. Joseph Leidy, a renowned paleontologist, comparative anatomist, and specialist in microorganisms; George Augustus Koenig, professor of mineralogy and metallurgy; and George S. Fullerton, a University Instructor in Intellectual and Moral Philosophy and the first holder of the chair endowed by Seybert. These professors also held faculty appointments in the university's new Department of Philosophy. The final commission members were Silas Weir Mitchell, the renowned Shakespearean scholar and university trustee Horace Howard Furness, and Coleman Sellers, an engineer and professor of mathematics at the Franklin Institute.

In addition to the commissioners appointed in the summer of 1883, auxiliary members were invited to join the investigation as it approached its second year. By May 1885, these additional members joined subcommittees tasked with investigating specific branches of spiritualism. On the subcommittee devoted to "investigating what connection, if any, exists between modern Spiritualism and hypnotism and its kindred diseases," Mitchell, Pepper, and Fullerton were joined by Drs. Francis Xavier Dercum, A.J. Parker, and Horatio C. Wood.¹⁵⁵ Dercum and Parker both received their PhDs from the university in 1878. Dercum soon joined Wood, who was a clinical Professor of

¹⁵⁴ The Board of Trustees met on July 5th 1883. University of Pennsylvania Office of the Secretary to Rev. George S. Fullerton, July 5, 1883. UPA 3, Box 53 (Seybert Commission on the Investigation of Spiritualism, No. 1), University of Pennsylvania Archives and Records Center.

¹⁵⁵ Horace Howard Furness to George Fullerton, May 25, 1885. UPA 3, Box 56 (Seybert Commission on the Investigation of Spiritualism), University of Pennsylvania Archives and Records Center. See also Parker's acceptance letter, Andrew J. Parker to Horace Howard Furness, May 27, 1885. Box 3, Folder 121, Seybert Commission for Investigating Modern Spiritualism records, 1884-1922, Kislak Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania.

Nervous Diseases, as an instructor of nervous diseases with an appointment at the University Hospital, while Parker was appointed professor of zoology and comparative anatomy.¹⁵⁶

The commission members were appointed because their individual expertise qualified them to either investigate specific spiritual phenomena or to examine a range of spiritual phenomena from a particular critical position. The *Philadelphia Press* reported shortly after the commission's appointment, "the branches of the investigation have been assigned with a view to the experience of the different members. Thus Dr. Pepper will look after the physiological and medical phases of the problem, and will devote his attention to attacking spiritualism from these standpoints," while Leidy and Koenig "will combat the physical aspects, so far as they relate to natural philosophy" and Fullerton "will view the subject from a purely intellectual and metaphysical standpoint." The article added that, while no member of the commission had professed a belief in spiritualism, "it must not be understood that any foregone conclusions are to be indulged in to the exclusion of honest scientific inquiry."¹⁵⁷

Yet, despite this avowal of objectivity, the implicit intent of the Seybert Commission's investigation was to "attack" spiritualism by proving that its phenomena were physical, rather than metaphysical, in origin. Like the Lazzaroni at mid-century, many of the Seybert Commissioners were motivated to discredit modern spiritualism because it threatened their professional authority. Thirty years previously, Leidy had listed "the pseudo-therapeutics of some of the disciples of modern spiritualism" among

¹⁵⁶ These auxiliary members are not listed in the commission's preliminary report.

¹⁵⁷ "A Disbelieving Committee to Carry Out a Spiritualist's Bequest," *Philadelphia Press*, July 6, 1883.

the “false systems” that “regular” physicians were forced to combat.¹⁵⁸ After its post-war resurgence, spiritualism was, if anything, even more problematic for physicians. Mitchell lampooned spiritualists in *The Case of George Dedlow* and *Autobiography of a Quack*, which he hoped would “serve to call the attention of the public to the various devices of quacks and charlatans”—including spiritualists.¹⁵⁹

But medicine was not the only field menaced by spiritualism; it also posed a significant challenge to the scientific standing of experimental psychology, which was then a fledgling discipline. Fullerton had stopped lecturing on the Scottish common-sense philosophy soon after his appointment to the Seybert Chair and instead taught courses in which “psychology was approached largely from the physiological side.”¹⁶⁰ Fullerton soon began working with the German-trained experimental psychologist James McKeen Cattell, first at Bryn Mawr, where they both held adjunct positions, and later at the University of Pennsylvania, where Cattell established the university’s Experimental Psychology Laboratory.¹⁶¹ Together, Fullerton and Cattell undertook groundbreaking research into individual differences in perception. However, as Deborah J. Coon has argued, experimental psychology’s process of professionalization in the 1880s was “haunted by a public...who thought that the most interesting questions about the mind concerned not the range of perceptions and the timing of thought but...whether the living could communicate with the dead.”¹⁶² Thus, to define the boundaries between psychology and spiritualism, Fullerton, like many experimental psychologists, began

¹⁵⁸ Joseph Leidy, *Valedictory Address*, 67.

¹⁵⁹ Silas Weir Mitchell to George M. Gould, December 9, 1899. MSS 2/0241-03, Series 4.2, Folder 6, Silas Weir Mitchell Papers, College of Physicians of Philadelphia.

¹⁶⁰ Quoted in Michael Mark Sokal, *The Education and Psychological Career of James McKeen Cattell, 1860-1904*. PhD. Dissertation, Case Western Reserve University, 1980, 344.

¹⁶¹ Sokal, *The Education and Psychological Career of James McKeen Cattell*, 368-680.

¹⁶² Deborah J. Coon, “Testing the Limits of Sense and Science: American Experimental Psychologists Combat Spiritualism, 1880-1920,” *American Psychologist* 47, no. 2 (February 1992), 145.

investigating spiritual phenomena. The philosopher Dickinson S. Miller, who studied with Fullerton as an undergraduate, recalled that Fullerton often added to his courses “a spice of ‘psychic research’ mediums, ghost-stories, and their exposure, choice samples of human credulity” to illustrate the vagaries of perception and “the tricks...our own minds play upon us.”¹⁶³

Furthermore, the close connections between the researches of Seybert Commission members and Muybridge’s motion studies demonstrate not only the shared interests of the two investigations, but also how the scientists involved used both investigations to further the larger objective of scientific professionalization. With the exception of Koenig, all of the Seybert Commission members contributed to Muybridge’s project. Both Pepper and Sellers were financial guarantors. Joseph Leidy was an official member of the commission appointed to supervise Muybridge’s work, while Mitchell was one of several Philadelphia-area neurological specialists who allowed Muybridge to photograph patients under their care at the University Hospital in the summer of 1884.¹⁶⁴ Even Furness, the Shakespeare scholar, was involved; in a 1929 letter detailing his work with Muybridge, Dercum mentions that Furness suggested *Animal Locomotion*’s title page.¹⁶⁵

Of all the Seybert Commission members, Dercum and Parker collaborated most closely with Muybridge. While neither scientist was on the official Muybridge Commission, Pepper requested that Dercum oversee Muybridge’s investigations during summer of 1885, as all the members of the commission had left the city. Muybridge told

¹⁶³ Dickinson S. Miller, “Fullerton and Philosophy,” in *Philosophical Analysis and Human Welfare: Selected Essays and Chapters from Six Decades* (Dordrecht: D. Reidel, 1975), 41.

¹⁶⁴ See Chapter 3 for a discussion of Muybridge’s photographs of “pathological” or “abnormal” movement.

¹⁶⁵ Francis X. Dercum to George E. Nitzsche, May 10, 1929. UPA 9 Box 2 Folder 26, University of Pennsylvania Archives and Records Center.

the *Philadelphia Ledger*, “as I am neither a physiologist nor an anatomist, two Professors from the University of Pennsylvania are assisting in the work to give it additional weight and value. They are Dr. Francis X. Dercum instructor on nervous diseases, and Dr. A. J. Parker, Professor of Comparative Anatomy and Zoology.”¹⁶⁶ Through the summer and into the fall Muybridge photographed patients at the University Hospital under Dercum’s direction. Dercum would later relate that he had been deeply interested in Muybridge’s experiments and worked with the photographer through the summer of 1886.¹⁶⁷

Like Dercum, Parker had only recently joined the university faculty. As Muybridge mentioned, it would have been logical for a comparative anatomist and zoologist to oversee his work, if only to give the photographs “additional weight and value”—in other words, to give the official sanction of scientific experts. Harrison Allen, a comparative anatomist and zoologist twenty years Parker’s senior, would later contribute a lengthy essay on Muybridge’s photographs to the volume of essays published by the university to accompany Muybridge’s work.¹⁶⁸ It is possible that Pepper tasked Parker with overseeing Muybridge’s work because of his more junior standing. Parker also modeled for Muybridge; on June 3, 1885 he walked up and down stairs and inclines “while,” as another subject later wrote, “the cameras buzzed and clicked like hornets on their shelves.”¹⁶⁹

¹⁶⁶ “Mr. Muybridge’s Photographs: Interesting Pictures to Be Taken of Wild Birds and Beasts in Motion,” *Philadelphia Ledger*, August 12, 1885.

¹⁶⁷ Francis X. Dercum to George E. Nitzsche, May 10, 1929. UPA 9 Box 2 Folder 26, University of Pennsylvania Archives and Records Center.

¹⁶⁸ Harrison Allen, “Materials for a Memoir on Animal Locomotion,” in *Animal Locomotion: The Muybridge Work at the University of Pennsylvania. The Method and the Result* (Philadelphia: J.B. Lippincott Company, 1888), 35-103. As late as September 28, 1886, when Muybridge had completed the majority of the Animal Locomotion plates, Muybridge believed that Parker was going to write “descriptive text” for the plates. “Topics of the Time: Muybridge and the Athletes,” *The Pennsylvanian* 2, no. 13 (September 28, 1886), 80.

¹⁶⁹ Percy Madeira, “Not so fast,” *Saturday Evening Post* (July 11, 1936), 80.

However, Dercum and Parker's investment in the work of the Seybert Commission, as well as their qualifications for investigating the connections between spiritualism and hypnotic diseases, are less clear. A clue can be found in a paper co-authored by Dercum and Parker titled "On the Artificial Induction of Convulsive Seizures."¹⁷⁰ The authors first presented their paper before the Philadelphia Neurological Society in October 1884 and published it in the *Journal of Nervous and Mental Disease* soon after.¹⁷¹ In the paper, Dercum and Parker describe an experiment they conducted on a female subject. The doctors instructed the subject to sit and touch her fingertips very lightly to a tabletop and, after a variable period, this precise and prolonged muscular exertion resulted in convulsive seizures throughout the model's body. Although the motivation for and results of this paper will be discussed in detail in chapter 3, its primary purpose was to examine the underlying cause of a sub-group of involuntary bodily movements symptomatic of certain pathological conditions.

But the results of these investigations also had implications for another field: spiritualist phenomena. Dercum and Parker began the paper by explaining that the experiment was inspired by "certain phenomena noticed during experiments upon table-tipping," and noted in their concluding remarks that the artificially induced seizures were most likely "one of the atoms of truth around which are collected the follies of

¹⁷⁰ Francis X. Dercum and Andrew J. Parker, "On the Artificial Induction of Convulsive Seizures," *Journal of Mental and Nervous Disease* 9 no. 4 (October 1884), 579-588.

¹⁷¹ According to the records of the Philadelphia Neurological Society, Dercum and Parker first presented their findings to the Society on October 27, 1884. They then gave a demonstration of the phenomenon during a special meeting of the society on March 10, 1885. "Dr. A.J. Parker explained the mode of producing these convulsive seizures. The demonstration was then made as follows: Dr. Parker, Dercum, Randolph, S.W. Mitchell, Barker, and Jackson, being seated at a table, were directed to place their finger tips upon the surface of the table very gently and to concentrate the mind as much as possible upon the hand. After a period of time, varying in each case, certain convulsive seizures of the hands, arms and even trunk were witnessed in the persons of Drs. Parker, Dercum and Barker, and slight tremor in the hands of Dr. Jackson. The other gentlemen were not affected." Records of the Philadelphia Neurological Society, College of Physicians of Philadelphia.

spiritualism and table-tipping. It is one of those curious states which has been too little, if at all, studied.”¹⁷² Thus, Dercum and Parker believed that a secondary finding of their experiment was a material explanation for the convulsive movements exhibited by mediums and séance-goers supposedly under the spell of otherworldly influences. It is probable, then, that Dercum and Parker were asked to be sub-committee members expressly because of this investigation.¹⁷³ Their expertise would have been an invaluable contribution to the Seybert Commission’s attempts to identify a physical cause for spiritual phenomena. Indeed, Dercum and Parker’s experiment was reported in the popular press explicitly as an exposé of table-tipping. At the beginning of April, 1885 the *Philadelphia Record* ran an article titled “Nervous Convulsions: How they May be Artificially Produced.” While the article borrowed much of its text from Dercum and Parker’s article, it concluded with a greatly abbreviated explanation of their findings. The experiment, the article reported, offers “an easy and perfectly satisfactory explanation of some of the ‘table-tipping’ of the spiritualists.”¹⁷⁴

Dercum and Parker’s exposé of spiritualism reached the wider public not only through newspapers, but also through Muybridge’s images. In addition to patients pulled from the neurological wards of the Philadelphia Hospital, at Dercum’s request Muybridge

¹⁷² Dercum and Parker, “On the Artificial Induction of Convulsive Seizures,” 584.

¹⁷³ The Commission members were certainly aware of Dercum and Parker’s experiments. In a letter from Henry James to Furness from 1886, James mentions that he has “just read Dr. Dercum’s pamphlet...I shall try to repeat the experiments as soon as I get a minute of leisure. I had a ‘subject’ here the other day who illustrated them beautifully. Fingers on table at first affected with vibratory movements and ending by grasping the sides of the (dining room) table and shifting it about so as almost to smash everything in the room. The movements were said to be quite involuntary by the patient.” Henry James to Horace Howard Furness, June 3, 1886. Box 2, Folder 104, Seybert Commission for Investigating Modern Spiritualism Records, 1884-1922, Kislack Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania. Mitchell was also present when Dercum and Parker demonstrated their method for inducing convulsions before the Philadelphia Neurological Society in March, 1885.

¹⁷⁴ “Nervous Convulsions: How they May be Artificially Produced,” *Philadelphia Record*, April 4, 1885.

also photographed a model in the throes of artificially induced convulsions (Figure 11).¹⁷⁵

In fact, Muybridge's photographs, which were taken in September, picture a re-creation of the experiments Dercum and Parker first conducted and published almost a year previously. Dercum would later include an article explaining these experiments in *The Muybridge Work at the University of Pennsylvania: The Method and the Result*.¹⁷⁶

Muybridge's photographs track the bodily progression described in Dercum and Parker's article, from self-possessed stillness to full-body and table-shaking convulsions, from voluntary to involuntary motions. The photographs therefore make visible the moment when the model's will lost control of her body. They position the model as a clinical subject rather than a spiritual medium, and her erratic movements as physical, rather than supernatural. Viewed alongside Dercum and Parker's text, the photographs become an alternative visual narrative for the supposed spirit possessions that members of the Seybert Commission and spiritualists across the country witnessed.

Even without the guiding framework of Dercum and Parker's text, audiences in 1885 would have immediately connected Muybridge's photographs to popular depictions of séances. From the media frenzy that followed the "Rochester rappings" to modern spiritualism's post-Civil War resurgence, illustrations of séances often featured a medium assuming the same position described by Dercum and Parker and pictured in Muybridge's photographic sequences. A woodcut published in 1853 depicts "a circle of spirit rappers in session." The medium sits on the right, flanked by four men and a single

¹⁷⁵ Dercum would later explain the origins of these photographs: "[Muybridge] also photographed for me a woman in convulsions. The subject that I selected was an artist's model. She was one of those which Mr. J. Liberty Tadd had sent to the studio..." Francis X. Dercum to George E. Nitzsche, May 10, 1929. UPA 9 Box 2 Folder 26, University of Pennsylvania Archives and Records Center.

¹⁷⁶ Francis X. Dercum, "A Study of Some Normal and Abnormal Movements Photographed by Muybridge" in *Animal Locomotion. The Muybridge Work at the University of Pennsylvania: The Method and the Result* (Philadelphia: J.B. Lippincott Company, 1888), 103-133.

woman (Figure 12). The figures sit erect and, like Muybridge's model, touch their fingertips lightly to the tabletop—they look, the text notes, “very ‘impressible.’”¹⁷⁷ Whether seated separately or in a “spiritual circle,” this was also the position which, according to many of the how-to séance manuals and spiritual journals that proliferated during the second half of the century, best facilitated communication with the spirit world.¹⁷⁸

These depictions of séances and Muybridge's photographs contrast different modes of vision. Another early illustration of the Fox sisters depicts Dr. Austin Flint, a physician from the University of Buffalo, tilting his head and listening to one of the Fox sisters' knees to discover the origins of the rappings. The other physician-investigators hover over the central pair, staring intently at their subject (Figure 13).¹⁷⁹ Likewise, one of the two frontispieces to *The Rappers*, an exposé first published in 1854, pictures a female medium surrounded by a group of predominantly male spectators (Figure 14).¹⁸⁰ The medium assumes the fingertips-on-tabletop position as the table tips upward off of its two legs, much to the surprise of the two men flanking her on either side. These prints not only depict the rappings and table-tipping that proved the presence of otherworldly spirit energy, but also evidence the complex dynamics of power and gender underlying séances. As Tom Gunning has observed, in modern spiritualism, the medium was often

¹⁷⁷ Rev. H. Mattison, *Spirit Rapping Unveiled! An Expose of the Origin, History, Theology and Philosophy of Certain Alleged Communications from the Spirit World* (New York: Mason Brothers), 1853.

¹⁷⁸ See for instance Robert Hare, *Experimental Investigation of the Spirit Manifestations, Demonstrating the Existence of Spirits and their Communion with Mortals* (New York: Partridge & Brittan, 1855); “How to Form the Spirit-Circle,” in J.C. Street, *The Hidden Way Across the Threshold or The Mystery Which Hath Ben Hidden for Ages and From Generations* (London: William Rider & Son, Ltd., 1887), 261-262; the journal *Medium and Daybreak* also published weekly directions on “How to Form a Spirit Circle.” Emma Hardinge Britten, “Rules for the formation and conduct of the spirit circle,” in *On the Road or the Spiritual Investigator. A Complete Compendium of the Science, Religion, Ethics, and Various Methods of Investigating Spiritualism* (Melbourne: George Robertson, 1878), 33-38.

¹⁷⁹ Louis Figuier, *Les Mystères de la Science Aujourd'Hui*. (Paris: Librairie Illustrée), 1887.

¹⁸⁰ A Searcher After Truth, *The Rappers, or, The Mysteries, Fallacies, and Absurdities of Spirit-Rapping, Table-Tipping, and Entrancement* (New York: H. Long and Brother, 1854), frontispiece.

under a man's control. "In the scientific discourse of Spiritualism, the medium became less the voice of a new revelation than a new phenomenon demanding scrutiny. Women mediums and the phenomenon of Spiritualism increasingly became a spectacle presented for observation...displayed for a scientific investigation with circumscribed roles of experimental subject and probing scientist."¹⁸¹

Gunning rightly points out that in modern spiritualism these roles were gendered and conformed and corresponded to cultural understandings of women as passive and receptive, and men as active. What is more, in both Muybridge's photographs and depictions of séances, this gender difference is reinforced by the attribution of distinctly different modes of vision to both experimental subject and probing scientist. Just as the investigators pictured in *The Rappers'* frontispiece inspect the medium from all sides, so too do Muybridge's cameras probe every angle of the subject's naked form. In contrast to the scrutinizing gaze of the scientists-cum-instantaneous cameras, the mediums and Muybridge's subject sit with their eyes either firmly closed or cast downward.

While these modes of vision are connected to long-established gender conventions (as John Berger reminds us, "men act, women appear"), the shared scientific discourse within which these representations function lend them, I would argue, a more specific valance.¹⁸² The photographs and prints emphasize the fluid commutability of instantaneous camera and probing scientist—a commutability that is only possible because the two typify the same ideal of trained and super-human perception. Indeed, Muybridge's instantaneous cameras stand in as surrogates for Dercum and Parker who,

¹⁸¹ Tom Gunning, "Phantom Images and Modern Manifestations: Spirit Photography, Magic Theater, Trick Films, and Photography's Uncanny," in *Fugitive Images: From Photography to Video*, ed. Patrice Petro (Bloomington: University of Indiana Press, 1995), 51.

¹⁸² John Berger, *Ways of Seeing* (London: Penguin Books, 1972), 47.

although absent, still haunt the photographs. These representations of parallel experimental situations therefore contrast the visual mode of the all-seeing scientists-cum-cameras against the insensible convulsive subject or the spiritualists' trance.

This contrast between observational competencies also runs throughout the Seybert Commission's *Preliminary Report*, as well as the Commission's internal correspondence and papers. The report establishes this perceptual divide within the first twenty pages. To begin, the commission laid out its procedural method and operational ground rules. Before agreeing to take part in the investigation, each of the commission members "expressed his entire freedom from all prejudices against the subject to be investigated and his readiness to accept any conclusion warranted by facts."¹⁸³ Further, the report explains, all conclusions were to be based "solely on our own observations; without at all imputing untrustworthiness to the testimony of others, we can really vouch only for facts which we have ourselves observed." In an internal memorandum, the Seybert Commission members expanded on these "guiding principles:"

Faraday says that nothing is too wonderful to be true, if it is consistent with the laws of nature. If anything is a fact, it must be consistent with the laws of nature. Wherefore we must obtain facts, facts alone, omitting all inferences of any nature whatsoever. When we have formed our facts, it will be time enough to draw our inferences...From this it follows that we can admit no testimony whatever from outside witnesses...¹⁸⁴

The great British chemist Michael Faraday wrote the quoted lines in a laboratory journal as he investigated the relationship between electricity and gravitation. Following the example of the great experimentalist, the commission members thus attested to their

¹⁸³ Seybert Commission, *Preliminary Report*, 5.

¹⁸⁴ "Sketch of the plan of action drawn up by Mr. Furness," March 18, 1884. UPA 3, Box 55 (Seybert Commission on the Investigation of Spiritualism), University of Pennsylvania Archives and Records Center.

shared commitment to empirical facts and observation unbiased by either personal prejudice or presupposition.

While the commission members professed their dedication to fact-gathering and unbiased observation in the name of the scientific method, the report also demonstrates that they eschewed second-hand testimony because they assumed spiritualists to be fundamentally blinded by bias and their eyewitness accounts untrustworthy. In the report, the commission explains that although spiritualists wish to tell “the truth, the whole truth, and nothing but the truth, concerning marvelous phenomena,” they are incapable of doing so. The report cites two reasons for this incapacity. “The first reason is to be found in the mental condition of the observer; if he be excited or deeply moved, his account cannot but be affected, and essential details will surely be distorted.” Secondly, the difficulty that came with accurately observing and describing even the most mundane occurrence was “increased a hundred-fold, when what we would tell, partakes of the wonderful.”¹⁸⁵

According to the report, then, the spiritualist's excitable mental condition and inability to observe accurately necessarily prejudiced his testimony. In contrast, the Seybert commissioners brought to bear “their own powers of close observation, sharpened and educated by experience.”¹⁸⁶ Like the illustrations of séances, the Seybert report contrasts the experienced scientist-observers against spiritualists, who are caught up in the thrall of the supernatural and who lacked the “scientific sight” that came from scientific training.

Throughout the Seybert Commission’s preliminary report, the commission members not only emphasized their own objectivity and observational expertise, but also drew an explicit comparison between themselves and their credulous counterparts, the

¹⁸⁵ Seybert Commission, *Preliminary Report*, 19.

¹⁸⁶ Seybert Commission, *Preliminary Report*, 20.

spiritualist believers. The report narrates the commissioners' experiences attending private and public séances held by several different mediums. In particular, the commission focused its investigation on "independent slate writing." Unlike automatic writing mediums, who transcribed the messages spirits whispered to them, independent slate writing mediums channeled spirits who wrote their own messages with a small pencil that had been sealed between two slates. Figure 15 pictures one of the two slates, which have been separated to reveal that the spirit directed the medium, Mrs. Patterson, to write her own name (a result that was disappointing for all involved). As the eminent British naturalist and spiritualist believer Alfred Russel Wallace wrote in a letter to Fullerton, "there is nothing is so easily or satisfactorily tested or so absolutely conclusive of the existence of nonhuman intelligences capable of acting on matter."¹⁸⁷

The report provides full accounts of the commission's sittings with several slate-writing mediums, including Henry Slade. Slade was perhaps the most famous medium of his day and had been investigated several times with conspicuously mixed results. To counter Wallace's public avowals of belief, the British zoologist E. Ray Lankester had several sittings with Slade to demonstrate "that 'men of science' are not exempt as a body from the astounding credulity which prevails in this country."¹⁸⁸ In short order, he exposed Slade's legerdemain. Over the course of the following two years, however, Johann Karl Friedrich Zöllner also carried out a long-term investigation of Slade. At the end, the eminent German astrophysicist concluded that his mediumistic powers were genuine. He described these experiences in his "Scientific Treatise," a book so widely

¹⁸⁷ Alfred Russel Wallace to George S. Fullerton, July 4, 1884. Box 3, Folder 187, Ms. Coll. 412, Seybert Commission for Investigating Modern Spiritualism Records, 1884-1922, Kislack Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania.

¹⁸⁸ E. Ray Lankester, "A Spirit-Medium," *The Times*, September 16, 1876, 7.

read and reviewed that, according to Fullerton, “no other investigation of Spiritistic phenomena has exercised so strong an influence upon the public mind in America.”¹⁸⁹

Despite Zöllner’s endorsement, the Seybert Commission pronounced within the first paragraph of its report that Slade’s sleight of hand was so obvious that “we were forced to the conclusion that the character of those which passed under our observation was fraudulent throughout. There was really no need of any elaborate method of investigation; close observation was all that was required.”¹⁹⁰ In addition to close observation, the commission used several optical devices to better perceive Slade’s sleight of hand. These included a small pocket mirror to furtively watch as Slade opened the slate under the table, and a microscope to examine the abrasions left when he pried the pencil out between the sealed slates. With their trained powers observation, augmented by optical devices, the investigators thus differentiated themselves from the “guileless, honest folk” deceived by unscrupulous mediums.¹⁹¹

While the Seybert Commission’s report as a whole is structured around this opposition between the “scientific sense” of the commission members and the blind faith of spiritualists, the complex politics of vision that informed the Seybert Commission’s investigation is most clearly articulated in George Fullerton’s reevaluation of Zöllner’s investigation of Slade. Zöllner had died in 1882 and was apparently unavailable to corroborate his own testimony from beyond the grave. Therefore, to test the validity of his conclusions, Fullerton resolved to interview the scientists who had participated in the séances. In his account, Zöllner claimed that the other scientists present at Slade’s séances were also “perfectly convinced of the reality of the observed facts, and that they

¹⁸⁹ Seybert Commission, *Preliminary Report*, 104.

¹⁹⁰ Seybert Commission, *Preliminary Report*, 7.

¹⁹¹ Seybert Commission, *Preliminary Report*, 10.

were not to be attributed to imposture or prestidigitation”—a conclusion that directly contradicted the Seybert Commission’s own findings.¹⁹² However, because the vagaries of memory would render any new information about the “observed facts” suspect, Fullerton interviewed the scientists not to either disprove or substantiate Zöllner’s conclusions, but rather, as he explains, to inquire “into their qualifications for making such an investigation into the phenomena of Spiritism.”¹⁹³ Fullerton would, in other words, judge the accuracy of the investigation by interrogating the investigators themselves.

As soon becomes clear, Fullerton’s inquiry into the scientists’ expertise centered wholly on their observational skills—or lack thereof. From his interview with Wilhelm Wundt, Fullerton surmised that the conditions of the investigation were as unsatisfactory as the physical and mental condition of many of the investigators. According to Wundt, Weber was “a very old man at the time, and presumably not an acute observer,” Gustav Fechner suffered from cataracts and “could see very little,” and Zöllner himself was suffering from the first stages of a hereditary insanity and prone to visual hallucinations. Fullerton’s interview with Fechner revealed “that he did not look upon Slade as a juggler, but accepted the objective reality of the facts; that he did this, however, not on the strength of his own observations, for these were unsatisfactory, but because he had faith in Zöllner’s powers of observation.”¹⁹⁴ As Fullerton points out, Fechner’s faith in Zöllner’s second-hand testimony was somewhat undercut by his admission that the sittings were held in the dark and that Zöllner’s mental state was greatly impaired. Finally, Scheibner declared himself unfit to make scientific judgments, as he knew

¹⁹² Seybert Commission, *Preliminary Report*, 104-105.

¹⁹³ Seybert Commission, *Preliminary Report*, 105.

¹⁹⁴ Seybert Commission, *Preliminary Report*, 106.

nothing about jugglery and “was merely a passive spectator, and could not, properly speaking, make observations.” Furthermore, his short sightedness meant that he “might easily have left unnoticed something essential.” More damning still, Wilhelm Scheibner described Zöllner as “a man of keen mind, but in his investigations apt to see ‘by preference’ what lay in the path of his theory. He could ‘less easily’ see what was against his theory.”¹⁹⁵ Fullerton concludes that Zöllner’s conclusions about Slade, “based merely upon the eminence in science of his name and those of his collaborators, neglecting to give attention to their disqualifications for this kind of work, cannot be a fair or a true estimate.”¹⁹⁶

Fullerton’s interviews, therefore, revealed that this august collection of German physicists and experimental psychologists were, by their own admission, flawed and biased observers. They were plagued not only with a medical dictionary’s worth of physical and mental maladies—cataracts, near-sightedness, partial blindness, incipient mental disorder—that invalidated any observations they might make; they were also, in the case of Zöllner, encumbered with a pre-existing mental bias which caused him to see only those phenomena that substantiated his preconceived theories. In the end, Fullerton dismissed the testimony of all the scientists save Wundt, whom he describes as “an experimental psychologist, and an observer” by profession.¹⁹⁷ Fullerton’s appendix to the Seybert Commission’s report is significant because of its singular focus on what was, in the 1880s, considered the defining attribute of the professional scientist: his trained observation skills. His report revealed the German scientists to be biased and impaired and Zöllner’s investigation to be an argument from authority, based on nothing more than

¹⁹⁵ Seybert Commission, *Preliminary Report*, 108-109.

¹⁹⁶ Seybert Commission, *Preliminary Report*, 114.

¹⁹⁷ Seybert Commission, *Preliminary Report*, 110.

the eminence of his name. In Fullerton's estimation, then, with the exception of Wundt, the scientists were no better than the spiritualists. Fullerton's investigation thus testifies to the importance of the trained "scientific sense" to both debates about spiritualism and, more broadly, to defining the professional scientist and the parameters of scientific inquiry.

Muybridge's 1878 motion studies sparked a debate among reviewers over how—or whether—artists should make use of the instantaneous photographs. After the publication of *Animal Locomotion* nine years later, this debate only expanded in scope and application. The vociferousness of this debate—not to mention the sheer number of writers who contributed to it—suggests that its meaning went beyond "the legitimate effect of instantaneous photography on art." John Ott has convincingly argued that Muybridge's first body of motion studies exemplified and naturalized the rationalization of natural phenomena made possible by scientific advances and new technologies, and epitomized the superhuman, automated gaze of the manager. The debate surrounding Muybridge's studies was, he contends, symptomatic of larger cultural anxieties about the mechanization and industrial expansion. To counter the hegemony of the managerial gaze, artists in turn argued for the visual authority of painting. Ott concludes, "At stake, ultimately, was the ability to lay claim to social authority through the very practice of representation."¹⁹⁸

In contrast, the debates that followed the publication of *Animal Locomotion* suggest that viewers and critics alike understood *Animal Locomotion* as a product and embodiment of "scientific sight" rather than the gaze of the industrial manager.

¹⁹⁸ Ott, *Manufacturing the Modern Patron*, 90.

Furthermore, Sarah Burns has demonstrated that as scientists were defining their professional scientific authority and identity in terms of a specific ideal of trained and objective vision—a vision that found an analogy in Muybridge’s photographs—artists were claiming subjective vision as a touchstone for their own professional practice. Burns argues that, at the end of the nineteenth century, claims to professional and aesthetic authority were increasingly premised on the artist’s “power to see, and interpret what he sees, uniquely, while dispensing with anecdote, sermon, and fidelity to outward appearances.”¹⁹⁹ As the moralizing genre scenes and the minutely detailed epic landscapes popular at mid century fell out of favor, aestheticized landscapes won critical acclaim because they demonstrated the “highly refined visual acuity that legitimized [artists] as specialists of sight and professionals of self-expression.”²⁰⁰ In works by John La Farge and Dwight Tryon “the painter’s super-sensitive seeing eye, which revealed beauties unseen by others, was at bottom the subject of every picture.”²⁰¹ Thus, concurrent with *Animal Locomotion*’s publication in 1887, artists and scientists alike were using these two antithetical modes of vision—“scientific sight” and “artistic sight”—to define and delimit the boundaries of their professional identities.

Mitchell concludes his history of precision instruments with one final device: Muybridge’s photographs. “A better example of the training given by precision instruments,” he writes, “is the fact that a careful study of Harrison Allen’s work, with Muybridge’s photographs, at last enables the unaided eye to see in truthful order both the

¹⁹⁹ Sarah Burns, *Inventing the Modern Artist: Art and Culture in Gilded Age America* (New Haven: Yale University Press, 1996), 120.

²⁰⁰ Burns, *Inventing the Modern Artist*, 122-123.

²⁰¹ Burns, *Inventing the Modern Artist*, 126.

swift changes of convulsive acts and the normal movements of man.”²⁰² Mitchell here refers to Allen’s “Materials for a Memoir on *Animal Locomotion*,” one of the essays included in *Animal Locomotion: The Muybridge Work at the University of Pennsylvania*. By studying the play of muscular action and sequences of footfalls revealed by Muybridge’s photographs, Allen identified and described general laws of locomotion that applied to horses, elephants, sloths, and crawling human children alike. These laws, moreover, contradicted previously-held theories of animal movement—theories that had been accepted because they were founded on observation but were false for the same reason: the movements they claimed to explain were too fast or complex to be parsed with any precision by the unaided eye. Mitchell goes further and argues that Muybridge’s photographs not only provided evidence that contradicted these erroneous, retinal-based laws, but could also be used to “train” the unaided eye to perceive the “truthful order” of movements. For Mitchell, then, Muybridge’s images were only the most recent example of instruments that both augmented vision and disciplined scientists to see more and with greater acuity.

Upon *Animal Locomotion*’s publication, the majority of reviewers agreed with Mitchell that, as one writer concluded, “science, not art is destined to be the gainer by instantaneous photography. It can give man what amounts to another sense—an instantaneous eye. Underlying the present movement to record what is swift and unseen to the ordinary eye is a scientific one.”²⁰³ Indeed, critics argued that Muybridge’s photographs were incompatible with art specifically because they transcended perceptual limitations. While allowing that Muybridge’s photographs had once again proved the

²⁰² Mitchell, *The Early History of Instrumental Precision*, 9.

²⁰³ John Trowbridge, “Photography,” *Scribner’s Magazine* 5 no. 5 (May 1889), 606.

retina to be a flawed instrument, these writers maintained that ocular, not mechanical, vision should still be the basis of art.

Some things must be told or painted not as they are, but as they affect the eye or the imagination...to the human eye, with its halting susceptibilities, the horse and the wheel do not appear exactly as when caught by Mr. Muybridge's camera, and the artist's office is to present them as they seem to us.²⁰⁴

The retinal image and the image imprinted on the sensitized plate are, the reviewer claims, simply incompatible. A painting that corresponds to the retinal image—no matter how inexact—is therefore truer than any instantaneous photograph. While scientists may regard the eye's "halting susceptibilities" and the imagination as impediments to perfected scientific sight, artists, he suggests, should care only for the seeable and the imaginable.

These critics, like Mitchell, often substantiated their arguments by comparing Muybridge's images to other optical technologies that had expanded the range of the human sensorium. The sympathy between instantaneous photographs and optical devices, they argued, proved the basic incompatibility of artistic vision and the "scientific sight" represented by Muybridge's photographs. For, like the microscope, Muybridge's photographs both revealed never-before-seen views of a subject and rendered the subject unrecognizable. "Unless the world takes to wearing lenses and microscopes," the artist and author Sarah W. Whitman wrote in 1886, "the human eye and what it sees, must be the gauge of the visible universe; and the appearance of things to our eyes...will remain

²⁰⁴ Edmund Clarence Stedman, "The Nature and Elements of Poetry. VI: Truth," *Century Magazine* 44 no. 4 (August, 1892), 616. See also Leon Vidal, "On the Influence of Photography on the Vision," *The Photo-Beacon* 6 no 54 (June 1893), 208-211; Emil du Bois-Reymond, "On the Relation of Natural Science to Art," *Nature* 45 no. 1157 (January 1892), 224-227.

the standard of vision by which works of art stand or fall.”²⁰⁵ And it was precisely this standard of truth to appearances that artists should aspire to achieve and by which art should be judged. As a reviewer for Harper’s New Monthly Magazine argued, “there are photographic and optical as there are microscopic and optical truths. We do not paint a drop of blood as it looks through the microscope, but as it appears to our eyes.”²⁰⁶ This, too, was the argument voiced by William de Wiveleslie Abney, Peter Henry Emerson, and Henry Peach Robinson, three of the most vocal and well-published defenders of art photography in the late 1880s. In a short chapter on “The Faculty of Artistic Sight” in *Pictorial Effect in Photography* Robinson explains that “artistic sight” must be cultivated. For, “the truth of nature is not to be discerned by the uneducated senses.”²⁰⁷ Just as “the botanist detects beauties in weeds, unseen and trodden down by others; the entomologist finds unsuspected wonders in every grub that crawls...the geologist discovers how worlds were made in the stones over which he stumbles,” so too does the artist, through laborious training, come to see and appreciate the overlooked details of nature.²⁰⁸ Yet, Robinson’s analogy between artistic and the scientific sight stops at the threshold of vision. For artistically-inclined photographers to picture “more than the eye sees,” Robinson writes, “however scientifically right, is artistically wrong, for it is the mission of the artistic photographer to represent what he sees and no more. The scientist may use the microscope if he likes but not the artist.”²⁰⁹

²⁰⁵ Sarah W. Whitman, “Photography,” in *The Making of Pictures: Twelve Short Talks with Young People* (Chicago: Interstate Publishing Company, 1886), 102.

²⁰⁶ J. Wells Champney, “Fifty Years of Photography,” *Harper’s New Monthly Magazine* 79 no. 471 (August 1889), 362.

²⁰⁷ Henry Peach Robinson, *Pictorial Effect in Photography* (London: Piper & Carter, 1869), 15.

²⁰⁸ Robinson, *Pictorial Effect in Photography*, 17.

²⁰⁹ H. P. Robinson, “Fog or Focus?” *International Annual of Anthony’s Photographic Bulletin* 2 (1889), 197. See also William de Wiveleslie Abney, “Are Instantaneous Photographs True?” *International Annual*

At the same time, a small minority of writers envisioned a utopian future in which Muybridge's photographs would cause the rapid evolution of perception and a corresponding representational revolution. The most fully-imagined projection of these transformations was described in Armand Goubaux and Gustave Barrier's "The exterior of the Horse." Goubaux and Barrier's treatise on the mechanics of the horse was first published in 1884. In 1892, it was translated into English and published as an expanded second edition by J.B. Lippincott, the Philadelphia company that published and partially funded *Animal Locomotion*. The authors liberally illustrate their text with Muybridge's instantaneous photographs. They also explain that their work would not have been possible if instantaneous photography had not made visible "the attitude of the members in movement."²¹⁰ In fact, so taken were they with Muybridge's photographs that Goubaux and Barrier interrupt their treatise with a lengthy aside:

The instantaneous photographs, when multiplied and scattered abroad, will soon appear less fantastical; painters and sculptors will in the long run draw from them those ideas which will give their works that stamp of accuracy and truth which is but too often conspicuous by its absence. The attentive observation of animals in motion, now that we have been warned of those phenomena which the eye was at first unable to seize, will become incontestably more perfect. Little by little animal painters will abandon the fictitious and fantastic attitudes to which they have accustomed us, and will show us more and more animated Nature as she is, and not as the imagination or our inexperience leads us to conceive.²¹¹

Goubaux and Barrier, therefore, envisioned the final subjugation of human vision to the super-human perception exemplified by instantaneous photographs. Deployed across the world, Muybridge's photographs would usher in a new era of better, faster, surer vision

of Anthony's *Photographic Bulletin* 2 (1889); Peter Henry Emerson, *Naturalistic Photography for Students of the Art* (London: Sampson Low, Marston, Searle and Rivingston, 1889).

²¹⁰ Armand Goubaux and Gustave Barrier, *The Exterior of the Horse*, trans. Simon J.J. Harger (Philadelphia: J.B. Lippincott Company, 1892), 485.

²¹¹ Goubaux and Barrier, *The Exterior of the Horse*, 488.

and force artists to abandon the “fictitious and fantastic” for “Nature as she is.” Artists of the future, they anticipate, would scorn the fictions of old and care only for the modern facts of instantaneous photography.

In their invocation of the “fictions” of art versus the “facts” of Muybridge’s images, Goubaux and Barrier echoed the language used in the “Classics Question” debate. Scientific professionalizers argued for the benefits of a scientific education by relating the objective “facts” that were the province of science to trained “scientific sight” and the idealized abstractions of language to conventional perception. This use of the word “fact” to describe Muybridge’s photographs runs rampant through reviews of *Animal Locomotion*. Muybridge, one writer commented, “collect[s] facts with regard to the movements of horses and other quadrupeds by means of instantaneous photography.” The photographs themselves were termed, variably, a “body of facts of nature” “records of facts,” impressed with the “indisputable stamp of fact,” endowed with “the evidence of facts,” or, playing upon the nudity of Muybridge’s models, “the naked, absolute fact.”

Like Goubaux and Barrier, these reviewers use “fact” and “record” to argue for the essential incompatibility between the *Animal Locomotion* photographs and works of art, and “scientific sight” and artistic vision. Yet, rather than advocating the world wide subjugation of art to fact, they contended the opposite: that artists should use Muybridge’s photographs selectively, if at all. Moreover, they argued their case by negatively reevaluating the epistemological status and meaning of “facts.” While Goubaux and Barrier, like the advocates of scientific education, argued that the “facts” of science were truer than the conventional symbols of art, the opposing camp countered that, while the motion studies may be factual, they certainly were not true. Whitman

summarized, “let us...not mistake the facts of science [Muybridge’s photographs] for the truths of art, any more than we should mistake the symbols of language for the beauties of literature.”²¹²

Muybridge’s motion studies, these critics argued, represented the antithesis of artistic vision: while the first operated through reproduction and analysis, parsing apart each motion into sub-visual components, the second was creative and synthetic. Thus, just as authors combine letters and words into poems, so too could artists transmute Muybridge’s “facts of science” into “the truths of art” only by using their trained powers of artistic vision to mentally combine the individual instantaneous photographs into a single, idealized composite. This argument drew, at least indirectly, from Sir Joshua Reynolds. In his third “Discourse on Art,” Reynolds wrote that the painter’s objective was to capture “one common idea and central form, which is the abstract of the various individual forms belonging to that class.”²¹³ It was this capacity for synthesis—for near-alchemical abstraction from the base materials of the world—that, for Muybridge’s critics, defined artistic vision.

Therefore, critics agreed that, while artists could benefit from studying Muybridge’s photographs, they should by no means copy them directly. Echoing Reynolds, one Muybridge commentator opined that any artist who studied the motion studies “may even do well to throw away his photographs altogether, the action once understood, and express it by a pose not actually found in any one of them, but conveying better than any one of them, taken separately, the total result of the series. For the end of

²¹² Whitman, “Photography,” 102.

²¹³ Sir. Joshua Reynolds, “Discourse III,” in *The Discourses of Sir. Joshua Reynolds* (London: James Carpenter, 1842:), 43.

art is not record but expression...”²¹⁴ In this way, critics lauded artistic vision for its individuality, its subjectivity, and its affiliation with the imagination—the very qualities of vision that scientists claimed to have overcome. Artists, like scientists, thus marshaled a specific ideal of vision as the defining characteristic of their practice, and defined this ideal as, expressly, the antithesis of “scientific sight”: the first was subjective and synthetic, the second objective and analytical. By defending the authority, validity and integrity of artistic vision, these writers contested the hegemony of the perfected scientific optic represented by Muybridge’s photographs and the global conquest of scientific vision that Goubeaux and Barrier so vividly described.

Provost Pepper and the other guarantors sponsored Muybridge’s project during a period of sweeping institutional changes. Like many other American Universities, in the 1870s and 1880s the University of Pennsylvania overhauled its curriculum, bolstered its scientific departments and shifted its focus from undergraduate education to graduate studies and long-term original investigations. These changes were indicative of a nationwide movement to reform the curriculum and structure of higher education in the United States. At the same time, scientists increasingly argued that the production of scientific knowledge should be contained within the walls of universities—a belief that both effected and was affected by the proliferation of graduate programs in the 1870s and 1880s—and limited to professional scientists.

However, as this chapter has argued, as these “professionalizers” worked to define and delimit the boundaries of their discipline, they participated in a nation-wide debate that encompassed both disciplinary and epistemological questions. Within this debate,

²¹⁴ “Animal Locomotion,” *The Nation* 1177 (January 1888), 55.

scientific “professionalizers” presented a specific ideal of trained and objective vision as the defining characteristic of the professional scientist and professional scientific practice.

This chapter has examined three sites where professionalizers developed and deployed this “scientific sight:” the “Classics Question,” scientific investigations of Modern Spiritualism, and critical responses to Muybridge’s motions studies. In the 1880s, proponents of the sciences argued that the Classics represented an outmoded and slavishly deferential system of knowledge akin to blind fetish-worship. These scientific professionalizers also shaped their arguments around the “scientific sense” that was, they claimed, a product of a thorough education in the sciences and the province of professional scientists. But they also claimed that, to navigate the modern world, sight needed just the kind of skilling that the sciences—and only the science—provided. They thus appealed to contemporary anxieties about an urban, industrial society that to many late nineteenth-century Americans seemed intrinsically deceptive.

Through a close examination of the Seybert archive, I argued that the Commission’s investigation was primarily concerned not with uncovering the truth about spiritual phenomena, but with drawing professional boundaries along the lines of vision. While spiritualists claimed to have empirically proven the presence of spirits through rigorous experimentation, the Commission argued that only trained scientists were equipped to make unbiased observations and draw empirical conclusions. Finally, this chapter examined critical responses to *Animal Locomotion*. In light of Muybridge’s photographic revelations, many writers debated whether artists should change how they depicted moving animals. As I have shown, within these debates artists defended the

primacy and legitimacy of artistic vision—defined as subjective and synthetic—against what they viewed as the unwelcome encroachment of the objective and analytical scientific vision represented by Muybridge’s images.

However, it is also important to remember Muybridge’s own motivations for embarking on the *Animal Locomotion* investigations. Muybridge’s own position was especially tenuous after the unhappy conclusion of his first body of motion studies. As I briefly discussed in Chapter one, other than a cursory mention of Muybridge as “a very skillful photographer” in Stanford’s employ, J.B.D. Stillman’s book *The Horse in Motion*, “executed and published under the auspices of Leland Stanford” in 1882, ignored Muybridge’s contribution to the first motion studies project altogether.²¹⁵ This purposeful omission caused Muybridge great personal and professional embarrassment. The Royal Society of London refused to print an article he had prepared for its Proceedings and accused the photographer of plagiarism.²¹⁶ In the following years, Stanford responded to the lawsuits Muybridge brought against him by dismissing Muybridge as an “employee.” Muybridge was, Stanford wrote, “an instrument to carry out my ideas.”²¹⁷ For Ott, a sequence of Muybridge, naked and swinging a pickaxe, is a metaphor for the individual’s impotence in the face of industrial power (Figure 16). “By performing the role of laboring instrument before his cameras,” Ott concludes, “Muybridge too became the object of the industrial gaze.”²¹⁸

Yet, through his *Animal Locomotion* investigations, Muybridge transformed himself from a mindless “laboring instrument” into a scientific expert. While

²¹⁵ Stillman, *The Horse in Motion*, [unpaginated].

²¹⁶ Mozley, “Introduction to the Dover Edition,” xxiv.

²¹⁷ Ott, *Manufacturing the Modern Patron*, 114.

²¹⁸ Ott, *Manufacturing the Modern Patron*, 114.

Muybridge's images were useful to the University because they could be easily reconciled with the dominant paradigm of scientific vision, they were useful to Muybridge for the same reason. At the University of Pennsylvania, Muybridge became "Professor Muybridge." He was counted among the professors who presided over the opening of the University's new Biological School in 1884, and, after the publication of *Animal Locomotion*, toured throughout the United States and Europe under the title "Prof. Muybridge." During the final decades of nineteenth century, the term "professional" replaced "professor" as a general term for practitioners of any craft or vocation.²¹⁹ At the same time, "professor" became restricted to, as Funk and Wagnall's Standard Dictionary defined it in 1893, "a public teacher of the highest grade in a university or college."²²⁰

Even taking this slippage of meaning into account, Muybridge's metamorphosis from employee to professor over the course of a decade underscores his canny exploitation of *Animal Locomotion*'s scientificity and its University pedigree to enhance his own professional standing. This is perhaps best exemplified by Muybridge's contributions to the Standard Dictionary. According to the dictionary, "Professor Muybridge spent many days in New York supervising the definitions of the Movements of Animals."²²¹ A reviewer for the journal *Nature* listed the many "men of science" who were enlisted to assure the dictionary's accuracy, noting, "Prof. Huxley has had evolution under his care; Dr. P.T. Mason, anthropology, and Mr. E. Muybridge, animal locomotion."²²² Named as a specialist amidst this august group of scientific experts,

²¹⁹ Bruce A. Kimball, *The "True Professional Ideal" in America: A History* (Cambridge: Blackwell Publishers, 1992), 276.

²²⁰ Isaac K. Funk, ed., *A Standard Dictionary of the English Language*, vol. 2 (New York: Funk and Wagnalls Company, 1893), 1422.

²²¹ Funk, *A Standard Dictionary*, vol. 1, x.

²²² "A New Standard Dictionary," *Nature* 50 no. 1285 (June 1894), 146.

Muybridge contributed entries for “amble” and “dog,” among others. As the cultural authority and prestige of the sciences became more and more entrenched by the century’s end, Muybridge parlayed his *Animal Locomotion* motion studies—photographs that embodied and exemplified the “scientific sight” emblematic of the professional scientist—into a career as a scientific authority.

Chapter 3

Bodily Symmetry and the “Return to Barbarism”: Eadweard Muybridge’s Photographs of Men from *Animal Locomotion*

In the past thirty years, several scholars have discussed the politics of gender at play in Muybridge’s *Animal Locomotion* photographs. Drawing upon the work of Michel Foucault and Laura Mulvey, Linda Williams, for instance, examines *Animal Locomotion* as a “prehistory” of pornography and an early illustration of how “the power exerted over bodies *in* technology is rendered pleasurable *through* technology.”²²³ She argues that, while Muybridge’s male models simply perform their actions, the female models are fetishized through surfeit additions of narrative and useless props and gestures. Williams therefore connects the fetishization of the female body to its aestheticization, and relates these twin processes to the emergent (and male-coded) technology of cinema. More recently, Elspeth H. Brown has connected Muybridge’s sequences to interrelated period discourses on race and masculinity. Centering her analysis on anthropometry and following John Tagg’s Foucauldian analysis of photography as a disciplinary technology, she proposes that “Muybridge project reveals an investment in gendered evolutionary race science.”²²⁴

Williams and Brown have made important contributions to the study of *Animal Locomotion*, and this chapter is indebted to both. But it also argues that their readings fail to consider the complexities of gender construction in the last decades of the nineteenth century and photography’s constitutive role in shaping gender ideals. Williams assumes

²²³ Linda Williams, *Hard Core: Power, Pleasure, and the “Frenzy of the Visible.”* (Berkeley, CA: University of California Press, 1989), 39.

²²⁴ Brown, “Racialising the Virile Body,” 631. Brown’s approach is influenced by the essays in John Tagg, *The Burden of Representation: Essays on Photographies and Histories* (Amherst: University of Massachusetts Press, 1988).

that Muybridge actively constructs women and merely depicts men—that, in other words, in the motion studies female identity is malleable and masculine identity stable.

Furthermore, she takes for granted that men are the subjects and women the objects of the gaze, that the subject positions constructed by visual technologies reinscribe and reinforce social positions, and that this economy of vision is transhistorical, built into cinema from its very birth with Muybridge's sequences. For both Williams and Brown, Muybridge's project, which equates truth and visibility, observation and objectification, disguises relationships of dominance and inequality as positivism.

But masculinity, like femininity, is not a fact of nature, but a social and ideological process that is always ongoing. Even though Williams is attuned to the specific historical circumstances of *Animal Locomotion*'s creation, her dismissal of Muybridge's studies of male models as, in effect, simply "men being men" implies that masculinity is biologically determined. Similarly, although she recognizes that race and gender are "categories that are articulated and contested in the realm of culture," Brown's analysis is, in the end, structured through a series of stable binary oppositions—black/white, object/subject, female/male—that map neatly onto one another.²²⁵

This categorical stability is particularly problematic given that, in the late nineteenth century, "masculinity was widely perceived as in crisis and in radical need of...restoration."²²⁶ Even historians like Gail Bederman who resist the term "crisis" on the grounds that it "suggests that manhood is a transhistorical category or fixed essence that has its good moments as well as its bad," nonetheless agree that, as Muybridge was

²²⁵ Brown, "Racialising the Virile Body," 631.

²²⁶ Michael Kimmel, "Consuming Manhood: The Feminization of American Culture and the Recreation of the Male Body, 1832-1920," in *The History of Men: Essays on the History of American and British Masculinities* (Albany: State University of New York Press, 2005), 37.

photographing men running, walking and climbing up stairs, masculinity became the point of convergence for a wide range of cultural anxieties.²²⁷

Yet, while scholars have described the formation of this new masculine discourse from a variety of perspectives, little attention has been paid to the viewing practices that were both integral to and fostered by it. For men in the late nineteenth century, masculinity was a self-conscious performance. “Men felt themselves on display at virtually all times... To be considered a real man, one had better make sure to always be walking around and acting ‘real masculine.’”²²⁸ This was especially true in the new homosocial spaces that proliferated during this period. Michael Hatt argues that boxing rings, gymnasiums, social clubs, and athletic fields all defined the male body as a “legitimate spectacle.”²²⁹ That is, they sanctioned—indeed, necessitated—the extended contemplation and examination of the body. These spaces are difficult to reconcile with theories of gendered looking that assume, as Williams does, that men are the subjects and women the objects of the gaze. But it was in these new homosocial arenas and through the visual economy they structured that these new ideals of masculinity were formed; “to be learnt or consolidated,” Hatt contends, “masculinity requires a visual exchange between men.”²³⁰

It is not coincidental that, as the male body was becoming newly visible in these socially-sanctioned spectatorial spaces, new photomechanical technologies also made

²²⁷ Gail Bederman, *Manliness and Civilization: A Cultural History of Gender and Race in the United States, 1880-1917* (Chicago: University of Chicago Press), 11.

²²⁸ Michael Kimmel, *Manhood in America: A Cultural History* (New York: Simon and Schuster, 1996), 100.

²²⁹ Michael Hatt, “The Male Body in Another Frame: Thomas Eakins’ The Swimming Hole as a Homoerotic Image,” *Journal of Philosophy and the Visual Arts* (1993), 13.

²³⁰ Michael Hatt, “Muscles, Morals, Mind: The Male Body in Thomas Eakins’s *Salutat*,” in *The Body Imaged: The Human Form and Visual Culture Since the Renaissance*, ed. Cathleen Adler and Marcia Pointon (New York: Cambridge University Press, 1993), 62-3.

possible the mass dissemination of the male body through photographs. As Thomas Waugh has commented, in the last decades of the century, “portraits of athletes documented individual and social identities to be sure, but the male body emerged above all as object of mediatic consumption: it not only worked, presided and earned, but also played and competed, and was displayed, recorded, endlessly reproduced, sold, [and] consumed.”²³¹

This chapter argues that Muybridge’s motion studies of men participated in the new discourse of embodied masculinity that emerged in response to the cultural and social upheavals of the Gilded Age. While the previous generation had equated manhood with inner virtues, in the 1880s masculinity was externalized. The muscled and symmetrically developed male body came to signify strength of character, strenuousness, and self-determination—attributes that were construed as specifically white and middle- and upper-class. I further demonstrate that, as the gymnasium and the playing field put the body on display, physical culture manuals presented physical culture as a visual project and used photographs to both encourage and naturalize the close scrutiny of the male body.

I will also focus on the mission and practices of the University of Pennsylvania’s Department of Physical Education, which was established and expanded during Muybridge’s tenure there. As I show, like many of the other collegiate physical culture programs instituted in the 1880s, the Department used anthropometric measurements to

²³¹ Thomas Waugh, *Hard to Imagine: Gay Male Eroticism in Photography and Film from their Beginnings to Stonewall* (New York: Columbia University Press, 1996), 85. The end of the century emergence of the male body that Waugh describes has an interesting counterpoint in Abigail Solomon Godeau’s account of the disappearance of the male body from French academic art in the first decades of the nineteenth century. Abigail Solomon-Godeau, *Male Trouble: A Crisis in Representation* (New York: Thames and Hudson, 1997).

make the male body fully visible and quantifiable. By examining Muybridge's photographs as part of this visual economy, I argue that Muybridge's sequences appropriate the tools of anthropometric photography—a technology usually associated with subjugation and the identification of deviance and difference—to exhibit a range of masculinities and affirm and consolidate the privileged social and racial identity of his models. This chapter thus argues that the critical engagement with photography as a disciplinary apparatus has obscured a second—and equally important—social function of photography: as a space where identities could be explored and negotiated.

In response to the wide-spread cultural and socioeconomic changes of the Gilded Age, a new discourse of masculinity emerged in the last decades of the nineteenth century. Definitions of manhood in the first half of the century were formed in the context of a competitive, small-scale capitalist system that emphasized the importance of personal liberty and the control of one's own labor. Within this framework, manhood was understood as a quality inculcated from within and defined by "the capacity for autonomy and responsibility."²³² After the Civil War, rapid industrialization, concentration of capital, and urbanization—related processes that, together, Alan Trachtenberg has termed "the incorporation of America"—"created a new sense of an oppressively crowded, depersonalized, and often emasculated life."²³³ With the rise of large corporations and mechanized industries, the middle-class men who held the many newly available low-level clerical positions had little hope of advancing in the managerial hierarchy. At the

²³² Kimmel, *Manhood in America*, 81.

²³³ Kimmel, *Manhood in America*, 58. Trachtenberg's classic "critical cultural history," as he describes it, is an invaluable account of the social and cultural changes brought about by the rise of corporatization in the Gilded Age. Alan Trachtenberg, *The Incorporation of America: Culture and Society in the Gilded Age* (New York: Hill and Wang, 2007).

same time, repeated cycles of economic boom and bust between 1873 and 1896 and the resulting decline in agricultural prices drove tens of thousands of small-scale businesses into bankruptcy and farms into foreclosure. According to the 1870 census, only 30 to 40 percent of the Northern work force worked for themselves. The percent of salaried workers was even higher in industrial states; in Pennsylvania, nearly three-quarters of the population worked for someone else.²³⁴ As the rise of big business created a new managerial elite in the last quarter of the century, the large influx of immigrants resulted in ever-widening divisions between the upper and lower classes. For the men stranded in the middle, the previous generation's promise of self-determination and prosperity achieved through honest toil seemed far from guaranteed. Under these conditions, "the sons of the middle class faced the real possibility that traditional sources of male power and status would remain closed to them forever—that they would become failures instead of self-made men."²³⁵

At the same time, there was a pervasive fear that immigration and overcivilization were threatening the physical vitality and cultural and social dominance of Americans of Anglo-Saxon extraction. The 1880 census had revealed that the birthrate among Anglo-Saxon families was in steady decline, a finding that inspired grim prognostications of "race suicide."²³⁶ Critics of the "new immigration" from Southern and Eastern Europe interpreted the supposed racial decline of the American populace through "the compound of American exceptionalism, racial hierarchy, and biological determinism known as

²³⁴ Daniel T. Rodgers, *The Work Ethic in Industrial America, 1850-1920* (Chicago: University of Chicago Press, 2014), 37.

²³⁵ Bederman, *Manliness and Civilization*, 12.

²³⁶ Harvey Green, *Fit for America: Health, Fitness, Sport and American Society* (Baltimore: The Johns Hopkins University Press, 1986), 224.

social Darwinism.”²³⁷ Rewriting social stratification as biological and evolutionary determination, Herbert Spencer envisioned social evolution as a long struggle from barbarism to civilization, from which the Anglo-Saxon race had emerged triumphant. Through this conflation of the physical, the social, and cultural, social Darwinists claimed cultural and social authority as the biological birthright of Anglo-Saxon, protestant men and the advanced technological culture of America as proof of this biological superiority. To Spencer and many like-minded Americans, the continued ascendancy of American civilization was assured as long as the populace continued to be composed of, as Spencer called it, a “mixture of the allied varieties of the Aryan race.”²³⁸ However, they also worried that the influx of Catholic and Jewish immigrants was introducing a bewildering cultural and spiritual heterogeneity into this homogenous Aryan mixture.²³⁹

Therefore, in the last decades of the nineteenth century, “Spencer’s followers translated the idea of natural selection into social terms as both a ‘competition of races’ and a ‘conflict of cultures.’”²⁴⁰ Francis A. Walker, an economist, statistician, and director of the 1880 census, wrote in 1896, “fifty, even thirty, years ago, there was a rightful presumption regarding the average immigrant that he was among the most enterprising, thrifty, alert, adventurous, and courageous, of the community from which he came.” These hardy souls who had dared to uproot themselves from their native lands and braved the dangerous crossing became living proof of the law of survival of the fittest. In

²³⁷ Kathleen Pyne, *Art and the Higher Life: Painting and Evolutionary Thought in Late Nineteenth-Century America* (Austin: University of Texas Press, 1996), 221.

²³⁸ Herbert Spencer, *Herbert Spencer on the Americans and the Americans on Herbert Spencer* (New York: D. Appleton and Company, 1883), 19. In the late Nineteenth Century, “Anglo-Saxon” and “Aryan” were often used interchangeably; both denoted Teutonic and Western European ancestry, but were also used to connote social, cultural, or national characteristics.

²³⁹ See also David N. Livingston, “Science and Society: Nathaniel S. Shaler and Racial Ideology,” *Transactions of the Institute of British Geographers* 9, no. 2 (1984), 181-210.

²⁴⁰ Pyne, *Art and the Higher Life*, 32.

contrast, the new immigrants were, in Walker's words, "beaten men from beaten races; representing the worst failures in the struggle for existence."²⁴¹ Furthermore, with the closing of the American West—a subject anxiously debated years before Frederick Jackson Turner's famous 1893 declaration, "The Significance of the Frontier in American History"—these new immigrants would be barred from the rigors of frontier life, which both symbolized and, it was widely believed, inculcated the Anglo-American (and implicitly masculine) cultural values of individualism, physical strenuousness, and ambition—the very values that, many Americans felt, modern, urban society was rapidly eroding.²⁴²

However, in the 1880s, a more insidious enemy was threatening the Anglo-Saxon body politic from within: nervous exhaustion, or neurasthenia. The neurologist George Miller Beard named and defined the disease in 1869 and described its full symptomology and etiology for a popular audience in *American Nervousness: Its Causes and Consequences*, first published in 1881.²⁴³ According to Beard, neurasthenia could manifest in any number of ways, including heart palpitations, shooting pains in the limbs, muscle spasms—as well as psychical—"fear of lightening, fear of responsibility, fear of open places or of closed places, fear of society, fear of being alone, fear of fears."²⁴⁴

However, while neurasthenia's symptomology was protean, its etiology was more easily

²⁴¹ Francis A. Walker, "Restriction of Immigration," *The Atlantic Monthly* 77 no. 464 (June, 1896), 826.

²⁴² Green, *Fit for America*, 224.

²⁴³ George Beard, "Neurasthenia, or Nervous Exhaustion," *Boston Medical and Surgical Journal* 80 (April 29, 1869), 217-21. George M. Beard, *American Nervousness: Its Causes and Consequences* (New York: G.P. Putnam's Sons, 1881). For Beard's formulation of neurasthenia, see Charles E. Rosenberg, "The Place of George M. Beard in Nineteenth-Century Psychiatry," *Bulletin of the History of Medicine* 36 (May-June 1962), 245-292.

²⁴⁴ Beard, *American Nervousness*, 7.

identifiable. Neurasthenia, Beard explains, resulted from the depletion of the body's innate reserves of "nerve force," the vital energy that, it was widely believed, transmitted impressions from sensory organs to the brain and messages from the brain throughout the body. "Nervous bankruptcy" could occur organically through, for instance, the overtaxation of the body through excessive studying or exercise.²⁴⁵ But Beard attributes the marked rise of the disorder in the late nineteenth century to the enervating effects of late contemporary life. Because of "steam power, the periodical press, the telegraph, the sciences, and the mental activity of women," modern civilization had simply outstripped the body's ability to cope with its new environment.²⁴⁶ "American nervousness," Beard summarizes, "is the product of American civilization."²⁴⁷ Although physicians in the ensuing decades would disagreed about its diagnosis, treatment and, indeed, its very existence, by the late 1880s, the majority concurred that neurasthenia was, as the title of Beard's book suggests, both the defining affliction of modern America and caused by modernity itself.

But the discourse of neurasthenia also reinforced existing class attitudes and helped to substantiate social theories that framed race and class as biologically determined. Although neurasthenia is—and was in the nineteenth century—a disease associated largely with women, Beard's etiology defined neurasthenia as, specifically, a masculine disorder and a disorder of masculinity. But not all men were equally susceptible. Nerve specialists believed that only the small number of "brain-workers" within the American populace were in danger of contracting neurasthenia. This class of "scientists, physicians, lawyers, clergymen, orators, statesmen, literati and merchants," as

²⁴⁵ Beard, *American Nervousness*, 9-13.

²⁴⁶ Beard, *American Nervousness*, 96.

²⁴⁷ Beard, *American Nervousness*, 176.

Beard defined it, possessed innate, biologically-determined attributes that both differentiated them from the majority of “muscle-workers” and qualified them to safeguard and advance American civilization.²⁴⁸ Yet, it was these same characteristics, neurologists believed, that made these “brain workers”—and only these “brain workers”—constitutionally susceptible to American nervousness. Other races were immune to the neurasthenia; from studying freed slaves, Beard was able to definitively conclude, “nervous diseases do not exist...among savages or semi-savages, or even among barbarians.”²⁴⁹

Beard’s theory of neurasthenia was, as George Frederick Drinka has called it, a modern-day “Prometheus myth.” by triumphing in the evolutionary struggle and masterminding a technologically advanced American civilization, middle and upper-class Anglo-Saxon men had created the means of their own destruction.²⁵⁰ Beard’s partner A.D. Rockwell warned physicians who were tempted to diagnose members of the lower classes as neurasthenic that “the doctrine to be taught and strongly enforced is that many of these patients are not neurasthenic...They do not belong to the type out of which neurasthenia is born, either mentally or physically. Many of them are unintellectual, phlegmatic, and intolerably indolent, and are pleased at a diagnosis which touches the nerves rather than the stomach, bowels, and liver.”²⁵¹ In Rockwell’s formulation biology is mapped onto social structure, with the upper class occupying the nervous system and the lofty reaches of the mind, the lower class relegated to the digestive tract.

²⁴⁸ Beard, *American Nervousness*, 193-291.

²⁴⁹ Beard, *American Nervousness*, 188.

²⁵⁰ George Frederick Drinka, *The Birth of Neurosis: Myth, Malady and the Victorians* (New York: Simon and Schuster, 1984).

²⁵¹ A.D. Rockwell, “Editor’s Preface” in George M. Beard, *A Practical Treatise on Nervous Exhaustion (Neurasthenia) its Symptoms, Nature, Sequences, Treatment*. ed. A.D. Rockwell (New York: E.B. Treat, 1888), 3.

Nervousness, he maintains, can only afflict those men and women whose elevated position in the raciocultural hierarchy made them predisposed to the disease.

Neurasthenia was, therefore, both a disease and a sign of class privilege that, Rockwell implies, the intestinal classes might try to appropriate. As a national affliction, neurasthenia was proof of America's technological greatness and ascendancy; as an individual malady, it was a sign of social, cultural, and racial superiority.²⁵²

To treat male neurasthenia, Philadelphia neurologist Silas Weir Mitchell developed the "camp cure."²⁵³ Although Mitchell made important contributions to several fields, including neurological toxins and, during the Civil War, battlefield medicine, by the late 1880s his name had become closely associated with neurasthenia. As the head of the Philadelphia Orthopedic Hospital's Infirmary for Nervous Diseases and the author of many works on nervous exhaustion aimed at both general and specialist audiences, Mitchell—perhaps even more so than Beard—had a profound influence on how neurasthenia was theorized and treated.²⁵⁴ It is also likely that Mitchell was among the Philadelphia-area neurologists who collaborated with Muybridge. He certainly

²⁵² , John Lutz, *American Nervousness, 1930: An Anecdotal History* (Ithaca: Cornell University Press, 1991), 6.

²⁵³ Because Mitchell used the name camp cure exclusively, I will refer to it as such. Mitchell describes the camp cure in several works, in particular: S. Weir Mitchell, *Wear and Tear, or Hints for the Overworked* (Philadelphia: J.B. Lippincott Company, 1871); S. Weir Mitchell, *Nurse and Patient and Camp Cure* (Philadelphia: J.B. Lippincott Company, 1877).

²⁵⁴ Mitchell is best known for developing the "rest cure" to treat female neurasthenics. Largely because of Charlotte Perkins Gillman's *The Yellow Wallpaper*, a semi-autobiographical tale of a woman slowly driven insane by the rest cure's forced intellectual and social isolation, the rest cure is also the neurasthenia treatment most discussed by modern-day historians and scholars of gender and literature. These writers have extensively, thoughtfully and productively analyzed how Mitchell's cure was shaped by and, in turn, reinforced late-nineteenth century gender ideology and have, in general, interpreted the rest cure as a means of disciplining women who had strayed from their domestic role through the reinscription of passive femininity. However, as Jennifer Tuttle has argued, the camp cure was equally well known to nineteenth-century neurologists. As Tuttle explains, "the Rest Cure and the West Cure...comprise complementary parts of one process through which normative gender identities were constructed and reinforced in the United States during the late nineteenth century." Jennifer Tuttle, "S. Weir Mitchell, Medicine Man: Race, Gender, and Medical Authority in Mitchell's West Cure," *Transactions & Studies of the College of Physicians of Philadelphia* 20 no. 5 (December 1998), 31-37.

contributed at least one patient to Muybridge's studies of pathological motion, although whether or not he was in attendance while Muybridge carried out these investigations is unclear.²⁵⁵ However, in the preface to his 1899 publication *Animals in Motion* Muybridge thanked Mitchell as one of several doctors and University professors who aided his researches, which suggests that the famed nerve specialist was directly involved in the motion studies project.²⁵⁶

In the 1880s, Mitchell's camp cure was widely considered the most effective treatment for male neurasthenia.²⁵⁷ Like Beard, Mitchell believed that an excess of "brain work" and the stresses of modern urban life contributed equally to the disease.²⁵⁸ For Beard, neurasthenia's relationship to masculinity is ambiguous; the disease was both a confirmation of social status and a threat to the vigorous physicality that, in the 1880s, had come to define manhood. For Mitchell, however, the true danger of over-work was not enervation, but emasculation. In "Clinical Lecture of Nervousness in the Male," he writes that, in men, the disease's "prominent peculiarity lies in over-excitability;" neurasthenic men are "too easily moved, too readily excited." The disease thus enacted a gender reversal: once afflicted with nervousness, Mitchell concludes, "the strong man

²⁵⁵ Rachelle A. Dermer has demonstrated that two of Muybridge's studies of pathological locomotion document the case of Robert Connelly, one of Mitchell's patients. Mitchell diagnosed Connelly as a "typical example of hysteria in the male." Rachelle A. Dermer, "Photographic Objectivity and the Construction of the Medical Subject in the United States," PhD dissertation (Boston University, 2002). S. Weir Mitchell and William G. Spiller, "A Case of Uncomplicated Hysteria in the Male Lasting Thirty Years, with Post-Mortem Examination," *Transactions of the Association of American Physicians* 19 (1904), 433–45.

²⁵⁶ Jayne Morgan, "Eadweard Muybridge and W. S. Playfair," 225–31.

²⁵⁷ Although Mitchell originally intended the camp cure as a curative for men, in *Doctor and Patient* he wrote that "I have been led to regret that I did not see...that what I therein urged as desirable for men was not also in a measure attainable by many women." Nothing dispelled "the host of little nervousnesses with which house-caged women suffer as this free life" of the camp. Silas Weir Mitchell, *Doctor and Patient* (Philadelphia: J.B. Lippincott Company, 1888), 155.

²⁵⁸ Mitchell, *Wear and Tear*, esp. 7–26.

becomes like the average woman.”²⁵⁹ Unlike Beard, who viewed neurasthenia as an inevitable—and even desirable—result of both American and evolutionary ascension, Mitchell regarded neurasthenia in men as a pathological condition that, if left unchecked, threatened to lead to the mass feminization of American civilization.

To treat male neurasthenia, Mitchell prescribed periodic trips to the undeveloped western territories, where the excitable, feminized neurasthenic would recover his lost masculinity through an atavistic regression to a pre-modern, “savage” state. According to Mitchell, the modern, urban man had traded the innervating contest with Nature waged by countrymen of old—those “naked ancestors, who made stone axes and slew their beasts in close battle”—for the enervating struggles of the marketplace. Therefore, he concluded, “the surest remedy for the ills of civilization is to be found in some form of return to barbarism:”

In a word, my tired man who cannot sleep, or who dreams stocks and dividends and wakens leg-heavy, and who has fifty other nameless symptoms, shall...reverse the conditions of his life. Wont to live in a house, he shall sleep in a tent, or...lie beneath ‘the moon’s white benediction.’ So shall he be in the open air all day and all night...if cold, he shall find warmth in the ‘ruby wealth of roaring logs’ he has helped to chop and carry. The best part of his meals he shall earn by sweet labor with his rod or his gun.²⁶⁰

Journeying from the city to the country, from the asphalt jungle to virgin wilderness, abandoning stocks and dividends for rods, guns and axes, the male neurasthenic cured himself by playing the part of his “naked ancestors”—a role reverse to “the conditions of his life.” The camp cure, then, counteracted the degenerative and emasculating effects of over-civilization through regular inoculations of physical activity and outdoor

²⁵⁹ S. Weir Mitchell, “Clinical Lecture on Nervousness in the Male,” *The Medical News and Library* 35 (1877), 178-179.

²⁶⁰ Mitchell, *Nurse and Patient and Camp Cure*, 47.

adventure.²⁶¹ “Barbarism,” like social Darwinism itself, collapses several meanings of distance and difference. The “return to barbarism” advocated by Mitchell simulated both the first contact between immigrants and the American frontier and the lives of late nineteenth-century “barbarians”—the working-class “hand workers” and racial others on the lower rungs of the evolutionary ladder.

The camp cure paralleled other attempts by late nineteenth-century men to seek out and reclaim what Anthony Rotundo has termed “primitive masculinity.” After the Civil War, cultural figures from William James to Theodore Roosevelt began to voice their fears that the modern, over-civilized man had lost touch with his primal instincts and drives, the very passions he needed in order to succeed in the contemporary world and the modern marketplace.²⁶² They therefore encouraged men from the business and professional classes to regain these primitive passions by taking part in a range of “savage” or “barbaric” activities appropriated from racial others or working-class men.²⁶³ As neurasthenics went on camp cures to hunt, fish and bivouack their way back to virility, the faux-Native American rituals and ceremonies adopted by the many fraternal orders founded during this period “provided solace and psychological guidance during

²⁶¹ Barbara Will, “The Nervous Origins of the American Western,” *American Literature* 70, no. 2 (1998), 300.

²⁶² The literature on Roosevelt and the doctrine of the “strenuous life” is extensive. See, for instance, Bederman, *Manliness and Civilization*, esp. 170-217.

²⁶³ Anthony Rotundo, *American Manhood: Transformations in Masculinity from the Revolution to the Modern Era* (New York: Basic Books, 1993), 227-232. Rotundo’s discussion of “primitive masculinity” can be situated within the larger antimodernist impulse that T.J. Jackson Lears has traced through cultural formations ranging from the Arts and Crafts movement to neo-Medievalism. T.J. Jackson Lears, *No Place of Grace: Antimodernism and the Transformation of American Culture* (Chicago: University of Chicago Press, 1981).

the young man's troubled passage to manhood in Victorian America."²⁶⁴ By adopting these "barbaric" rituals, men sought to reclaim a powerful and primal masculinity that social and racial others supposedly embodied and that they themselves were on the verge of sacrificing to the Moloch of modernity. As Rotundo observes, "men who saw themselves as the pinnacle of civilization were zealous to play the parts of those they considered primitive."²⁶⁵

However, nowhere was this new, physically-embodied masculinity more spectacularly conveyed than on the playing field and in the gymnasium. If the characteristics and qualities that had defined the self-made man at the beginning of the century were unattainable at its end, men could still recuperate their eroding masculinity by remaking their bodies in the image of this archetype. Action, as Park explains, "was the watchword of the new ideal."²⁶⁶ In the 1880s, the physical culture movement that had been gathering momentum since the 1850s reached a fever pitch. According to a 1905 bibliography, only 69 books and articles dedicated to physical training were published in the United States in the 1870s. Over the course of the next decade, there were 371 new publications, over a five-fold increase.²⁶⁷

The 1880s also saw the rapid, nation-wide expansion of collegiate athletics, as universities and colleges replaced older, informal sporting organizations with

²⁶⁴ Mark Carnes, *Secret Ritual and Manhood in Victorian America* (New Haven: Yale University Press, 1989).

²⁶⁵ Rotundo, *American Manhood*, 228.

²⁶⁶ Roberta J. Park, "Physiologists, Physicians, and Physical Educators: Nineteenth-Century Biology and Exercise, Hygienic and Educative," in *Sport and Exercise Science: Essays in the History of Sports Medicine*, ed. Jack W. Berryman and Roberta J. Park (Urbana: University of Illinois Press, 1992), 141.

²⁶⁷ J. H. McCurdy, *A Bibliography of Physical Training* (Springfield: Physical Directors' Society of the Young Men's Christian Associations of North America, 1905).

departments of physical education and constructed new college gymnasias.²⁶⁸ Advocates of physical education encouraged young men to take up baseball and football specifically because they were thought to inculcate aggression and competitiveness, male passions that, previously deemed dangerous, were now considered healthy and essential components of Gilded Age manhood.²⁶⁹ In an 1883 letter, Charles Francis Adams emphasized the social urgency of developing a muscular and active collegiate student body. “I think we’ve had all we want of ‘elegant scholars’ and ‘gentlemen of refined classical taste’,” Adams wrote. “I want to see more University men trained up to take a hand in the rather rough game of American nineteenth-century life.”²⁷⁰ By 1887, an editorial titled “Brains and Brawn” published in the University of Pennsylvania student paper *The Pennsylvanian* could proclaim, “again we are swinging in the world’s ever-recurring cycles into a renaissance of physical culture. In truth, the fashion of starving into intellectuality, or of evaporating into spirituality, is at last growing unpopular, and a demand for swarthier, fuller blooded, more vigorous and manly stamp of intellectual and spiritual leaders is rising.”

This new cultural authority of the “icon of the muscular, ‘active,’ male body” was also shaped and validated by contemporary physiological researches that gave new credence to the old adage from Juvenal, *mens sana in corpore sano*. In the second half of the century, the physiological researches of, among others, Emil du Bois-Reymond and Hermann von Helmholtz had indicated that mind and body were not discrete entities, but

²⁶⁸ According to a special report published by the Bureau of Education in 1886, thirteen universities and colleges constructed gymnasias between 1882 and 1884, and at least three more were under construction. In comparison, only sixteen gymnasias were built in the 1860s and 1870s. Edward Mussey Hartwell, “The Rise of College Gymnasias in the United States,” in *Special Report by the Bureau of Education of World’s Industrial and Cotton Exposition, New Orleans, 1884-1885* (Washington: U.S. Government Printing Office, 1886), 432-433.

²⁶⁹ Rotundo, *American Manhood*, 222.

²⁷⁰ Quoted in Rotundo, *American Manhood*, 224.

rather integrated and interdependent. As Du Bois Reymond wrote, “all forms of bodily skill, such as dancing, skiing, skating, riding, swimming, fencing, etc., depend in the end on a complicated activity and on the suitable interaction of impressions obtained through the senses of which we are only partially conscious. All these accomplishments, therefore, pertain equally as much to the nervous system as to the muscles.” “All gymnastics,” he concluded, “is as much exercise for the nervous system as for the muscles.” Proponents of physical culture seized upon these findings to argue, mainly through analogy, that the development of the body, the development of will power, and the development of moral character were intimately connected.²⁷¹ According to these new researches, the body neither contained the man’s essential being nor expressed the inner self to the world; instead, the body—in a way that surpassed the metaphorical—*was* the man. Thus, the cultural conflation of powerful physicality with moral and intellectual superiority was validated by physiological research that proved the development of the corporeal system fundamental to the achievement of mental and moral power.

The many physical culture manuals and collegiate athletics programs published and founded in the 1880s framed the “training up” of men as, first and foremost, a project of visibility: to be remade in the gymnasium or on the athletic field, the body first had to be fully seen. In 1879, William Blaikie published *How to Get Strong and How to Stay So*, an immensely popular fitness guide that went through several editions before it was

²⁷¹ Roberta J. Park, “Biological Thought, Athletics and the Formation of a ‘Man of Character,’” *The International Journal of the History of Sport* 24 no. 12 (December 2007), 1543-1569; Park, “Physiologists, Physicians, and Physical Educators,” 154-6.

expanded and republished in 1899.²⁷² While Blaikie's text prescribes exercises to compensate for specific physical deficits, it focuses as much on the faculty of sight as it does on the physical faculties. Before Blakie even begins to discuss exercise, he first teaches the reader how to see and judge the body, how to discriminate between well-formed and poorly-developed muscles. He opens the first chapter with a detailed description of a New York street corner crowded with "men of all nations and ages, heights and weights." Blaikie and exhorts his reader to,

Look at [the men] carefully as they pass, and you will see that scarcely one in ten is either erect or thoroughly well-built. Some slouch their shoulders and double in at the waist; some over-step; others cant to one side; this one has one shoulder higher than the other, and that one both too high; some have heavy bodies and light legs, others the reverse; and so on, each with his own peculiarities. A thoroughly erect, well-proportioned man, easy and graceful in his movements, is far from a frequent sight.²⁷³

Blaikie therefore directs the reader to picture, through a sort of imaginative projection, the crowd of malformed men and describes each man's "peculiarity" in minute and vivid detail.

Blaikie uses this device several times throughout the book. At one point he urges the reader to, "stand by the gate as the senior class of almost any college in this country files out from its last examination before graduation, and look the men carefully over" to gauge the relative strength and weakness of legs, arm and torsos, all of which Blaikie details in full.²⁷⁴ Several pages later, he directs the reader's mind's eye to a college rower whose "calves have come to be well-developed and shapely, and so too have his thighs, while his loins are noticeably strong-looking and well muscled up, and so indeed is his

²⁷² William Blaikie, *How to Get Strong and How to Stay So* (New York: Harper & Brothers, Publishers, 1879, 1899).

²⁷³ Blaikie, *How to Get Strong and How to Stay So* (1879), 9.

²⁷⁴ Blaikie, *How to Get Strong and How to Stay So* (1879), 32.

whole back.”²⁷⁵ And so Blaikie continues this virtual inspection, moving up the rower’s body from ankle to neck, visually dissecting each and every physical feature on the way. Blaikie enjoins the reader to translate this verbal portrait, which fills nearly two pages, into an image and to judge it accordingly—“Certainly it will not be claimed that his is not a well developed body,” he writes. “Let us look at him and see.”²⁷⁶ Blaikie thus transforms these humdrum bodies of college students, rowers, and urbanites into spectacles. Through these repeated appeals to vision, he normalizes the close scrutiny of the male body and gives his reader license to take part in it.

Furthermore, in *How to Get Strong and How to Stay So*, Blaikie uses woodcut reproductions of photographs to emphasize the importance of bodily visibility to the workings of physical culture. In the second chapter, titled “Half-Built Boys,” Blaikie includes two illustrations of oarsmen, professional and college respectively (Figures 17, 18). The woodcuts, which face each other on consecutive pages, both feature men casually sitting in chairs. While one figure wears a singlet that leaves his arms and sides exposed, the college rower bares his naked chest. Cropped to half-length and eliminating any background details, the woodcuts carefully delineate the musculature of both sitters. Blaikie explains that he included these images as illustrations of “warped” men “imperfectly developed in muscles not used in rowing.” He orders the reader to look closely at the images, to “notice in the cuts...the flat and slab-sided, almost hollow, look about the upper chest and front shoulder,” and to compare these “warped” figures to the image on the book’s cover (Figure 19).²⁷⁷ Blaikie contrasts the rowers’ hollow chests,

²⁷⁵ Blaikie, *How to Get Strong and How to Stay So* (1879), 36.

²⁷⁶ Blaikie, *How to Get Strong and How to Stay So* (1879), 33.

²⁷⁷ Blaikie, *How to Get Strong and How to Stay So* (1879), 38.

scrawny arms and shoulders “plainly warped and rounded forward” against the bulging muscles and barrel chest of the cover model.

This comparative method of analysis became the *modus operandi* of the expanded 1899 edition of *How to Get Strong and How to Stay So*. Benefiting from the ready availability of cheap photographic reproductive technology, in this edition Blaikie substituted the woodcuts of the “half-built” oarsmen with photographs of the Ward brothers, who won several four-oar and singles championships in the 1860s, and the world champion Canadian rower Edward Hanlan (Figures 20, 21).²⁷⁸ In place of the original cover illustration, Blaikie swapped in an image of a Robert J. Roberts, a pioneer of the early physical culture movement (Figure 22).²⁷⁹ In the image, Roberts stands facing away from the viewer and, dressed only in briefs, flexes his arm and back muscles. Yet, as in the previous example, the physical differences between Roberts and the underdeveloped Wards and Hanlan only become apparent after a minute examination of the images. Blaikie’s text compels the reader to flip back and forth between the plates and the cover, to study each image separately and, importantly, to compare one arm to another, one torso to the next.

Blaikie’s text therefore demands an interaction with the photographed bodies that is both analytical in its detachment, couched as it is in forensic language that reduces the body to discrete muscles and limbs, and intimate in its duration and intensity, in its very access to the naked form. The kind of spectatorship Blaikie’s text models is, above all, active—it judges, scrutinized, and measures the bodies he describes and presents to the viewer through photographs. Yet, Blaikie also intimates the opposite: that, as the reader

²⁷⁸ Blaikie, *How to Get Strong and How to Stay So* (1899), 20-22.

²⁷⁹ Blaikie, *How to Get Strong and How to Stay So* (1899), 82.

strengthens his muscles and compares his legs to others' legs, his arms to others' arms, his body will also become the subject of another's analytical gaze. By involving his reader in the bodily display he describes, Blaikie implies that physical culture both creates the space for and operates through the visual exchange between men. And this circuit of active gazes he describes within the text also models real-world visual encounters in the gymnasium. Blaikie thus teaches his readers not only "how to get strong and stay so," but also—and equally importantly—how to see and be seen. To develop an ideally masculine body men, Blaikie implies, must become both spectacles and spectators.

It is significant that, in 1881, Roberts coined the term "bodybuilding." The phrase "physical culture" placed exercise within a high-minded and elite realm, implying that, while the body may have been the medium, it was the mind and morals that were being developed. In contrast, "bodybuilding" connected the gymnasium and its adherents with the working classes—"hand workers" rather than "head workers"—who were, simultaneously, social and cultural inferiors and models of the superior physicality to which the poorly-formed middle and upper-classes aspired. These two names, then, expressed the irresolvable contradictions that "primitive masculinity" held in uneasy suspension. Roberts is, writes Blaikie, both "a rare model indeed" and "an object lesson" to be examined and emulated. "A statuette of him in each gymnasium and gallery of art," he concludes, "would be eloquent of the best type of nineteenth century physical manhood."²⁸⁰

²⁸⁰ Blaikie, *How to Get Strong and How to Stay So* (1899), 84.

The fantasy of rendering the body wholly observable was the cornerstone of the physical education program that the University of Pennsylvania instituted in 1883, the year Muybridge arrived to begin his photographic investigations. For the previous decade, athletics at the University of Pennsylvania had been under the aegis of the Athletic Association, which had been founded in 1873 “for the promotion of manly exercises.”²⁸¹ In 1882, the Association was reorganized and incorporated. Executive powers transferred from the University’s students to its alumni, who took on the financial burden of all intercollegiate sports.²⁸² The *Philadelphia Times* reported that the reorganized Athletic Association aimed to “systematize the athletic training of the undergraduates.”²⁸³ It took as its motto “mens sana in corpore sano.” These changes were necessitated by the poor conditions of the University’s facilities and athletic program. A writer for University’s student newspaper complained in 1882, “few members of the University, outside of the undergraduates, have any idea of the disadvantages under which our athletics are conducted. We have no suitable gymnasium; no athletic grounds; no track upon which to hold our sports.”²⁸⁴ Soon these disadvantages would be alleviated. In 1883, the University’s Board of Trustees accepted funding from the Athletic Association to build new facilities and approved the use of the land bounded by 36th and 37th streets to the east and west, and Spruce and Pine to the north and South for new athletic fields.²⁸⁵ In May of 1885, the athletic grounds were completed and, in December,

²⁸¹ University of Pennsylvania, *University Record* 4 no. 1 (Philadelphia: Spangler & Davis, 1874), 23.

²⁸² “The University’s Athletes: A Movement to Gather them all Into One Association,” *The Times*, Philadelphia, April 18, 1882, 4.

²⁸³ “University Athletic Club: Opportunities to be Given the Students for Physical Development,” *The Times*, Philadelphia, November 22, 1882, 2.

²⁸⁴ *The University Magazine* 8 no. 2 (December 20, 1882), 16.

²⁸⁵ “A University Gymnasium,” *The Philadelphia Inquirer*, November 23, 1883, 8.

a new gymnasium opened on the bottom floor of University Hall.²⁸⁶ While these facilities were being constructed, Muybridge was photographing University students in motion in his outdoor studio at Pine and 36th streets, a stone's throw away from the new athletic grounds (Figure 23).

However, Provost William Pepper had long envisioned the full integration of physical culture into the college curriculum, and a greater institutional intervention in the bodies of its students. Largely through Pepper's leadership, in December of 1884 the University had founded a Department of Physical Education and appointed Dr. J. William White, a demonstrator of surgery and lecturer on venereal diseases in the Department of Medicine, as its first Director and faculty member.²⁸⁷ The University also added to its athletics staff Ellis Ward, the rower whose "warped" body appears in Blaikie's book, and, in 1885, Richard Pennell, a "well-known trainer of the New York Athletic Club," who would, along with White, be put in charge of the gymnasium.²⁸⁸ Care of the bodies of the student body would thus be split between the Athletic Association and the new Department; while the former would, as the *Times* noted, "systematize" athletic teams and competitions, the later would supervise the students' physical development.

But, for both White and Pepper, the new regime of physical culture that the University instituted also had racial and social valences: its larger purpose was to build the bodies of University students in the image of an upper-class, Anglo-saxon ideal. Like

²⁸⁶ "University Athletics: Opening of the New Gymnasium—an Address by J. William White," *The Times*, Philadelphia, December 4, 1885, 2; "The New Gymnasium: Prof. J. William White, M.D. Delivers the Dedicatory Address," *The Philadelphia Inquirer*, December 4, 1885, 3.

²⁸⁷ *The University Magazine* 10 no. 7 (December 20, 1884), 190; University of Pennsylvania, *Annual Reports of Provost and Treasurer of the University of Pennsylvania, for the year Ending October 1, 1885* (Philadelphia: Collins Printing House, 1887), 16. White also maintained appointments in the Department of Medicine, and was promoted to clinical professor of genito-urinary diseases in 1886.

²⁸⁸ "Students' Sports. The Professional Trainer and his Place in Physical Education. Symmetrical Development," *The Times*, Philadelphia, May 30, 1886, 9. This article wrongly identifies Pennell as Robert Pennell.

many physical education proselytizers, White considered himself the steward of the moral as well as physical development of his students. In 1887 White presented a defense of athletics in a lengthy article titled “A Physician’s View of Exercise and Athletics.”²⁸⁹ Like many physical culture advocates, White argued that the “association between physical, intellectual, and moral strength is a natural one, unchangeable in its essential principles.” Yet, White also quotes heavily from the British ethnologist John Beddoe’s study “On the Stature and Bulk of Man in the British Isles.” Beddoe’s work added race to the chain connecting the physical to the moral and intellectual. Quoting Beddoe, White notes, “if we examine only a single race...we shall find that wherever that race attains its maximum of physical development it rises highest in energy and moral vigor.”²⁹⁰ But what at first seems like relativism is actually biological determinism: for Beddoe used race as a category both to differentiate between social groups and to claim civilization itself as the product of the superior physicality of the upper classes. The vigorous and muscular student body that White hoped to build may have been borrowed from the nebulous class of racial and social “primitives,” but it embodied specifically upper-class and Anglo-Saxon virtues. For Pepper, too, “the development of the white, male student body was directly linked to white racial progress.”²⁹¹ In 1887, Pepper delivered a public address on the occasion of an athletic exhibition by American and British athletes. After speaking about the important place of physical education within the college curriculum he concluded, “it is to the cultivation of manly and courageous qualities, and to the promotion of sound education and training among those two great branches of the

²⁸⁹ J. William White, “A Physician’s View of Exercise and Athletics,” *Lippincott’s Monthly Magazine* 29 (June 1887), 1008-1033.

²⁹⁰ White, “A Physician’s View of Exercise and Athletics,” 1012.

²⁹¹ Brown, “Racialising the Virile Body,” 639.

English speaking race that the world has most to hope for in the maintenance of peace and the ultimate triumph of liberty.”²⁹²

Physical development at the University took place within a scopic regime that used anthropometric measurements, charts and photographs to identify and make difference and deviance visible. One of the primary duties of the Department of Physical education was the systematic analysis and observation of undergraduate bodies. Each incoming student was, according to White, “carefully examined as to his weight, height, the circumference of his chest, and the size and condition of his legs, thighs, arms, and forearms,” as well as given a battery of tests to establish strength and lung capacity.²⁹³ These measurements were then “repeated at stated intervals, certainly once a year of his college life, and the record will show the improvement or deterioration of each student.” For all students, White states in the 1887 University course catalogue, “require to have their work, whether voluntary or compulsory, directed by proper methods, so that the result may be a harmonious and symmetrical development of the entire organism.”²⁹⁴

This minute accounting of the bodies of University of Pennsylvania students had a specific source and model. Like many of the collegiate athletic programs instituted in the 1880s, the University of Pennsylvania patterned its new Department of Physical Education as well as its new gymnasium after the program and facilities designed by Dudley Allen Sargent at Harvard University.²⁹⁵ After arriving at Harvard 1879, Sargent continued to refine the exercise system he had devised as the Director of Gymnastics at

²⁹² “Page beats his Record. Six Feet and Four Inches Made by the High Jumper. Scenes of Wild Excitement on the University Grounds. The Greatest of Great Days for the Famed Athlete-Presented with a Costly Gold Watch,” *The Times*, Philadelphia, October 8, 1887, 3. Cited in Brown, 639.

²⁹³ White, “A Physician’s View of Exercise and Athletics,” 1031.

²⁹⁴ University of Pennsylvania, *Catalogue of the University of Pennsylvania, 1886-1887* (Philadelphia: Collins, 1887), 137.

²⁹⁵ The University Magazine reported that Sargent “will furnish all the necessary apparatus” for the new gymnasium. *The University Magazine* 11 no. 2 (October 5, 1885), 20.

Bowdoin College.²⁹⁶ The “Sargent system” had two primary components: measurements to gauge weakness and bodily asymmetries, and purpose-built exercise machines, or “developing appliances,” to strengthen underdeveloped muscle groups. Many of the Universities and colleges that instituted physical education programs in the 1880s adopted the Sargent system. According to a special report issued by the Department of Education in 1886, in eight of the thirteen colleges and universities that built gymnasias between 1881 and 1885 (what the report terms the “third period” of gymnasias building), “the Sargent system is in vogue to a great extent” while a number of additional schools were “chiefly fitted with the Sargent appliances.”²⁹⁷ At the same time, Sargent’s developing appliances were marketed to physical culture enthusiasts across the country, and his system reached a broad public through Blaikie’s *How to Get Strong and Stay So*, which largely espouses Sargent’s methods and philosophy.²⁹⁸

As the Sargent system reached its full realization in the 1880s, anthropometry, or the study of the measurements and proportions of the body, played an ever more central role.²⁹⁹ Anthropometry was first developed by anthropologists in the late eighteenth century. However, it was not widely applied until the mid-nineteenth century, when it was used primarily for racial classification.³⁰⁰ Like many nineteenth-century practitioners of anthropometry, Sargent believed in the close interdependency of measuring and

²⁹⁶ Carolyn de la Peña, *The Body Electric: How Strange Machines Built the Modern American* (New York: New York University Press, 2003), 51-55.

²⁹⁷ Hartwell, “The Rise of College Gymnasias in the United States,” 432-433.

²⁹⁸ As de la Peña discusses, the direction of influence is up for debate; de la Peña concludes that, although Sargent never credited him, Blaikie most likely contributed to Sargent’s ideas about physical fitness as well as publicizing them. de la Peña, *The Body Electric*, 53.

²⁹⁹ According to Roberta J. Park, “In America, anthropometric measuring of college-aged students had begun in 1861 when Edward Hitchcock was appointed professor of hygiene and physical education at Amherst College.” Roberta J. Park, “Muscles, Symmetry and Action; ‘Do you Measure Up? Defining Masculinity in Britain and America from the 1860s to the early 1900s,” *The International Journal of the History of Sport* 22 no. 3 (May 2005), 379.

³⁰⁰ John S. Haller, Jr. *Outcasts from Evolution: Scientific Attitudes of Racial Inferiority* (Carbondale: Southern Illinois University Press, 1971), 3-39.

observing. Quoting the British anthropometrist Charles Roberts, Sargent noted, “the indispensable part of the experimental observation of physical facts is the measurement of quantities.”³⁰¹ Close observation required the body to be measured with greater accuracy and in finer detail. Sargent therefore enlisted into his collegiate physical education program a vast array of statistical measures, purpose-built apparatus, and measurement devices to augment observation with numerical data. Sargent took forty anthropometric measurements of each Harvard freshman, ranging from the circumference of the head to the length and girth of the forearm and thighs.³⁰² Sargent also measured strength with “three spring-dynamometers, a spirometer, a manometer, a pair of suspended rings, and a set of parallel bars.” These devices allowed the ingenious physical educator “to test the strength of nearly every part of the body.” The end result of these physical tests and battery of examinations was a comprehensive data set meant, as Sargent wrote, to “widen the range of observation.”³⁰³

Furthermore, Sargent created a graphical representation of each student by plotting his measurements on a patented “Sargent Anthropometric Chart.” Sargent’s thinking was informed by the work of the Belgian astronomer, statistician and sociologist Adolphe Quetelet. By applying statistical methods to social phenomena, Quetelet determined that large sets of social data—for instance, anthropometric measurements—always fell in a binomial distribution. The “*homme moyen*,” or typical man, stood at the absolute statistical mean or center of the bell curve, while deviations from this type were

³⁰¹ D.A. Sargent, “The Physical Proportions of the Typical Man,” *Scribner’s Magazine* 2 no. 1 (July 1887), 7.

³⁰² de la Peña, *The Body Electric*, 64.

³⁰³ Sargent, “The Physical Proportions of the Typical Man,” 7.

equally distributed on either side.³⁰⁴ So regular were these distributions that scientists and social theorists, including Francis Galton and Herbert Spencer, saw in Quetelet's findings "empirical revelation of natural law."³⁰⁵

Sargent believed that, unlike classical canons of beauty, the typical man was a real, statistically derived ideal. "Unfortunately the wise and good men of old have left us no standards by which to judge of symmetry or strength. The ancient masterpieces...were made largely from ideal standards, certainly not from actual measurements."³⁰⁶ Because the "typical man" represented the statistical mean Sargent reasoned that his muscular development would be perfectly symmetrical, with each muscle strong in and of itself and perfectly in proportion to all others. Accordingly, the "Sargent anthropometric chart" was pre-printed with a straight line representing the average of, he claimed, ten thousand young men—in other words, a "typical man."³⁰⁷ "This," Sargent writes, "is the grand object to be attained. The straight line is the physical sign of health and longevity, of perfect structure and harmony of function, and a symmetrical development of the whole body."³⁰⁸ When an individual student's measurements were plotted, the chart revealed every positive and negative deviation from the symmetrical, straight-line ideal. With a single glance, a student could see whether the girth of his chest, length of his right forearm, and lung capacity surpassed or fell short of the normal standard, and gauge which body parts should be built up accordingly. An 1886 "Sargent Anthropometric

³⁰⁴ For a discussion of Quetelet's social statistics and photography, see Allan Sekula, "The Body and the Archive," *October*, vol. 39 (Winter, 1986), 19-23.

³⁰⁵ John F. Kasson, *Houdini, Tarzan and the Perfect Man: The White Male Body and the Challenge of Modernity in America* (New York: Hill and Wang, 2001), 41.

³⁰⁶ Sargent, "The Physical Proportions of the Typical Man," 6.

³⁰⁷ Dudley Allen Sargent, *An Anthropometric Chart, Showing the Relation of the Individual in Size, Strength, Symmetry and Development to the Normal Standard*. UPA 3, Box 58 (1886), University of Pennsylvania Archives, General Administration Records, "Physical Education."

³⁰⁸ Sargent, "The Physical Proportions of the Typical Man," 16.

Chart” filled in with the measurements of a somewhat underweight student with below average arm strength and above average chest girth now housed in the University of Pennsylvania archives suggests that White also implemented this element of the Sargent System (Figure 24).³⁰⁹

The physical asymmetries revealed by the Sargent chart were, he believed, the result of culture, not nature. Just as Beard attributed the epidemic of neurasthenia to modern American civilization, so too did Sargent believe that, although the “tendency of the race is to attain this type”—the symmetrical “typical man”—in the United States this natural law “is controverted by social laws that tend to foster an inharmonious development. The division of labor, for instance, has made it possible for a man to earn a livelihood and to maintain a footing in the world by the use of very few muscles and faculties.”³¹⁰ In Sargent’s view, then, both the overdeveloped, brawny forearms of a blacksmith and the weak arms of the University of Pennsylvania student mentioned above were unnatural distortions, the unfortunate byproducts of civilization. But, as exemplified by Blaikie’s “warped” rowers, the unevenly muscled bodies of athletes also, according to Sargent, signified modernity’s subversion of nature and natural law. As de la Peña writes, “the yeoman farmer, symbol of vigorous national health since Jefferson’s time, and the athlete, a hero of strength since ancient Greece, were proven weak through the very accomplishments that once validated their strength.”³¹¹

To achieve the symmetrical muscular development of Sargent’s “perfect form or type of man,” the student had to reverse the ill effects of civilization on the body. To do so, Sargent prescribed exercises with his patented “developing appliances” that mimicked

³⁰⁹ Sargent Anthropometric Chart, UPA 3 Box 58.

³¹⁰ Sargent, “The Physical Proportions of the Typical Man,” 16.

³¹¹ de la Peña, *The Body Electric*, 54.

the motions performed by laboring bodies. For, Sargent reasoned, if specific forms of labor targeted specific muscle groups, “why will not a system of exercises in the gymnasium, resembling actual labor, accomplish the same result in opposite directions, and in this way be made to supplement the deficiencies of one occupation, and to develop him where he is weak.”³¹² Sargent might direct the weak-armed University of Pennsylvania student to build up his muscles with the use of pulley weights that mimicked the motion of chopping—swinging the weight over the head and down—or sawing—pulling the weight back and forth.³¹³ In this way, the Sargent system participated in the late nineteenth-century discourse of “primitive masculinity:” within the hallowed halls of Harvard and the University of Pennsylvania, students who would soon become the “scientists, physicians, lawyers, clergymen, orators, statesmen, literati and merchants” who comprised Beard’s class of “brain workers,” played the part of manual laborers to build an ideally masculine body and compensate for the degenerative forces of modernity.

Yet, while these symmetrical bodies may have been produced through simulated manual labor, they were visibly different than the bodies of the farmers or blacksmiths whose movements they mimicked. The machine-built body “was not simply an atavistic recapitulation of some classical or primitive past, nor was it the sign of a history of labor or competitive play; rather it signified the history of its own disciplined self-creation.”³¹⁴

Moving from one machine to another, the student would progressively build up his

³¹² D.A. Sargent, “The System of Physical Training at the Hemenway Gymnasium,” in *Physical Training: A Full Report of the Papers and Discussions of the Conference Held in Boston in November, 1889*, ed. Isabel C. Barrows (Boston: Press of George H. Ellias, 1890), 63.

³¹³ de la Peña, *The Body Electric*, 57.

³¹⁴ James B. Salazar, *Bodies of Reform: The Rhetoric of Character in Gilded Age America* (New York: New York University Press, 2010), 144.

underdeveloped muscles, molding his body to achieve a symmetrical form that signaled masculine strength of character, moral balance and well-developed will power. At first glance, Sargent's system seems to follow the assembly-line logic that, in the late 1880s, was only just beginning to characterize industrial capitalism. Yet, Sargent's vision was far from utopian or democratic. Unlike the blacksmith whose livelihood shaped his overdeveloped arms, the University student's body, broken down into minute measurements and built up by Sargent's "developing appliances," signaled that its owner could afford to spend time going through the motions of chopping and sawing in the gymnasium, far removed from both productive labor and laboring bodies. Sargent's ideally symmetrical, mass-produced bodies thus made class affiliation visible.

Sargent's system also enlisted photography into its regime of bodily visibility: he not only took detailed anthropometric measurements of each incoming Harvard freshman, but also photographed them. Sargent began the systematic use of photography as an adjunct to anthropometry in 1885, but photographs in the Harvard archives suggest that he began the practice—at least sporadically—in the early 1880s.³¹⁵ These photographs were "preserved for comparison with those to be taken of him later" as the student advanced through the course of weight training and exercises Sargent prescribed.³¹⁶ In yoking photography to anthropometry, Sargent drew upon techniques of anthropometric photography developed in the 1860s when, through the marriage of the purportedly objective photograph and quantifiable anthropometric data, ethnologists and

³¹⁵ Anthropometric Photographs, UAV 689.270.7 and UAV 689.270.7.1, Harvard University Archives.

³¹⁶ D.A. Sargent, *Physical Education* (Boston: Ginn & Company, 1906), 137.

physical anthropologists hoped to substantiate evolutionary race theories by establishing a hierarchy of racial classification.³¹⁷

There is no evidence that the University of Pennsylvania adopted the practice of taking before and after photographs of its students when they implemented the Sargent system. However, the use of anthropometric photography was widespread in University athletic programs. Many of the Universities that used the Sargent system, including Yale and Princeton, amassed vast archives of anthropometric photographs.³¹⁸ While Sargent standardized his anthropometric photographs and rendered his students' bodies quantifiable by posing them next to a measuring stick, many physical educators advocated photographing students in front of a screen crisscrossed with evenly-spaced, white threads running vertically and horizontally to form a grid. After John H. Lamprey, Assistant Secretary of the Ethnological Society of London, published a description in 1869, this system was widely adopted by ethnographers and anthropologists.³¹⁹ The grid mitigated the problems of lens curvature and perspective that had plagued previous attempts to glean morphologically accurate measurements from photographs. It also aided the project of comparative ethnography. With the addition of the gridded backdrop, photographers could amass an archive of standardized photographs and eliminate extraneous visual information such as background details. As Lamprey explained, by

³¹⁷ For anthropometry and photography, see Frank Spencer, "Some Notes on the Attempt to Apply Photography to Anthropometry During the Second Half of the Nineteenth Century," in *Anthropology and Photography 1860-1920* ed. Elizabeth Edwards (New Haven: Yale University Press, 1992), 99-107; Elazar Barkan and Ronald Bush, ed. *Prehistories of the Future: the Primitivist Project and the Culture of Modernism* (Stanford: Stanford University Press, 1995), especially part IV (Ethnographic Images); Elizabeth Edwards, "Photographic 'Types': The Pursuit of Method," *Visual Anthropology* 3, nos. 2-3 (July 1990): 235-58; James Ryan, *Picturing Empire: Photography and the Visualization of the British Empire* (Chicago: University of Chicago Press, 1997).

³¹⁸ These photographs were the late nineteenth-century forebears of the "posture photographs" taken at many Ivy League schools until as late as the 1970s. See Patricia Vertinsky, "Embodying Normalcy: Anthropometry and the Long Arm of William H Sheldon's Somatotyping Project," *Journal of Sport History* 29 (2002), 95-133.

³¹⁹

photographing figures in front of the screen, “the anatomical structure of a good academic figure or model of six feet can be compared with a Malay of four feet eight in height” (Figure 25).³²⁰

Muybridge also began using the Lamprey grid early in the summer of 1885 as he photographed athletes running, batting, and playing catch. Marta Braun and Elspeth Brown have demonstrated that Muybridge first adopted the gridded backdrop when he photographed Ben Bailey, identified in the Prospectus as “a mulatto and professional pugilist,” early in the summer of 1885 (Figure 26).³²¹ Brown has further shown that Harrison Allen, Francis X. Dercum, Joseph Leidy and William Pepper—all either members of the Muybridge commission or, in the case of Dercum, a close collaborator—were also founding members of the American Anthropometric Society and that their individual researches “had various linkages to shifting ideas of race science in the nineteenth century.”³²² Brown thus convincingly argues for the complicity of *Animal Locomotion* with a “discourse of racial hierarchy that placed the European or white race at the top and Africans and American Negroes at the bottom.”³²³ Of the photographs of Ben Bailey, she writes, “although the other ninety-four models were white, the

³²⁰ J. H. Lamprey, “On a Method of Measuring the Human Form, for the Use of Students in Ethnology,” *Journal of the Ethnological Society* 1 (1869), 85. This is the system that Paul C. Phillips, director of the department of physical education and hygiene at Amherst, suggests in his 1894 address “Photography in Anthropometry,” in *Report of the Ninth Annual Meeting of the American Association for the Advancement of Physical Education* (New Haven: Clarence H. Ryder, 1894), 17-25.

³²¹ In his experimental notebooks now housed in the George Eastman House, Muybridge recorded information about each model he photographed, as well as mechanical details and a negative series number. This numbering system bears no relation to the published plate numbers. Therefore, reconstructing the chronology of the motion studies requires using Muybridge’s collotype proofs, which are labeled with both numbers, to match negative number to plate number. Three out of (an assumed) four notebooks are extant; the first, which most likely detailed negative series 1-523 is missing. The second begins with 524 and continues to negative 1084 (June 2–August 4, 1885), the third, negatives 1322-1540 (September 15–October 28, 1885). *Muybridge Notebooks*, George Eastman House, International Museum of Photography and Film, Rochester, NY.

³²² Brown, “Racialising the Virile Body,” 639.

³²³ Brown, “Racialising the Virile Body,” 642.

anthropometric grid first appears behind the only model who was African American. It is as if the non-white ‘other’ cannot be understood, scientifically, without the anthropometric grid, a technology for mapping racial difference.”³²⁴ As Braun summarizes, the grid’s “simultaneous appearance with Bailey transforms him from a subject into an object, part of the taxonomy of race constructed by *Animal Locomotion*.”³²⁵

Brown and Braun argue, in effect, that Muybridge’s studies of Bailey exemplify what Allan Sekula has termed photography’s repressive function. Photography is, Sekula claims, a “double system: a system of representation capable of functioning both *honorifically* and *repressively*.” For Sekula, photography’s essentially Janus-faced nature is made most evident through the workings of portrait photography. While the studio portrait “provides ceremonial presentation of the bourgeois self,” when the camera was turned on criminals, deviants, or racial “others,” the photograph also “came to establish and delimit the terrain of the other, to define both the generalized look—the typology—and the contingent instance of deviance and social pathology.”³²⁶ In the essay *The Traffic in Photographs*, Sekula further links these binaries to another pair: aestheticism and scientism, the two “chattering ghosts” that haunt photography.

Muybridge’s studies of Bailey, the only African American included in Muybridge’s work, thus define the “other,” and, by extension, the Anglo-Saxon, middle-class “self” of the remaining male *Animal Locomotion* models.

³²⁴ Brown, “Racialising the Virile Body,” 637. It is worth noting that *Animal Locomotion* does include one other African American model, the jockey who rides the horse “Annie G” in plates 580, 620 and 626. As Edward Hotaling has chronicled, the majority of jockeys in the nineteenth century were African American. Edward Hotaling, *The Great Black Jockeys: The Lives and Times of the Men who Dominated America’s First National Sport* (Rocklin: Forum, 1999).

³²⁵ Marta Braun, “Muybridge/Technology,” 59.

³²⁶ Sekula, “The Body and the Archive,” 6.

Several scholars have posed a similar argument about a subset of Muybridge's *Animal Locomotion* motion studies that capture no movement whatsoever. In plate 530, for instance, the model strikes a series of poses as he shifts his weight from one leg to the other and clasps his hands behind his head (Figure 27). Plate 321 is a composite of two studies; the model lifts a 50 lb dumb-bell in the top register and, on the bottom, runs through sequence of hands-on-hips poses, flexing his arms through the last four frames to better display his muscles (Figure 28). These sequences closely mirror Thomas Eakins' "naked series" photographs, sets of seven images that picture different models, both men and women, assuming a sequence of standard poses (Figure 29).³²⁷ Eakins began taking these images a year before his work with Muybridge in the summer of 1884.³²⁸ Ellwood C. Parry argues that Eakins used these photographs primarily as instructional aids, but also connects the images to Francis Galton's typological composite photographs and physician Samuel George Morton's phrenological project *Crania America*. He concludes that the impetus behind Eakins' project was largely comparative—that amassing series of standardized images would “make individual differences leap out at the viewer.”³²⁹ Drawing upon Parry's work, Allan Braddock has further contended that, in both Eakins' "naked series" and Muybridge's *Animal Locomotion*, “at issue in each case is an archival impulse to record morphologies of human difference... The Philadelphia projects were not explicitly ethnographic in the way Lamprey's was, but they nevertheless deployed similar techniques and terms; they participated in the same overarching enterprise of

³²⁷ Although Muybridge's sequences resemble Eakins' "Naked Series" photographs, they also differ from them in significant ways; the poses that the models strike vary greatly, each sequence contains more than seven frames, and they picture the model from different simultaneous angles.

³²⁸ For the background of Eakins's "Naked Series," see Anne McCauley, "'The Most Beautiful of Nature's Works,'" 36-45.

³²⁹ Ellwood C. Parry, "Thomas Eakins's Naked Series Reconsidered: Another Look at the Standing Nude Photographs Made for the Use of Eakins's Students," *American Art Journal* 20, no. 2 (1988), 65.

mapping and archiving bodies.”³³⁰ At the end of his article, Braddock invokes Sekula’s terms by proposing that Muybridge’s *Animal Locomotion* “honorifically privileged the human figure as the focus of archival practice while repressively subjecting it to a nascent scientific and bureaucratic logic, by which different types and peculiarities—racial and otherwise—were made visible and available as a body of knowledge.”³³¹

Yet, throughout *Animal Locomotion*, these binary oppositions and opposing processes are constantly confounded. While it is unclear exactly when physical educators began using the Lamprey grid, what is certain is that, in the 1880s, the anthropometric gaze of which the grid was both product and sign was also being directed toward University students. In other words, by the time the University of Pennsylvania students ran, jumped and walked between the gridded backdrop and Muybridge’s cameras, they had already been reclassified from subjects to objects of the anthropometric gaze. Thus, given the simultaneity of Muybridge’s photographic investigations and the University’s institution of the Sargent system—as well as Pepper’s close involvement in each—I would argue that the gridded backdrop was put in place to better analyze the bodies of the white college students rather than the “non-white ‘other.’” With the superadded gloss of scientificity and objectivity the grid afforded, Muybridge’s photographs could be repositioned within Sargent’s system, thereby rendering the anthropometric views taken by many physical educators unnecessary. His photographs of the University’s athletes

³³⁰Braddock, “Eakins, Race, and Ethnographic Ambivalence,” 160.

³³¹Braddock, “Eakins, Race, and Ethnographic Ambivalence,” 160-161.

served a dual purpose, as both investigations of human motion and anthropometric data.³³²

One way to reconcile these two functions is to posit that, when anthropometric photography was incorporated into physical education, the anthropometric gaze also became part of the viewing economy that Blaikie models in *How to Get Strong and Stay So*. Taken within Harvard's Hemenway gymnasium or, in Muybridge's case, in his outdoor studio adjacent to the playing fields, these photographs, in some ways, epitomize the close and calculating looking Blaikie describes. In both cases, the objective was to size men up and, by doing so, discern differences and aberrations. But it was also in these homosocial arenas, and importantly, through these viewing practices, that a new ideal of active and muscular masculinity was constructed in the 1880s. As Hatt reminds us, "the stability of masculinity depends upon the visibility of the male body; to be learnt or consolidated, masculinity requires a visual exchange between men." The spectatorial gaze and the anthropometric gaze, then, seem fundamentally incompatible: in Sekula's terms, the former functions honorifically to affirm the subjectivity and social identity of the individual, while the latter operates repressively, turning the individual's body into a body of knowledge, subject into object.

³³² Muybridge's sequences, in fact, improved upon the images taken by other physical educators. They supplied a 270 degree view of the subject, made it possible to quantify hard-to-measure cognitive and physiological functions like reaction time and coordination, and furnished more and better data for analysis than did the still, front and profile views taken by physical educators. All of these were benefits of Muybridge's photographs pointed out by writers at the time. In addition, the negative sequences of Ben Bailey are the first Muybridge recorded in his second experimental notebook, which possibly indicates that, in Muybridge's mind, he had completed one group of motion studies and begun another. This suggests that Muybridge may have added the gridded backdrop as his studio set-up, and therefore his range of representational possibilities, evolved. Muybridge Notebooks, Notebook 2, negatives 524–1084, June 2–August 4, 1885, George Eastman House, International Museum of Photography and Film, Rochester, NY. For a detailed account of the changes in Muybridge's studio set up during his time in Philadelphia, see Gordon Hendricks, *Eadweard Muybridge: The Father of the Motion Picture* (New York: Grossman Publishers, 1975), 147-200.

But Muybridge's motion studies, I would argue, represent an instance when the anthropometric gaze functioned honorifically, rather than repressively. If Sargent's photographs of incoming freshman were meant to be "preserved for comparison with those to be taken" later, Muybridge's photographs *were* those later images. As Muybridge notes in the Prospectus, the majority of his male models were University athletes, "each one of whom has a well-earned record in the particular feat selected for illustration."³³³ The University's student newspaper reported that "nearly every well-known University athlete of the past two or three years has served as model in the nude, many of them showing magnificent physiques, and exhibiting exquisitely the play of every muscle."³³⁴ By cross-referencing the *Animal Locomotion* plates against Muybridge's cyanotype proofs and experimental notebooks, it is possible to reconstruct a chronology of Muybridge's work and to identify his models. On June 3, 1885—the day after Bailey walked, climbed up and down stairs, "struck a blow" and, finally, heaved a 75-pound rock—Muybridge also photographed Morris Hacker, Jr (Figure 30).³³⁵ Hacker, then a sophomore at the University, was a member of the class of 1886 football and baseball teams.³³⁶ On the 9th, Thomas Love Latta performed for Muybridge's cameras (Figure 31). Latta, who, like Hacker and the majority of Muybridge's models and assistants, was in the sciences course at the newly founded Towne School, had an equally impressive athletic record. He not only played for the Class of 1887's baseball, football

³³³ Eadweard Muybridge, *Animal Locomotion: An Electrophotographic Investigation of Consecutive Phases of Animal Movements: Prospectus and Catalogue of Plates* (Philadelphia: J.B. Lippincott Company, 1887a), 12.

³³⁴ *The Pennsylvanian* 2 no. 13 (September 28, 1886), 106.

³³⁵ Muybridge Notebooks, Notebook 2, negatives 538-539, June 4, 1885. George Eastman House, International Museum of Photography and Film, Rochester, NY.

³³⁶ See, for instance, an account of Hacker's athletic prowess in "Athletics: '86 vs. '88," and "'86 vs. '89," *The University Magazine* 11 no. 2 (October 5, 1885), 27; "Athletics. Baseball. '86 vs. Medicals," *The University Magazine* 10 no. 16 (May 5, 1885), 220.

and tug of war teams, but was also a member of the University's baseball team, the coveted "Baseball Nine."³³⁷

Muybridge photographed both Hacker and Latta batting, catching, and pitching—all against the backdrop of the Lamprey grid. While they may have been anthropometric objects, to nineteenth century eyes, these paragons of physical fitness would have closely resembled the stable ideal against which racial "others" were compared, the biological and cultural cousins of Lamprey's "good academic figure or model of six feet" and the evolutionary superior of the "Malay of four feet eight in height" Lamprey posed against his grid. They were also, then, evidence of the efficacy of the athletic system Pepper had put into place. In these sequences, Muybridge captures bodies that had already been crafted into the Anglo-Saxon, upper-class ideal articulated by Sargent, Pepper, and White alike. This is certainly one way that Muybridge's contemporaries interpreted his photographic sequences. Upon discovering that the highest-ranking students had "more than their fair share of spinal curvature," the medical directors of Yale's athletic facilities ordered a set of motion studies of University of Pennsylvania athletes, against which these malformed weaklings—sterling examples of Blaikie's "warped" men—could be compared and evaluated accordingly.³³⁸ In Braddock's words, *Animal Locomotion* "honorifically privileged the human figure" *through*—rather than *while*—"subjecting it to a nascent scientific and bureaucratic logic."

Animal Locomotion also evinces the same contradictory impulses of appropriation and proscription that Sargent's system and other instances of "primitive masculinity"

³³⁷ "Thomas Love Latta," in *The Record of the Class of '87* (Class Yearbook). University of Pennsylvania, University of Pennsylvania Archives, 17.

³³⁸ George W. Pierson, "Apostles of Physical Culture," *Yale Alumni Magazine* (1973), 11–17. Cited in Brown. Neither the Yale librarians nor I have been unable to find any other documentation of this purchase, although Yale did institute its own program of physical culture photography during this period.

negotiated. Amongst Muybridge's student athletes and next to Ben Bailey, farmers, blacksmiths, masons, and other "laborers and mechanics" demonstrate their trades (Figures 32, 33, 34). In the Prospectus, Muybridge notes that, just as the student athletes were selected because of their athletic distinctions, "the mechanics are experts in their particular trades, and the laborers are accustomed to the work in which they are represented as being engaged."³³⁹ He thus assures the reader that all of the models are "experts" in whatever action they perform—and therefore that the action itself is a model of its kind. Muybridge thus frames his inclusion of the laborers and mechanics as evidence of *Animal Locomotion*'s archival plenitude and neutrality, what Sekula terms the "archival promise" of "a vast taxonomic ordering of images of the body."³⁴⁰ Placed side by side with sequences of athletes batting and University professors running, these photographs of blacksmiths and farmers completed Muybridge's encyclopedic record of "actions incidental to every-day life" in late nineteenth-century America.

Throughout *Animal Locomotion*, however, the work's archival objectivity—its pretention of presenting these photographs as undifferentiated images of men—is constantly interrupted by a concurrent drive to image a range of masculinities defined by and through social class. As we have seen, Lucinda Williams proposed that Muybridge depicts men and constructs women. In Muybridge's work, "men's bodies appear natural in action: they act and do; women's must be explained and situated: they act and appear in mini-dramas that perpetually circle about the question of their femininity." Yet, like Muybridge's female models, his farmers and blacksmiths act out previously-formed social identities before Muybridge's cameras, identities that, in Williams' words, "circle

³³⁹ Muybridge, *Prospectus and Catalogue of Plates*, 12.

³⁴⁰ Sekula, "The Body and the Archive," 16.

about the question” of their class. Although the grid and the numbering system that Muybridge also introduced in the summer of 1885 unify the motion studies aesthetically, Muybridge represents his student athletes and the laborers and mechanics very differently. While the athletes run or climb stairs, the mechanics and laborers enact exaggerated narratives of working class lives that span several sequences. Flipping from one page to the next, the viewer follows a farmer through the agricultural process. Muybridge photographs the farmer “using a long-handled shovel” (Figure 35) and “using a spade,” to dig furrows, “scattering seeds” (Figure 36), and, finally, “mowing grass” (Figure 37). Nearby a bricklayer carries a hod of bricks up a ladder (Figure 38). He empties the hod in the first frames of the next sequence and continues to mortar and laying bricks through the next page (Figures 39, 40).

But *Animal Locomotion* also made these working-class bodies available to readership that was predominantly wealthy and, it can be assumed, white and male. The laboring bodies captured in Muybridge’s photographs are both the social “others” of his student athletes and exempla of masculine bodies forged through the kind of pre-industrial toil that Mitchell prescribed to his emasculated, neurasthenic patients and Sargent made his sickly, asymmetrical students perform in the gymnasium. In fact, many of the motions Muybridge’s laborers act out—sawing, hammering, pounding—were also the occupational actions Sargent’s “developing appliances” were built to replicate. And the actions Muybridge’s laborers and mechanics perform are equally unproductive. The mason carries his hod of bricks up a ladder that goes nowhere and begins to build a wall that will never be completed. The farmer scatters seeds that will never grow and mows invisible grass. The motion studies present these laboring bodies as the sole product—

rather than the bi-product—of their labor. Unlike the athletes, the laborers and mechanics are identified in the Prospectus and Catalog of Plates only as “Farmer,” “Miner” and “Blacksmith,” and so on, a system of identification that transforms these individual bodies into types. This constructed social identity is only reinforced by the fact that the laboring bodies are easily commutable. The sequential arrangement in *Animal Locomotion* does not follow the order in which the plates were shot. In some cases, different models enact a single narrative; the bricklayer who carries the hod up the ladder in plate 405 is, for instance, a different man than the bricklayer who empties the hod and mortars and lays bricks in the plates 505 and 506, which follow 405. In these cases, individual identities are subsumed by the social identity Muybridge has pieced together for them.³⁴¹

Another way to understand *Animal Locomotion*’s collapsing of binaries—honorific and repressive, other and self, object and subject, science and art—is through the grid itself. Although the grid was, as I have argued, both a tool and a symbol for the anthropometric project, it was originally used by artists to map and measure bodily proportions. In the Prospectus, Muybridge states that his intent was “to select models who fairly illustrate how—in a more or less graceful or perfect manner—the movements appertaining to every-day life are performed.” But what Muybridge characterizes as an aesthetics of movement is always an aesthetics of the body as well. This is especially evident when Muybridge depicts the muscled University students as the modern-day equivalents of Greek athletes immortalized in sculpture. In the 1880s, track and field

³⁴¹ This argument is somewhat complicated by the fact that the *Animal Locomotion* plates were sold through subscription as well as in complete sets. In addition, whether Muybridge himself or his assistants (or some combination of the two) decided on the sequencing of the volumes is unclear; however, I believe that the case for intentional narratives can be made—whether the intention was Muybridge’s or not is ultimately unimportant.

included various running events, as well as the pole vault, shot put and hammer throw, all of which are well documented in Muybridge's studies. However, Peter Daley, another favorite model, also throws a javelin, J. Kinzer Shell, the "celebrated sprinter," wrestles, and Latta throws the "discobulus," as Muybridge terms it in his notebook (Figures 41, 42).³⁴² These sporting events were not part of intercollegiate competitions, but represent three of the five events of the ancient Greek pentathlon. Sarah Gordon has noted the resemblance between these motion studies and, for instance, Myron's Diskobolus (Figure 43).³⁴³ In Muybridge's photographs, the ancient ideal of masculine physicality merges with the anthropometric ideal of the white, male body sculpted through physical education.

In this way, Muybridge's studies anticipated another method through which Sargent made the anthropometric ideal visible. For the 1893 World's Columbian Exposition in Chicago, Sargent commissioned the sculptor H.H. Kitson to create two statues of the perfect fiftieth-percentile male and female forms (Figure 44). Kitson fashioned these *homme* and *femme moyen* as classical figures, borrowing a gesture from the Doryphorus and the contrapposto of the knidian Aphrodite, but replacing Polyclitean or Praxitelean proportions with measurements derived from the anthropometry measurements of Harvard and Radcliffe students. Sargent named the statues Adam and Eve. Displayed in the Anthropology Building, this modern Adam was offered up as the epitome of nineteenth-century masculinity and the culmination of an evolutionary

³⁴² *The Times* mentions Shell's participation (misspelled Schell) in an article about the motion studies. *The Times* (Philadelphia), August 2, 1885. Braun has described Daley as a student athlete, but he was, as Muybridge identifies him in the Prospectus and Catalogue of Plates, a "public acrobat" who would later tour throughout the United States and Europe under the name Professor Paulinetti. He describes his experiences with Muybridge and reprints one of Muybridge's sequences in Professor Paulinetti and Robert L. Jones, *The True Art and Science of Hand Balancing*, ed. and foreword by Logan Christopher, 2007 (first published 1931).

³⁴³ Gordon, *Sanctioning the Nude*, 197.

progression that the visitor could trace back in time through the “barbaric” bodies, both prehistoric and modern, exhibited nearby, and out into the seamier and more exotic displays of bodily difference—both racial and social—on the Midway Plaisance. Visitors could also have their own measurements taken and a chart drawn up to better visualize where they stood in the hierarchies of race, gender, and class.³⁴⁴

This chapter has demonstrated that, in the 1880s, masculinity was reconceived as a set of attributes made legible through the muscled body forged in the gymnasium and on the playing field. As I have argued, the new ideal of embodied masculinity was formed and consolidated not only in these spaces, but also through the visual economy they structured. The anthropometric measurements and photographs used by collegiate physical education departments and in physical culture manuals were, I have argued, incorporated into this economy. The Sargent system, used anthropometry and photography to better visualize the bodies of college students. Once these “warped” bodies were made visible and knowable, they could then be built up to conform to an ideal of bodily symmetry that, I have argued, was specifically Anglo-Saxon, Protestant, and middle- and upper-class.

I have further contended that Muybridge’s photographs should be read as part of this larger field of visual technologies and viewing practices. Because the motion studies were taken as the University was instituting Sargent’s system as part of its physical education program, it is likely that the University considered Muybridge’s photographs to be both an investigation of animal movements and anthropometric data that could be used in place of the anthropometric photographs other universities took of their students. Thus,

³⁴⁴ Kasson, *Houdini, Tarzan and the Perfect Man*, 51.

the student athletes Muybridge photographed running, jumping, throwing the “discobolus” and posing in front of the gridded backdrop had already been reconceived as anthropometric objects.

But this reading complicates the argument that Muybridge began using the grid to render the body of *Animal Locomotion*’s sole African American model quantifiable and his bodily differences visible. Using Allan Sekula’s observations about the honorific and repressive functions of photography, I have argued that *Animal Locomotion* collapses the binary oppositions between self and other, subject and object, honorific and repressive. This categorical instability was also, as I have shown, characteristic of “primitive masculinity,” the idea that overcivilized and feminized men could regain their lost manliness by appropriating the primal drives and physicality of working class men and racial others—men who were conceived as both less evolved and more essentially masculine, both less civilized and more capable of withstanding the enervating effects of modernity. Sargent, for instance, translated the occupational movements of laborers into gymnasium apparatus. But the bodies built up with these machines were also visibly different than the laboring bodies that had inspired them. Their symmetrical development signified their affiliation with a leisure class that could afford to spend unproductive hours laboring in the gymnasium. However, this “return to barbarism,” as Mitchell called it, was always done in service of maintaining the status quo and reinforcing the perceived social and racial superiority of white, middle- and upper-class men. As I have shown, when Muybridge photographed laborers and mechanics, he turned these individuals into types. In these studies, the narratives “the farmer” or “the blacksmith” enact, which often

stretch through multiple sequences, are less about movement than they are about social class made visible through the body.

Chapter 4

“Disordered Actions”:

Eadweard Muybridge's Studies of “Abnormal Movements” from *Animal Locomotion*

Plate 532 of Eadweard Muybridge's *Animal Locomotion* pictures a hand inscribing a circle (Figure 45). The hand moves deliberately, the wrist arched and held nearly still as the fingers guide and twist the pencil below. “Movement of the hand, drawing a circle” is the first of five studies of disembodied hands executing finely-coordinated and controlled motions. These sequences, which fall at the end of volume 7—the final body of images dedicated to the “normal movements” of men and women—also form a prelude to volume 8: Muybridge's photographic investigations of “Abnormal Movements.”³⁴⁵

As an 1886 article titled “Neural Disorders of Writers and Artisans” explains, this pictorial progression from normal to abnormal could easily become a corporeal reality.³⁴⁶ The article appeared in “A System of Practical Medicine by American Authors,” an encyclopedic medical text edited by Dr. William Pepper, provost of the University of Pennsylvania and head of the commission appointed to supervise Muybridge's work. Its author, Morris J. Lewis, was only one of the many Philadelphia-area specialists in

³⁴⁵ For Muybridge's studies of “Abnormal Movements,” see Brown, “Racialising the Virile Body,” 627-656; Braun and Whitcombe, “Marey, Muybridge and Londe,” 218-224; Gordon, *Sanctioning the Nude*, 143-146, 191-202; Dermer, *Photographic Objectivity and the Construction of the Medical Subject*, 38-66; Douglas J. Lanska, “The Dercum-Muybridge Collaboration for Sequential Photography of Neurological Disorders,” *Neurology* 81 (October 22, 2013), 1550-1554.

³⁴⁶ Morris J. Lewis, “Neural Disorders of Writers and Artisans” in *A System of Practical Medicine by American Authors, Vol. 5, Diseases of the Nervous System*, ed. William Pepper (Philadelphia: Lea Brothers and Co., 1886), 504-543.

neurological diseases who contributed both articles to Peppers's text and patients to Muybridge's investigations.³⁴⁷

In his essay, Lewis discusses “copodyscinesis,” the painful spasms more commonly known as “writers' cramp.” As he explains, Copodyscinesis belonged to the class of functional nervous disorders, conditions that had no known organic cause but shared a single defining symptom—erratic and involuntary movements, or, as they were often called, “disordered actions.”³⁴⁸ Lacking any evidence of common structural abnormalities, nerve specialists believed that the seat of the disease lay instead in the “the will.” The will was conceived as a mechanism that regulated and coordinated nervous impulses sent to motor centers by the mind. It was thought that any loss of will power could lead to the “disordered actions” described by Lewis and photographed by Muybridge.

The majority of Muybridge's pathological subjects were afflicted with various manifestations of functional disorders, including paralysis agitans, epilepsy and chorea. Muybridge undertook these studies at the request of Francis X. Dercum, instructor of nervous diseases at the university. Dercum also published “A Study of Some Normal and Abnormal Movements Photographed by Muybridge” in *Animal Locomotion: The Muybridge Work at the University of Pennsylvania: The Method and the Result*, a

³⁴⁷ These include Francis X. Dercum, Charles K. Mills, William Pepper, Silas Weir Mitchell, and James H. Lloyd.

³⁴⁸ For instance, Charles K. Mills, a Philadelphia-area specialist in neurological disease, defined functional disorders as “affectations in which disordered actions without recognizable permanent alteration of structure are present.” Charles K. Mills, “Hysteria,” in *A System of Practical Medicine by American Authors, Vol. 5, Diseases of the Nervous System*, ed. William Pepper (Philadelphia: Lea Brothers and Co., 1886), 205.

collection of essays penned by Muybridge's collaborators and published by the university in 1888.³⁴⁹

Beginning with an examination of Dercum's study, this chapter situates Muybridge's images of pathological patients within the larger context of photographically illustrated medical texts and, in particular, texts dealing with functional movement disorders. While the advent of wide-spread photomechanical reproduction in the 1880s promised more accurate and objective documentation, for nerve specialists writing about functional disorders this new possibility also came with a new problem: how to make the tremors and spasms pathognomonic of functional disorders legible with and in still photographs. I argue that these specialists negotiated the inherent technical constraints of the medium, devised new pictorial strategies, and used the camera as an instrument for investigation rather than a technology of representation. Despite—or perhaps because of—the fact that these images constitute an extreme case scenario for photographic depiction, they raise larger questions about how photographs were viewed and used in the late nineteenth century: How was the evidential authority of photography established? On what grounds was photographic evidence deemed adequate?

In *Objectivity*, Lorraine Daston and Peter Galison chart a tripartite history of the idea of objectivity through a careful examination of illustrated scientific atlases.³⁵⁰

Although we tend to equate objectivity and truth, Daston and Galison argue that objectivity is a negative concept determined by historically specific notions of the

³⁴⁹ Francis X. Dercum, "A Study of Some Normal and Abnormal Movements," 103-133. A later textbook edited by Dercum also used Muybridge's photos to illustrate the gaits of specific functional nervous disorders. See the illustrations from Muybridge photographs in F.X. Dercum, "Cerebral Palsies of Childhood"; Morton Prince, "General Affections"; and Frederick Peterson, "Systemic Affections," in *A Text-Book on Nervous Diseases by American Authors*, ed. Francis X. Dercum. (Philadelphia: Lea Brothers & Co., 1895), 506-520, 556-611, 661-666.

³⁵⁰ Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007).

meanings and values of subjectivity. As scientists in the nineteenth century grew more and more wary of their own subjectivity, a new epistemological position became dominant. The authors term this emergent “drive to repress the willful intervention of the artist-author, and to put in its stead a set of procedures that would, as it were, move nature to the page through a strict protocol, if not automatically,” “mechanical objectivity.”³⁵¹ Because of its mechanical means of creation and seemingly unmediated relationship to the referent, in Daston and Galison’s text the photograph is emblematic of this new scientific norm.

This conception of the photograph recalls the American philosopher Charles Sanders Peirce’s discussion of the semiotics of the photographic image. In the late nineteenth century, Peirce charted a tripartite taxonomy of the relationships between signs and their referents, designated by the terms symbol, icon, and index.³⁵² Symbols, Peirce argued, signify through common usage or convention: the word “hand” has a conventional (rather than causal or formal) relationship to the particular body part it designates. For Peirce, a photograph was an example of both an icon and an index. It bears a physical resemblance to its object, and is connected to it through physical contiguity or causation: the photographic image is created when light reflected from an object strikes the photo-sensitive paper or plate. Both symbols and icons are contingent on the viewers past experiences and knowledge; an icon only functions as such if the viewer recognizes it as a representation, while a symbol only has meaning for a specific community. The index is, in theory, not subjective. Yet, as François Brunet has pointed out, we only understand the photograph as an index if we know that photographs are

³⁵¹ Daston and Galison, *Objectivity*, 121.

³⁵² Charles Sanders Peirce, "What is a Sign?" in *The Essential Peirce: Selected Philosophical Writings, Volume 2 (1893-1913)*, ed. the Peirce Edition Project (Indianapolis: Indiana University Press, 1998), 4-10.

produced through photochemical reactions.³⁵³ Thus, Peirce was less interested in the classification of signs than he was in exploring how signs produce meaning and understanding the viewer's integral role in this process.

When scholars and theorists in the mid-1970s seized upon Peirce's concept of the index, they largely overlooked the dynamism of his semiotic system. Instead, they interpreted Peirce's discussion of the photograph as supplying both an ontological definition of the photographic image and an explanation for its authority and privilege. In the ensuing decades, historians of photography have contested this reading of the medium, arguing instead that photographs derive meaning exclusively through the social and cultural contexts in which they are deployed. Even scholars who are attuned to the contingency of photographic images still often assume that the photograph is essentially objective, unmediated, and physically bound to its referent, and define photographic authority exclusively in these terms.³⁵⁴

Yet, this conception of the photograph as either an objective tool or an indexical trace is a matter of belief, not ontology, and the result of dynamic social and cultural pressures. Several scholars have recently argued that, in the mid-nineteenth century, scientific photography and, in particular, photographs documenting phenomena beyond the realm of ordinary, unaided perception became an important locus for debates about

³⁵³ François Brunet, "Visual Semiotics Versus Pragmaticism: Peirce and Photography," in *Peirce's Doctrine of Signs: Theory, Applications, and Connections*, ed. Vincent Michael Colapietro et al (New York: Water de Gruyter & Co., 1995), 295-313; François Brunet, "'A Better Example is a Photograph': On the Exemplary Value of Photographs in C.S. Peirce's Reflection on Signs," in Robin Kelsey and Blake Stimson, eds., *The Meaning of Photography* (New Haven: Yale University Press, 2008), 34-49.

³⁵⁴ Carol Armstrong, for instance, writes "a document drawn up by the pencil of Nature, the photograph is a guarantee of its own veracity; hence, its evidentiary status is ontological, in the nature of its being an image. Everything, in short, rests on its tautological naturalness." Carol Armstrong, *Scenes in a Library: Reading the Photograph in the Book, 1843-1875* (Cambridge: MIT Press, 1998), 49.

photography's objectivity.³⁵⁵ Because photographs that captured the flagella of bacteria and the “unsupported transit” of the horse could not be corroborated by the naked eye, they raised questions about photography's nature and evidentiary status. As Jennifer Tucker explains, “scientific photography strongly expressed a powerful underlying paradox of photography in the nineteenth century: the paradox between the philosophical ideal of ‘mechanical objectivity’ or automatism, and the realities of photographic evidence in practice.”³⁵⁶

The following is an exploration of a particular kind of photographic evidence in practice. I argue that, for the physician-authors writing about functional disorders, the photograph was a useful and persuasive form of representation not because of its ontological stability, but because of its semiotic flexibility. Even as these writers characterize the photograph as essentially objective, unmediated, and physically bound to its referent, they also exploited the photographic artifact of the blur as a symbol for pathological locomotion. That Muybridge's stop-action photographs posed a significant problem for Dercum specifically because of their precise focus suggests that, by the late 1880s, the photographic blur had become a pictorial convention for representing “abnormal” movements.

Furthermore, in the late nineteenth century, locomotion was closely connected to self-representation. While every normal movement was considered an index of the self's essential character, abnormal movements were thought to be unwilled and, therefore,

³⁵⁵ See, for instance, Joel Snyder and Neil Walsh Allen, "Photography, Vision, and Representation," *Critical Inquiry* 2, no. 1 (Autumn 1975); Joel Snyder, "Picturing Vision," *Critical Inquiry* 6, no. 3 (Spring 1980), 499–526; Jennifer Tucker, *Nature Exposed: Photography as Eyewitness in Victorian Science* (Baltimore: Johns Hopkins University Press, 2005); Josh Ellenbogen, *Reasoned and Unreasoned Images: The Photography of Bertillon, Galton, and Marey* (University Park: Penn State Press, 2012); as well as the essays by Tom Gunning, Jennifer Tucker, and Erin O'Toole in *Brought to Light: Photography and the Invisible, 1840-1900*, ed. Corey Keller (New Haven: Yale University Press, 2008).

³⁵⁶ Tucker, *Nature Exposed*, 3.

nonrepresentational. Movement disorders thus disrupted the body's ability to signify—to physically communicate the inner dictates of the mind to the outer world. In addition, articles on functional disorders often incorporated samples of choreic patients' handwriting as further evidence of the will's loss of control over the body. Through a close analysis of these works, as well as contemporary manuals on handwriting analysis, I situate texts on functional disorders within a larger discourse that frames movement, handwriting, and photography as similar processes and contend that studies of movement disorders conflate the choreic body's failed corporeal expression and the failure of photographic and autographic representation.

Although Dercum's article "A Study of Some Normal and Abnormal Movements Photographed by Muybridge" discusses many of Muybridge's "abnormal" motion studies, it pays particular attention to two sequences of an artist's model whose disordered actions were induced rather than organic (Figures 11, 46). Dercum described the phenomenon staged by Muybridge's cameras in an 1884 study titled "On the Artificial Induction of Convulsive Seizures," which he liberally excerpts throughout his study of Muybridge's photographs.³⁵⁷ As Dercum's article made clear, this experiment, which artificially reproduced "a group of phenomena...closely related to certain nervous affections," served as a method for investigating the etiology of functional disorders.³⁵⁸ In

³⁵⁷ Francis X. Dercum and Andrew J. Parker, "On the Artificial Induction of Convulsive Seizures," *Journal of Mental and Nervous Disease* 9 no. 4 (October 1884), 579-588. To a twenty-first century audience, this experiment seems, at best, unethical and, at worst, sadistic. And indeed, Dercum only performed these experiments for a short time before abandoning them. In a letter from 1929 Dercum describes this body of work and explains, "I need hardly add that the artificial induction of convulsions came soon to be regarded by myself and friends as of such a nature that they were early discontinued." Francis X. Dercum to George E. Nitzsche, May 10, 1929. UPA 9 Box 2 Folder 26, University of Pennsylvania Archives and Records Center.

³⁵⁸ Dercum and Parker, "On the Artificial Induction of Convulsive Seizures," 588.

other words, by reproducing the symptoms of functional disorders, Dercum hoped to understand their cause: the underlying mechanism of the will. His experiment hints at the deep anxieties that functional disorders elicited during the last quarter of the nineteenth century. For nerve specialists of Dercum's generation, disease "was a well differentiated clinical entity with distinct cause and pathology."³⁵⁹ Functional nervous disorders, however, seemed to lack any common underlying structural abnormality or neurological damage. As one writer noted, they presented "many difficulties and mysteries."³⁶⁰

Neurologists often had to base a differential diagnosis on little clinical evidence other than the specific nature of a patient's "disordered actions." It was necessary not only to correctly identify which pathological movements were symptomatic of a specific disorder, but also to distinguish between, for instance, the "incoordinate action of the muscles" characteristic of chorea and the "constant tremor" of paralysis agitans. "The whole subject of tremor, ataxia, irregular spasm, and local convulsion," Philadelphia nerve specialist James Hendrie Lloyd concluded, "presents numerous difficulties to clinical pathological study."³⁶¹ Nerve specialists also recognized that functional disorders were intimately connected to the will: some movements ceased while the patient performed voluntary actions, others were unaffected by volitional effort. Thus, they diagnosed functional disorders through the careful observation of the body to classify the

³⁵⁹ Charles E. Rosenberg, *No Other Gods: on Science and American Social Thought* (Baltimore: Johns Hopkins University Press, 1976), 100.

³⁶⁰ While the majority of nerve specialists seem to have accepted that neurological disorders could be classed as either functional and organic, a minority believed that all functional disorders were actually organic in nature. Dr. Horatio C. Wood, a specialist in nervous diseases at the University of Pennsylvania, argued "there is no such thing as functional and organic disease. The line which we draw is a purely arbitrary one. . . . Our microscopic eye is so blind and gross that it cannot see these fine changes [that cause functional disorders] until they become so distinct that we can detect them, and then we say that organic disease exists." Horatio C. Wood, "The Basal Pathology of Chorea," in *Transactions of the College of Physicians of Philadelphia* 15 (Philadelphia: P. Blakiston, Son & Co., 1886), 157-164.

³⁶¹ James Hendrie Lloyd, "Cretinism: Cases Presenting Tremor as a Symptom with the Exhibition of a Patient Showing Symptoms of Paramyoclonus Multiplex," *The Medical and Surgical Reporter* 58 no. 20 (May 19, 1888), 623.

patient's "tremor, ataxia, irregular spasm, and local convulsion" and to determine the relationship between these movements and the patient's will. Dercum enlisted Muybridge's photographs to help with this close observation of the body.

To induce the seizures, Dercum explains, the model placed her fingertips lightly on a tabletop, thereby subjecting a specific group of muscles to an effort of constant and precise readjustments. After the subject held this position for "a variable period of time, extending from a few minutes to an hour," rhythmic tremors commenced in her hands. According to Dercum, the lower series of plate 545 (Figure 11) pictures "the position of the subject in the early stages of an induced convulsion" as "the tremor is just being magnified into the to-and-fro movements of the hands and feet." As the experiment continued, however, all the muscles of the body became affected. The upper series, which captures the model in the grip of "a most violent convulsion," was taken directly before she "was thrown to the ground in a strong, general convulsion."³⁶²

Dercum attributes the convulsive seizures to a specific cause: the will. He explains that, initially, the convulsions induced by the model's targeted muscular exertions were rhythmical and limited by the will to her hands and arms—the "to and fro" movements captured in the final sequence of six images. However, as the experiment continued the model's sustained concentration caused "a loss of intensity in will power." Her will grew weaker and weaker until what began as a local muscular disturbance soon spread unchecked through the entire neuromuscular apparatus, resulting in the "violent explosion" of arrhythmical convulsions pictured in the upper series. In this final state,

³⁶² Dercum, "A Study of Some Normal and Abnormal Movements," 122-123.

“the will was absolutely powerless.”³⁶³ Dercum, therefore, reads the movements captured in Muybridge’s images as a bodily expression of the will’s progressive failure.

Without Dercum’s dramatic narrative, Muybridge’s photographs communicate only static flesh and form. While Dercum explains exactly which stage of the will’s decline each motion study pictures, the motion studies themselves cannot discriminate between willed and unwilled movements. Rather than the disordered actions symptomatic of functional disorders, in the images, all of the model’s motions take on the automaticity of Muybridge’s photographic process. Quantized and spatialized across the grid, both the rhythmic “to-and-fro” motions that marked the first stages of the experiment and the “violent explosion” of convulsions that signaled the model’s final loss of will power become normalized. In his discussion of the upper series of plate 545 (Figure 11), Dercum alludes to this problematic contradiction between the stop-action photographs and the model’s incessant movements. “The individual pictures of this series are especially interesting. The entire pose or attitude assumed by the subject is, so to speak, hysteroidal.”³⁶⁴ Muybridge’s images pose a representational problem for Dercum: they capture hysteroidal poses but not abnormal movements.

Dercum did not illustrate his “Study of Some Normal and Abnormal Movements Photographed by Muybridge” with Muybridge’s photographs. Instead, he included drawings that collapse the sequences into one frame. He explains that figure 15 is “the result of a number of tracings of the serial photographs of Plate 545, lower series, being

³⁶³ Dercum and Parker, “On the Artificial Induction of Convulsive Seizures,” 587.

³⁶⁴ Dercum, “A Study of Some Normal and Abnormal Movements,” 123. Horatio C. Wood, another specialist in neurological diseases in the Philadelphia medical community, defines hysteroidal convulsions as “a convulsion of the general character seen in hysteria” in contradistinction to the “epileptiform convulsion,” although he notes that “the distinction is, however, a somewhat arbitrary one, since every gradation between the two forms exists, and an hysteroidal convulsion may occur in true epilepsy and an epileptiform convulsion in hysteria.” Horatio C. Wood, *Nervous Diseases and Their Diagnosis* (Philadelphia: J.B. Lippincott Company, 1887), 99.

superimposed” (Figure 47).³⁶⁵ These figures reverse Muybridge’s representational strategy, substituting overlapping lines for the sharply focused instantaneous photographs and superimposition for sequential order. By collapsing the series of photographs into one frame, the drawings also disrupt the temporal linearity and legibility of Muybridge’s images—it is impossible to deduce where the subject’s hands were at the beginning or the end of the convulsion, or in which direction they moved in between. While Muybridge’s images render the moving body legible and visible, the drawings signify movement through pictorial disorder.

Dercum does not explain why he has chosen this mode of illustration. Other essays within the volume include engravings of entire sequences or individual frames, and therefore his representational decision cannot be attributed to the exigencies of publication. However, the resemblance of these superimposed drawings to another class of images within Dercum’s text points to a possible motivation. The text is illustrated with three engravings from Marey wheel photographs that Muybridge took at Dercum’s request.³⁶⁶ While Muybridge’s banks of cameras captured images sequentially on separate photographic plates, the Marey wheel camera, named after the French physiologist Etienne-Jules Marey, used a rotating shutter to expose a single plate multiple times. The first of these figures depicts the same phase of movement as figure 15—the early stage of the induced convulsion (Figure 48). Like the line drawings, the Marey wheel image depicts the model’s arms and feet—the parts of her body most affected by the convulsions—as a series of overlapping exposures against the dark background. It is

³⁶⁵ Dercum, “A Study of Some Normal and Abnormal Movements,” 123.

³⁶⁶ In his introduction, Dercum writes, “Mr. Muybridge kindly made, upon request, a number of clinical photographs armed with a fenestrated wheel—i.e. a Marey’s wheel.” Dercum, “A Study of Some Normal and Abnormal Movements,” 103.

exactly this aspect of the engraved Marey wheel photograph that Dercum identifies as the most significant. He explains, “the blurring of the hands and feet [in this figure] show the extent of the convulsion.”³⁶⁷ Dercum’s use of “extent” is ambiguous. It is unclear whether he reads the blurring quantitatively or qualitatively. But this ambiguity also underscores the semiotic complexity of the blur. Was he reading—or did he want his reader to interpret—the blur as an index or symbol, as a direct and objective registration that could be measured and analyzed, or as an expression of the subjective characteristics of the convulsions?

Dercum’s descriptions of these blurred drawings suggest the latter. Of figure 17 (Figure 49), he notes, “in a short time, as shown by the figure, a most violent convulsion was the result,”³⁶⁸ and observes of figure 18 (Figure 50), “the convulsion, as shown by the figure, was of considerable violence.”³⁶⁹ Dercum thus intended the blur—as either an artifact of the Marey wheel camera or effected through superimposition—to signify the violence, rapidity and irregularity of the model’s convulsions, the very characteristics that defined them as pathological, and the very characteristics that Muybridge’s sequences failed to transmit. By superimposing the photographs, Dercum thus attempted to reconcile the disorder’s bodily presentation and its photographic representation. The blurred drawings pictured symbolically what Muybridge’s images could not depict photographically: “disordered actions” no longer correlated with or caused by the will.

This chapter has argued that, for Dercum, Muybridge’s process proved inadequate to the task at hand. The instantaneous exposures and the normalizing authority of the grid

³⁶⁷ Dercum, “A Study of Some Normal and Abnormal Movements,” 123.

³⁶⁸ Dercum, “A Study of Some Normal and Abnormal Movements,” 123.

³⁶⁹ Dercum, “A Study of Some Normal and Abnormal Movements,” 124.

acted together to impose order on even the most “disordered actions.” But Dercum was also working within another set of constraints: the representational practices of the Philadelphia medical community. When he published his article on the abnormal motion studies in 1888, nerve specialists were just beginning to use the blur as a symbol for the erratic and involuntary movements symptomatic of functional disorders. By layering Muybridge’s photographs, he was not only compensating for the limitations of Muybridge’s process, but also making the motion studies conform to this nascent pictorial convention—a convention that Dercum himself would continue to develop in subsequent publications.

Dercum’s collaboration with Muybridge was his first extensive engagement with photography. This experience seems to have convinced him of the medium’s merit, for in the following decades he illustrated the majority of his many books and articles on motion disorders with photographs. In published clinical lectures Dercum used blurred photographs as substitutes for the flesh-and-blood subjects who acted out their symptoms for the audience. He begins a lecture on “Adult Chorea,” which he delivered at the Philadelphia Hospital and published in the journal *International Clinics* in 1891, by introducing the first patient and describing how what began as “irregular and involuntary movements in the legs” progressed until he was no longer able to walk.³⁷⁰ Dercum narrates as the subject performs his movements before the audience: “as he sits before you and I ask him to rise, the legs are thrown violently about, as are also the arms, while the head is forcibly flexed and twisted to one side.”³⁷¹ Dercum not only describes the erratic motions of the patient, but also appeals to the audience members as participant-

³⁷⁰ Francis X. Dercum, “Adult Chorea,” in *International Clinics: A Quarterly of Clinical Lectures* 3 (Philadelphia: J.B. Lippincott Company, 1891), 293.

³⁷¹ Dercum, “Adult Chorea,” 294.

observers, drawing their attention to the most clinically significant symptoms of the disorder—in particular, the arrhythmic and violent movements of the patient’s head and arms. In this way, the clinical lecture dramatizes a diagnostic method predicated on visibility.

While the lecture’s audience witnessed the patient performing his erratic movements as Dercum narrated, for the reader of *International Clinics* a photograph takes the place of the flesh-and-blood clinical subject (Figure 51). The text never draws attention to this substitution; with a casual “here is another case,” Dercum introduces the patient to the audience as the text directs the reader to “see Fig. 2.”³⁷² The image pictures the patient sitting on a cane-backed chair with his legs stretched out. His upraised arms seem to both cast shadows and dissolve into the shadows they cast on the theatrical backdrop. A foot enters the frame at the bottom left, presumably to keep the chair from moving under the force of the patient’s convulsions. The caption reads: “Adult (hereditary) Chorea. Showing excessive and rapid movements. The arms are blurred in the figure in consequence.”³⁷³

The caption thus draws a direct connection between the photographic blur and the patient’s movements. It both tells the viewer what the picture shows—movements symptomatic of adult chorea—and why it is blurred—because of the very movements the photograph pictures. Moreover, there is an implied connection between the patient’s body and the photographic apparatus: the caption suggests that the patient’s movements were so rapid, so excessive, that even the camera could not arrest them. The caption correlates not only cause and effect, but also symbol and referent. As was the case in Dercum’s

³⁷² Dercum, “Adult Chorea,” 293.

³⁷³ Dercum, “Adult Chorea,” unpaginated.

study of Muybridge's photographs, here the blur stands not for the movement itself, but for the movement's rapidity and excessiveness, the very qualities that characterize it as pathological.

The blur signifying the pathological motions of patients afflicted with functional disorders occurs over and over in the medical literature of the late 1880s and 1890s, even as photographic technologies improved and exposure times grew shorter and shorter. By 1894, the pathological blur had become so well established as to merit inclusion in Wilson's *Cyclopaedic Photography*, a popular encyclopedia and manual published by Edward Livingston Wilson, founder and editor of the *Philadelphia Photographer*.³⁷⁴

The entry for "Surgical Photography" is largely dedicated to the instantaneous chronophotographs of Albert Londe, assistant to the French neurologist Jean-Martin Charcot and chief operator of the Salpêtrière's photography studio.³⁷⁵ Three drawings based on Londe's instantaneous photographs of a patient with rhythmical chorea are also appended to the text (Figure 52). The editor of the encyclopedia had most likely seen these images in the 1889 English edition of Charcot's collected clinical lectures.³⁷⁶ The original plate, included in a lecture on "Tremors and Choreiform Movements—Rhythmical Choreia," is a composite of nine chronophotographs—or rather, wood engravings from the chronophotographs—arranged in a numbered three-by-three grid

³⁷⁴ Edward L. Wilson, *Wilson's Cyclopaedic Photography: A Complete Hand-book of the Terms, Processes, Formulae and Appliances Available in Photography, Arranged in Cyclopaedic Form for Ready Reference* (New York: Edward L. Wilson, 1894). *Wilson's Cyclopaedic Photography* appeared in updated editions until at least 1915.

³⁷⁵ Charcot established the photography studio in 1878. Londe was also one of the founders of the *Nouvelle Iconographie de la Salpêtrière*, a journal that emphasized photographic illustration of neurological diseases. For Charcot's use of photography and the *Iconographie*, see Georges Didi-Huberman, *Invention of Hysteria: Charcot and the Photographic Iconography of the Salpêtrière*, trans. Alisa Hartz (Cambridge: The MIT Press, 2003).

³⁷⁶ Jean-Martin Charcot, *Lectures on the Diseases of the Nervous System* 3, trans. Thomas Savill (London: The New Sydenham Society, 1889).

(Figure 53). Wilson's Cyclopaedic Photography reproduces numbers 37, 39 (which has become flipped in reproduction), and 45.

While the rough wood engravings in Charcot's text are difficult to interpret, the encyclopedia reproductions have been cleaned-up and clarified, and depict details not present in the originals, such as the folds of the patient's clothing and the buttons on her coat. However, the most obvious alteration is the blurring of the choreic model's upraised hand in the third image. The original frame freezes the subject in the midst of a movement that Charcot likens to an Andalusian dance. Her hand is clearly delineated. As in Dercum's essay on the pathological *Animal Locomotion* photographs, in Wilson's Cyclopaedic Photography the addition of the blur conveys the disorder of the patient's dance-like tremors and convulsions.

Furthermore, the blur is central to the encyclopedia's description of Londe's images and its exposition on "surgical photography" in general. The entry explains that Londe's cameras are "particularly useful in depicting the movements of nervous people... In cases where rhythmic chorea is the malady and the movements are varied and rapid—almost too rapid to be seen—very helpful studies may be had for the surgeon. Not only are the erratic movements of the patient caught, but the slightest tremor of the hands is shown by the blurred photograph."³⁷⁷ It concludes: "with ease and rapidity successive pictures quickly caught, followed by careful analysis, supply very valuable results for the students of disease."³⁷⁸

According to Wilson's text, Londe's instantaneous cameras have two equally revelatory, although seemingly contradictory, functions: they both parse motions "almost

³⁷⁷ Wilson, *Wilson's Cyclopaedic Photography*, 373.

³⁷⁸ Wilson, *Wilson's Cyclopaedic Photography*, 374.

too rapid to be seen” into discrete, still images to be studied at the investigator's leisure, and reveal the “slightest tremor” of the patient’s hand through the tell-tale blur. There is a curious relationship here between the human eye and the photographic apparatus. While the camera bests the human eye in capturing clear images of some rapid movements, it makes others visible only as blurs—in other words, it simultaneously improves upon and replicates flawed human vision. The camera described in the encyclopedia entry is far removed from Daston and Galison’s ideal of mechanical objectivity. Far from simply a machine offering, as Daston and Galison claim, “freedom from will,” in Wilson’s entry on “surgical photography” the camera is ascribed agency and intelligence—given, that is, a will of its own. It is itself a surgical instrument that operates selectively and reveals symptoms by exposing different visual registers.

The blur signifying pathological motion was also added to photographs through textual descriptions. In 1900, Dr. William D. Spiller, professor of nervous diseases in the Philadelphia Polyclinic, published “A Case of Malaria Presenting the Symptoms of Disseminated Sclerosis, with Necropsy” with photographic representations of the titular symptoms.³⁷⁹ The patient presented with “marked ataxia” of the legs, while extending the

³⁷⁹ William G. Spiller, “A Case of Malaria Presenting the Symptoms of Disseminated Sclerosis, with Necropsy,” *American Journal of the Medical Sciences* 20, no. 6 (December 1900), 629-647. Disseminated sclerosis, or multiple sclerosis (MS) was not considered a functional disorder. Charcot had first connected the symptoms of the disorder to pathological changes in post-mortem samples in 1868. Despite the organic nature of the disease, MS was still inextricably connected to the workings of the will. One of the three pathognomonic signs of MS identified by Charcot—the third of the so-called “Charcot’s Triad”—was the presence of an intention tremor. As Dr. Landon Carter Grey explains in an article on “functional tremors” in Dercum’s *A Text-book on Nervous Diseases*, “when tremor is of the intentional type it will be evidenced by making some voluntary movement, as by having the patient approximate a glass of water to the lips, or write the name, or do some other voluntary act.” Thus, that the will lacked control over the body during volitional movement—indeed, that the tremor only appeared during movements that should have been under the control of the will—was an identifying feature of the disease. Moreover, it was also the symptom that defined the disease as organic rather than as a by-product of the will’s slow loss of control over the musculature of the body. Therefore, although the etiology of MS was understood to be organic, its diagnosis still relied on theories of the mechanism of the will and its control—or lack thereof—over the body. See Landon Carter Grey, “Functional Tremors,” in *A Text-book on Nervous Diseases* ed. Francis X.

left arm with the fingers separated induced “coarse up-and-down movements.”³⁸⁰ The photograph Spiller includes pictures the patient facing the camera. His right arm hangs by his side and he holds his left aloft, elbow bent and hand half-closed (Figure 54). The accompanying description of his condition thus provides a textual gloss for the action reproduced photographically: the patient is shown extending his left arm and separating his fingers, voluntary actions that provoked the intentional tremor characteristic of disseminated sclerosis.

The caption reads “An instantaneous photograph. The left upper limb is blurred because of the tremor, but the blurring has in large measure disappeared in the reproduction. The expression of the face is striking.”³⁸¹ Rather than providing supplemental information or directing the reader’s interpretation of the photograph, here the caption directly contradicts the visual information conveyed by the image: it informs the viewer that what appears to be an evenly and sharply focused photograph is actually blurred and, by extension, that the man who appears to be standing still is actually a pathological subject afflicted with a perpetual tremor. By attesting to its presence in absentia, the caption suggests the blur’s importance as a symbol of pathological movement. That the picture is identified as an “instantaneous photograph” further alludes to the specific nature of the subject’s movements. It implies that the patient’s “ataxia”—meaning motions that are literally “without order”—was so severe, so “excessive” that even an instantaneous image could not still it (although, apparently, reproducing the instantaneous image could). The caption also makes clear that the function of the blur

Dercum (Philadelphia: Lea Brothers & Co., 1895), 280. For Charcot’s anatomic-clinical method, cerebral localization, and the diagnosis of multiple sclerosis, see Christopher G. Goetz, *Charcot: Constructing Neurology* (Oxford: Oxford University Press, 1995), 113-120.

³⁸⁰ Spiller, “A Case of Malaria, 634.

³⁸¹ Spiller, “A Case of Malaria, 635.

was not only symbolic. Whether visibly present or promised but imperceptible, the blur also proved the presence of the disorder.

Rather than writing in a blur not depicted in the actual photograph, an article on “convulsive tics” written by Dr. Otto Lerch takes the opposite approach.³⁸² Published in the Philadelphia journal *American Medicine* in 1901, Lerch’s study sought to illuminate the clinical differences between convulsive tic, or echokinesis, chorea, and hysteria. “Echokinesis,” he writes, “is a repetition of involuntary movements of which the patient is conscious. The movements consist of sudden, spastic contractions of the muscles, especially those of the face, head and neck. In fact these parts are so frequently involved that their affection is almost pathognomonic of this form of tic.”³⁸³ To ground his general observations, Lerch presents a “typical case” of echokinesis. The only symptoms of the disease present in the patient, Dr. Lerch reports, “are the characteristic spasms.”³⁸⁴

The accompanying, uncaptioned photograph was taken, Lerch explains, while the patient was in mid-spasm (Figure 55). The sharply focused placard hanging into the frame identifies the sitter as a clinical subject, a numbered specimen to be studied as such. In contrast, the patient’s features are blurred beyond recognition. The photograph is not a likeness, and still less a depiction; rather than an icon, it functions only as a symbol for the involuntary and violent movements Lerch describes. At the end of the article, he thanks the doctor who took the photograph, only to then add, “Unfortunately it proved a failure. The photograph is blurred.”³⁸⁵

³⁸² Otto Lerch, “Convulsive Tics,” *American Medicine* 2, no. 8 (November 1901), 694-695.

³⁸³ Lerch, “Convulsive Tics,” 694.

³⁸⁴ Lerch, “Convulsive Tics,” 695.

³⁸⁵ Lerch, “Convulsive Tics,” 695.

That a blurred photograph could be deemed a failure but still used to document the erratic motions symptomatic of functional disorders raises another possibility: that the very inability to be photographed was itself a marker of pathology. As we have seen, neurologists at the turn of the century believed that functional disorders such as chorea and convulsive tic were caused by the will's progressive loss of control over the motor centers of the body. Within the medical literature, this failure of self-control was often presented as an expressive incapacity.

To explain the origins of functional disorders, Octavius Sturges, a leading expert in child choreoid disorders, adapted the theory of recapitulation. According to this theory, which was widely propounded by late nineteenth-century scientists and social theorists, human development closely followed the evolutionary progression of the species from savage to civilized states.³⁸⁶ The infant, Sturges observes, is unable to control its movements; its “aimless springs and kicks and grimacing” form “a language as little coherent as its thoughts.” As its mind develops and will-power strengthens, “the infant becomes a restless, impressionable child, moving its limbs much more than it uses them, with no defined purpose, and expressing such mind as it has almost entirely by that method.”³⁸⁷

Once the child has grown into an adolescent and developed the twin faculties of will and mind, “mental impressions are now first clearly apprehended and intelligently expressed

³⁸⁶ This theory, often summarized as “ontogeny recapitulates phylogeny,” has a long history that, as Stephen J. Gould has demonstrated, stretches back to Aristotle. In the mid-nineteenth century, these ideas were both given new credence by evolutionary theory and reconsidered in light of it. A very generalized form of Darwinism was used to support hierarchical theories of race. As Gould notes, “biological arguments for racism may have been common before 1859, but they increased by orders of magnitude following the acceptance of evolutionary theory.” These “recapitulationists”—Gould discusses Herbert Spencer and G. Stanley Hall, among many others—viewed non-white races as both akin to children and evolutionarily inferior to the Anglo-Saxon race that topped the hierarchical scale. Stephen J. Gould, *Ontogeny and Phylogeny* (Cambridge: Harvard University Press, 1977), 127.

³⁸⁷ Ibid. Octavius Sturges, “Chorea” in *Chorea and Whooping Cough: Five Lectures* (London: Smith, Elder and Co., 1877), 50.

by words and appropriate gestures.” Finally, with “the complete sedateness of middle life, with its habitual attitudes of body and fixed expression of face...control of mind over the body is complete.” We often overlook, Sturges concludes, how “the voluntary muscles are the visible expression of the mind and the instrument of the will. Consider in what intimate respects muscular movement and posture express the man... His muscular carriage becomes the index of his mind, and is, in fact, a part of it.”³⁸⁸

According to Sturges, human development could thus be measured by the will’s progressive control over the body and the body’s progressive legibility. It thus followed that chorea was a form of atavism, a return to a child-like (or, as he often described it, primitive) state wherein the movements of the body were no longer meaningful or legible. Sturges thus modifies recapitulation theory to account for chorea, amending what Stephen J. Gould terms the “primitive-as-child” argument to “primitive-as-child-as-choreic.” Sturges emphasizes that, while the will’s mastery of the adult body may seem absolute, it is, in fact, tenuous. The potential for bodily disorder is always present. Chorea, he explains, not only “exhibits certain of the characteristics of childhood in unnatural exaggeration,” but is in fact caused by the residuum of childhood that “is always visible in the background.”³⁸⁹ Infancy supplies “the material out of which [chorea] is made.”³⁹⁰ When this latent bodily disorder overcomes the will and overruns the system, chorea results. Far from an instrument of the will or an index of the mind, the choreic body neither exemplifies corporeal discipline nor communicates the vital self to the world. Like the “aimless springs and kicks and grimacing” of infants, the involuntary jerks and tremors of choreic patients are nothing but physical gibberish, unmotivated by

³⁸⁸ Sturges, “Chorea,” 51.

³⁸⁹ Sturges, “Chorea,” 51.

³⁹⁰ Sturges, “Chorea,” 42.

the will. Unlike healthy bodies, which express their self-control and character through every “muscular movement and posture,” choreic bodies are incapable of self-representation.

Nerve specialists therefore believed that patients suffering from chorea and other functional disorders were incapable of expressing themselves somatically. In other words, they understood chorea as an autographic incapacity. It is not, therefore, coincidental that nerve specialists often reproduced examples of patients’ handwriting to document their varying degrees of bodily control and the relationship—if any—between voluntary effort and their “disordered actions.” In 1898, Silas Weir Mitchell published a paper entitled “A Clinical Re-Examination of the Motor-Symptoms of Chorea” in the *Philadelphia Medical Journal*.³⁹¹ Mitchell introduces his study by explaining that chorea, no matter the type, was widely thought to progress through the same stages, from early incoordination to continuous, constant, irregular spasms that made voluntary actions impossible—the same progression exhibited by the model with artificially induced convulsions. Mitchell hoped to re-examine this progression and to create more exact clinical subclassifications of the disease based on the effects of willed movements on involuntary choreic motions. His object, therefore, was to redefine and refine the disorder’s descriptive categories.

Mitchell supplies very brief descriptions of ten patients, focusing on whether or not the patient was able to execute voluntary motor acts, and what effect these motions had on their involuntary tremors. He illustrates these cases with examples of signatures

³⁹¹ S. Weir Mitchell and J.H. Wallace Rhein, “A Clinical Re-examination of the Motor-Symptoms of Chorea,” *Philadelphia Medical Journal* 1, no. 4 (January 22, 1898), 153-156. For a cultural history of handwriting in America, see Tamara Plakins Thornton, *Handwriting in America: A Cultural History* (New Haven: Yale University Press, 1996), 53.

(Figures 56, 57). In the case of patient sixteen, for instance, “general continuous movements were quieted by volition and fine muscular efforts. Two points were approximated perfectly, every sign of chorea for the minute disappearing.” Conversely, the willed exertions of writing increased the continuous movements of patient twenty-one.³⁹² While each letter in the writing sample of the former is clearly executed with a continuous stroke of the pen, the handwriting of the latter is nearly illegible. One letter blends into the next, and the breaks in the line indicate interruptions caused by the choreic motions. Mitchell, therefore, correlates lack of willpower and autographic legibility. The incoherent handwriting samples represent the will’s lack of command over the body. Mitchell’s text implies that chorea renders patients unable to express themselves physically or represent themselves graphically.

For Mitchell and his readers these signatures signified more than pen marks on paper. This evidentiary use of patients’ signatures presupposed a set of late nineteenth-century beliefs about the relationship between handwriting, character, and the will. For Sturges, it was not the body’s movements, but rather handwriting that provided the best proof of the intimate relationship between an individual’s body and mind. He argues that a man’s signature becomes fixed only when his character is full-formed and the will’s mastery of the body is complete. After this point, “it is with pain and effort and ill success that we write a feigned hand—so soon as attention is removed, the fingers slip back into their old habit.”³⁹³ As Tamara Plakins Thornton explains in her cultural history of handwriting in America, “the key role in the process of character formation—in both

³⁹² Mitchell and Rhein, “A Clinical Examination of the Motor-Symptoms of Chorea,” 153-154. By “Two points were approximated perfectly,” Mitchell seems to mean that the child managed to touch the tips of two fingers together, a common test for determining muscular control.

³⁹³ Sturges, “Chorea,” 46.

senses of the term—was assigned to the will...an attribute whose object of discipline was the body.”³⁹⁴

Handwriting, like movement, was conceived as an index of the individual, a visible representation of the innermost self. “Like character,” Thornton explains, “handwriting functioned as a form of self-presentation in nineteenth-century America... [Victorians] expected their handwriting to reveal something more interior, namely, the solidity and integrity of the writer’s character—or lack thereof.”³⁹⁵ Thus, every footstep and every stroke of the pen evidenced both the will’s control over the body and the character forged through this bodily discipline. However, as Sturges’s adoption of recapitulation theory reminds us, bodily discipline signified not only character, but also acculturation. It identified the body as developmentally, evolutionarily, and racially separate from and superior to the undisciplined bodies of “primitives” and children. In other words, the body’s submission to the will evidenced the individual’s voluntary submission to the rules and conventions that ordered society. But this constellation of associations between bodily regulation, character formation, and social convention also suggests that the shaky, broken signatures of Mitchell’s choreic patients signified not only their loss of will-power, but also a more fundamental and dangerous infirmity: that it was not their bodies, but rather their social and individual identities that were “disordered.”

Photographically illustrated medical texts conflate not only failed bodily presentation with failed photographic representation, but also bodily health and social

³⁹⁴ Thornton, *Handwriting in America*, 53.

³⁹⁵ Thornton, *Handwriting in America*, 52.

fitness. In 1876, Dr. George Thomas Stevens first suggested a new treatment for functional disorders. Structural problems within the eye, Stevens explained, caused eyestrain, which in turn lead to localized muscular disturbances and, eventually, to the decline of the whole neuromuscular system. This bodily breakdown manifested as any number of functional disorders.³⁹⁶ Stevens therefore treated chorea and related disorders by correcting ocular defects through repeated and often very invasive surgical procedures.

Stevens does not clarify exactly how or why this rapid devolution from ophthalmological errors to chorea occurred, presumably because, to his audience, the deleterious effects of eyestrain would have been too self-evident to require any justification. In the last quarter of the nineteenth century, a wide range of conditions

³⁹⁶ In principle, then, Stevens's proposed etiology mirrored the clinical findings of Dercum's experiment in artificially-induced seizures, which pointed to localized muscular disturbance as the root cause of functional disorders. Indeed, Ambrose Loomis Ranney, whose work on the ocular roots of functional disorders is discussed below, cites Dercum's experiment to substantiate his own clinical findings. See Ambrose Loomis Ranney, *Lectures on Nervous Diseases: From the Standpoint of Cerebral and Spinal Localization, and the Latter Methods Employed in the Diagnosis and Treatment of These Affections* (Philadelphia: F.A. Davis, 1888), 463-464. The connection between eyestrain and functional disorders was not new. S. Weir Mitchell was the first doctor—or so he would later claim—to recommend treating functional disorders by “glassing” the patient. See S. Weir Mitchell, *Clinical Lessons on Nervous Diseases* (Philadelphia: Lea Brothers, 1897), 220-230. However, treating functional diseases with eye surgery was a radical and controversial new development. In 1887, the Judicial Council of the New York Neurological Society appointed a committee to examine Stevens's findings. After two and a half years, the committee concluded that “the method of Dr. Stevens does not afford a sufficient degree of relief to patients suffering from chorea and epilepsy to warrant its adoption.” Despite the commission's findings, Stevens's theories continued to be supported and practiced well into the next century, although not without continued criticism. Many prominent Philadelphia nerve specialists lead the charge against the therapeutic benefits of surgery for treating chorea and epilepsy. For Mitchell's criticisms of Stevens's methods, see Mitchell, *Clinical Lessons on Nervous Diseases*, 226-228. See also Howard F. Hansell, “General Considerations: Epilepsy; Chorea; Vertigo; Gastric Disturbances; Spasmodic Movements of the Head other than Choreiform; General Asthenopia,” part II of chapter 18, “Neuroses and other Conditions Occasioned by Errors of Refraction and Imbalance of the Extra-Ocular Muscles, and the Effect of Lenses and Operative Procedure in Relieving the Same,” in *The Eye and the Nervous System*, eds. William Campbell Pose and William G. Spiller (Philadelphia: J.B. Lippincott Company, 1906), 775-827. For a brief summary of Stevens's work, as well as an overview of the Stevens Commission's findings, see James R. Keane, “Strabismus Surgery for Neurological Illness: The Stevens Commission 1887-1889,” *History of Neurology* 46 no. 3 (March 1989), 323-324.

loosely classified as nervous in origin were regularly attributed to eyestrain.³⁹⁷ But we can glean the thought process and theoretical justification behind Stevens's surgical cure-all from Horatio C. Wood's discussion of optical defects in *Brain-work and Overwork*.³⁹⁸ Wood explains, "if there be optical defects in the eye, the retinal image will be indistinct, and only by an effort will the upper brain be able to recognize the blurred record made upon the lower brain." Eventually, this constant effort caused first the brain and ocular muscles and then the body as a whole to "become wearied out by the incessant overwork and act irregularly."³⁹⁹ Functional disorders, therefore, resulted from the stress and strain of deciphering blurred retinal images. Stevens's cure sought to restore the body to health by correcting ocular defects—by, in other words, restoring the blurred retinal image to focus.

In his 1887 text *Functional Nervous Diseases*, Stevens not only presents multiple cases that he has cured surgically, but also illustrates these cases with before-and-after photographs that represent this cure through their differential focus.⁴⁰⁰ The portraits of one subject, a sixteen year old boy with chorea, are framed in an oval vignette (Figure 58). While the first image, taken directly before the patient's first ophthalmic surgery, is blurred, the sharp focus of the second photograph makes legible every detail of the patient's face and clothing. Stevens explains that before the first treatment "[the patient's] whole body was in perpetual motion. This is well shown in the photograph...when, notwithstanding the rapidity of modern photography, it was quite too slow to get a clear

³⁹⁷ See, for instance, George M. Gould, *Biographic Clinics: The Origin of the Ill-Health of De Quincey, Carlyle, Darwin, Huxley, and Browning* (Philadelphia: P. Blakiston, Son & Co., 1903). Gould attributes the ill-health of these famous nineteenth-century figures to eyestrain.

³⁹⁸ Horatio C. Wood, *Brain-Work and Overwork* (Philadelphia: P. Blakiston, Son & Co., 1885).

³⁹⁹ Wood, *Brain-Work and Overwork*, 63.

⁴⁰⁰ George S. Stevens, *Functional Nervous Diseases: Their Causes and Their Treatment* (New York: D. Appleton and Company, 1887).

picture. The shaded borders of the picture show the movements of the head.” After the operation “the change in the boy’s condition was marvelous...the two portraits do not exaggerate the improvement.”⁴⁰¹ In Stevens’s text, the camera does not simply record the patient but gauges his pathology: the modern and fast-acting photographic instrument acts a standard for assessing the rapidity of the patient’s movements.

In addition, the before-and-after photographs exploit pictorial conventions of photography to convey the “before” and “after” of Stevens’s cure in more subtle ways. In the first photograph, the patient seems to lean into the vignette at an off-kilter angle. Next to this deviant image, the patient in the “after” photograph appears both literally and metaphorically upright, and far removed from the ill-formed pathological next to him. Despite these differences, the patient’s pose in the two photographs is nearly identical save for his gaze: in the first, he stares out at the viewer, in the second into the distance and to right.

In an article titled “The Head Vignette” published in the *Photographic Times and American Photographer* in 1884, Henry Peach Robinson addresses the importance of this seemingly insignificant deviation.⁴⁰² After offering a few tips on the most flattering poses and hints for dealing with difficult sitters, Robinson puts forth this dictum: “the eyes should always go with the head. Nothing is more disagreeable than to see an eye looking out of the corner, or twisted across the face... If the head is turned to the right, the eye should go as much to the right.” Robinson illustrates this advice with a drawing of two

⁴⁰¹ Stevens, *Functional Nervous Diseases*, 100.

⁴⁰² Henry Peach Robinson, “Hints on Posing and Management of the Sitter: Chapter II—the Head Vignette” *Photographic Times and American Photographer* 14 no. 48 (December 5, 1884), 633-636.

identical heads “with the position of the eyes only altered” (Figure 59). He concludes, “the first is constrained and self-conscious, the other easy and natural.”⁴⁰³

To Stevens’s contemporaries, skilled at reading the nuances of studio photography, his before and after photographs may have had widely divergent connotations. Robinson’s interpretation of the first picture as “constrained and self-conscious” and the second as “easy and natural” suggests that in the “after” photograph the patient is not only posing, but posing right. That is, that he has mastered the conventions of portraiture, marshaling his previously disordered body into order and arranging his features into an image that, paradoxically, connotes ease and naturalness. As Sturges explained, freedom of self-expression was contingent on the body’s submission to the will. To appear easily and naturally—to appear, in other words, as oneself—was, in fact, neither easy nor natural, but rather the result of the will’s hard-fought victory over the bodily disorder always lurking in the background, the vestigial traces of a “primitive” or pre-social stage of evolution. Viewed in this context, posing for the camera becomes a self-conscious reenactment of everyday acts of self-presentation. The patient’s pose proved him capable of the more quotidian displays of bodily discipline that defined him as both an individual and a social being.

This imbrication of the medical and the aesthetic is even more apparent in a case study of a patient described in Ambrose Loomis Ranney’s *Lectures on Nervous Diseases*, published in 1888. Ranney was a neurologist rather than an ophthalmologist, but his treatment for functional disorders is similar to Stevens’s, and his clinical study follows a similar narrative. After performing an initial ophthalmological surgery on a patient who exhibited the “disordered actions” of chorea, Ranney writes that he,

⁴⁰³ Robinson, “Hints on Posing and Management of the Sitter,” 636.

...instructed the patient to try and get a photograph taken, if possible, before she saw me again. She laughingly said that she had never been able to have a picture taken, but she would do so if she could... The first picture received of this case was one that she was able to have taken three weeks after the operation, when her head and shoulder had become comparatively calm... You can see in it the blurred outlines which indicate that the movements were still somewhat active.⁴⁰⁴

Ranney operated a second time, and then sent the patient off to be photographed again.

He concludes, “the second picture will give, better than words can describe it, an idea of the wonderful improvement which has taken place.”⁴⁰⁵ As in Stevens’s text, the before and after photographs of Ranney’s patient signal her physical improvements through aesthetic correctives, including the slight change in the direction of the patient’s gaze (Figure 60). Both accounts image the patient’s role in the photographic process as active, rather than passive. If the blur symbolizes the pathological movements symptomatic of functional disorders, then within Ranney’s and Stevens’s texts, “ability to be photographed”—and to be photographed well, obeying all of the conventions of portrait photography—functioned as a diagnostic criterion for normality and a sign of the patient’s return to the social order.

In plate 532 of *Animal Locomotion*, the first image discussed in this chapter, the “hand, inscribing a circle” belonged to J. Liberty Tadd, the director of the Public Industrial Art School of Philadelphia. The objective of Tadd’s pedagogical method, which he describes in *New Methods of Art Education*, was “to make the hand obey the dictates of the mind, to make the hand obedient to the will.”⁴⁰⁶ To do so, Tadd prescribed a series of drawing exercises, the first of which was drawing a freehand circle (Figure

⁴⁰⁴ Ranney, *Lectures on Nervous Diseases*, 499.

⁴⁰⁵ Ranney, *Lectures on Nervous Diseases*, 500.

⁴⁰⁶ J. Liberty Tadd, *New Methods in Education: Art, Real Manual Training, Nature Study* (New York: Orange Judd Company, 1899), 76.

61). Muybridge's photographic sequence is thus both a demonstration of the initial stage of the will's progressive disciplining of the hand and a display of the manual dexterity that is its final result.

This chapter has situated Muybridge's "abnormal motion studies" within both the related nineteenth-century discourses of medicine, the body, and photography, and the larger field of emerging conventions for representing movement disorders photographically. In his study of Muybridge's images, Dercum attempted to resolve the seemingly inescapable incompatibility between Muybridge's stop-action photographs and the "disordered actions" of the pathological subjects by layering tracings of the images from a particular sequence in one frame. By doing so, he both mimicked the blurred, palimpsested photographs taken with the Marey wheel camera and expressed bodily disorder through pictorial disorder.

I have also argued that, by creating these drawings, Dercum was not only compensating for the shortcomings of Muybridge's photographic method but was also making Muybridge's sequences conform to a developing pictorial convention for representing motion disorders: the photographic blur. As this chapter has demonstrated, physicians writing about functional disorders used the blur not only as an index of pathological movements—an actual, physical trace of the movements themselves—but also as a symbol of their violence and rapidity, the very qualities that characterized the "disordered actions" as pathological. In its absence, these authors introduced the blur by either altering the photograph or writing the blur into the image with captions or other textual additions.

However, functional disorders were also understood as impairments of self-expression.

As Sturges's discussion of chorea suggests, in the nineteenth century every bodily movement was considered "an index of the mind." While the willed movements of healthy bodies expressed the innermost and unchanging self to the outer world, Muybridge's pathological subjects had lost the ability to signify: their tremors and spasms were unwilled and therefore meaningless. In medical texts, the patient's very inability to record his thoughts on paper or imprint his likenesses onto the photographic plate thus became a sign of pathology. Nerve specialists therefore presented the camera as a diagnostic tool rather than a machine for the manufacture of objective and unmediated images. In its very failure to take a perfect picture, the camera communicated something beyond the body itself: "disordered actions" uncontrolled by the will.

Epilogue

Galloping Horses and Hybrid Monsters: Muybridge, Galton, Cattell and the Perception of Movement

In 1889, the eminent invertebrate zoologist E. Ray Lankester, one of the British scientists who investigated and exposed the medium Slade, wrote a glowing review of Eadweard Muybridge's *Animal Locomotion*.⁴⁰⁷ Lankester describes Muybridge's initial attempts to photograph the movements of men and animals in the 1870s, and his expanded photographic investigations at the University of Pennsylvania in the 1880s. To summarize, Lankester notes that the photographs are valuable "on account of the actual facts of natural history and physiology which they record"—an interpretation that perhaps is not surprising given Lankester's academic bent. But he continues by arguing that the true interest of Muybridge's photographs is not physiological. They have, he observes, "a quite distinct and perhaps their most definite interest in their relation to psychology." For they force us to ask "How is it that this (which is demonstrated by the photograph to be the actual series of attitudes assumed by the galloping horse) has given rise through the human eye and brain to the conventional representation with outstretched fore and hind legs?" Lankester continues, "what do we really see as opposed to what really is? What is the objective fact—the brain picture—as opposed to the objective fact—the sun picture?" He adds that, if Muybridge or another investigator should continue these psychological-photographic experiments, they would have to follow "the scientific method of theory, test hypothesis, and experiment"—they would, in other words, have to be more rigorous.⁴⁰⁸

⁴⁰⁷ E. Ray Lankester, "The Muybridge Photographs," *Nature* 40 (May 23, 1889), 78-80.

⁴⁰⁸ Lankester, "The Muybridge Photographs," 79.

This reading of Muybridge's images was hardly unprecedented. As we saw in Chapter 2, advocates of the sciences interpreted the *Animal Locomotion* photographs as embodiments of the machine-trained, disciplined, and nearly super human "scientific sense" that, they believed, could only be developed through a thorough scientific education. On the one hand, critics received the motion studies as powerful indictments of faulty artistic vision and evidence that human perception needed the training that the sciences provided. On the other hand, artists argued that Muybridge's photographs only affirmed the authority and legitimacy of artistic sight. More fundamentally, however, Muybridge's images exposed discrepancies between, in Lankester's words, what we really see and what really is, and, by extension, how we represent the world around us. For many viewers Muybridge's photographs revealed that the human eye was a flawed apparatus, insensitive and incapable of capturing the fleeting impressions registered by his instantaneous plates.

However, Lankester was the first writer to relate Muybridge's photographs not to sensory physiology—in this case, the study of how the eye is structured and how it processes stimuli—but to psychology. More specifically, Lankester implies that the questions Muybridge's photographs raised about the relationship between the "brain picture" and the "sun picture" belonged to the domain of experimental psychology, a new field of inquiry at the time.

As a short coda and conclusion, I will briefly examine how Muybridge's images shaped and challenged the thought of two early experimental psychologists, Sir Francis Galton and James McKeen Cattell. In 1882, Galton wrote two articles on Muybridge's first body of motion studies. In these articles, Galton attempts to explain the

discrepancies between how moving animals appear in Muybridge's photographs and how they are perceived by the naked eye.⁴⁰⁹ Like Galton, Cattell investigated how we perceive motion, or, more specifically, why we perceive moving objects the way we do. To do so, he used photographs in general and Muybridge's photographs in particular as metaphors and models for human perception. The ways in which Galton and Cattell struggled with the implications of Muybridge's project points to its larger influence on visual culture and modern thought and a reordering of photography's relationship to the objective "reality" it was presumed to capture. This conclusion therefore situates not only Muybridge's photographs but also the researches of Muybridge's collaborators discussed in this study within a larger intellectual history of vision.

Although Galton was more a career polymath than he was a devoted experimental psychologist, his interest in individual difference, mental associations, and perception greatly influenced the direction of the discipline. Galton is best known today as the father of eugenics. Beginning in the late 1860s, the majority of his work focused on the development of statistical methods for studying and quantifying heredity. In *Hereditary Genius*, for instance, Galton claimed to have gathered statistical proof that human intelligence is inherited. Noting that these statistics followed a binomial distribution, he theorized that Quetelet's "natural law" also governed the intelligence of different races, with men of Anglo-Saxon descent at the top of the bell curve. Based on his statistical evidence and driven by the wide-spread fear that stock of British Great Men—and therefore civilization itself—was in decline, Galton argued, "it would be quite practicable to produce a highly-gifted race of men by judicious marriages during several consecutive

⁴⁰⁹ Francis Galton, "Conventional Representation of the Horse in Motion," *Nature* 26 (July 6, 1882), 228-229; "A Rapid-View Instrument for Momentary Attitudes," *Nature* 26 (July 13, 1882), 249-251.

generations.”⁴¹⁰ In this way, Galton’s researches used the same statistical tools and relied on the same assumptions about racial difference as the anthropometry-based physical education system developed by Sargent and instituted by the University of Pennsylvania.

In addition, Galton used both anthropometry and physiognomic theories to quantify and visualize differences between individuals, social classes, and races. As Allan Sekula notes, “Galton’s passion for quantification and numerical ranking coexisted with a qualified faith in physiognomic description.”⁴¹¹ These twin passions also converged with Galton’s long-standing interest in photography. In 1878, Galton developed a method for creating composite photographs—or, as he often called them, “generic images.”⁴¹² Galton exposed a single photographic plate with multiple negatives to form a single, composite image. By doing so, Galton believed that the characteristics common to the group as a whole would dominate, while the incidental, the irregular and the deviant would be reduced to a dim corona around the darker, more sharply-defined features. Like Sargent’s charts, which visualized deviations from an ideal statistical type, these composites were, Galton believed, a form of pictorial statistics: the dominant areas representing the statistical average, and the blurring around the edges signifying “the tendency of individuals to deviate from the central type.”⁴¹³ Galton used this process to produce

⁴¹⁰ Francis Galton, *Hereditary Genius: An Inquiry into its Laws and Consequences* (London: MacMillon and Company, 1869), 1.

⁴¹¹ Sekula, “The Body and the Archive,” 44.

⁴¹² Galton explained this process in several articles published in 1878 and 1879. Francis Galton, “Composite portraits made by combining those of many different persons into a single figure,” *Nature* 18 (May 23, 1878), 97-100; “Composite Portraits,” *Journal of the Anthropological Institute* 8 (1879), 132-144; “Generic images,” *Nineteenth Century* 6 (1879), 157-169; “Generic Images,” *Proceedings of the Royal Institution* 9 (1879), 161-170.

⁴¹³ Galton, “Generic images,” 166.

“generic images” of, among others, criminals, Jews, and consumptives—a gallery of the “unfit” that underscores Galton’s eugenicist ambitions (Figure 62).

However, as Sekula observes and Josh Ellenbogen has discussed at greater length, Galton also believed that the composite photograph was a model for the workings of the human sensorium. According to this logic, just as exposing a single photographic plate with multiple portraits forms a generic image of “the criminal type,” so too do we compose a mental generic image of “the criminal” from all of the individual criminals we have seen. It is through this combinatory process, Galton claims, that we form abstract concepts. Galton’s photographic project, therefore, relied on a structural analogy between the photographic plate and the human sensorium. Galton could only consider the composite photograph and a mental image “like things” if he conceived of the mind as a sensitive photographic plate, a model not far removed from Locke’s *tabula rasa*. In fact, Galton describes mental images as “nothing more than a generic portrait stamped on the brain by the successive impressions made by its component images.”⁴¹⁴

Yet, in his investigations of Muybridge’s photographs, Galton presents a more nuanced—if also more confused—model of the human sensorium. The first of two articles published in consecutive issues of *Nature*, Galton attempted to solve the mystery of how and why the human brain forms the conventional representation of the horse—the outstretched fore and hind legs position mentioned by Lankester—from the positions captured in Muybridge’s instantaneous photographs. Galton’s hypothesis is that “the shape of the blur made on the eye by [the horse’s] rapid and various movements” justifies the convention.⁴¹⁵

⁴¹⁴ Galton, “Generic images,” 166.

⁴¹⁵ Galton, “Conventional Representation of the Horse in Motion,” 228.

To prove this theory, Galton makes two composite images from Muybridge's photographs. As we saw in Chapter 4, Francis X. Dercum used a similar process. Indeed, both Dercum and Galton used these composites to mediate between Muybridge's instantaneous photographs and the experiential perception of movement. Dercum expressed the unquantifiable qualities of the "disordered actions" characteristic of pathological patients through the blurred drawings traced from Muybridge's sequences. Galton, on the other hand, used the composites to explain how our minds form the conventional yet objectively false hobby-horse position. His first composite comprises all of the photographs from one of Muybridge's Stanford motion studies (Figure 63) that capture the horse's forelegs extended (Figure 64). The second combines all of the photographs with extended hind legs (Figure 65). Galton concludes that the eye cannot take in both the back and front halves of the fast-moving horse at the same time. Instead, it "wanders from one to the other and seizes the most characteristic attitudes of each, and combines them into a hybrid monster."⁴¹⁶ He demonstrates this process by combining the two halves of the composites into a single image (Figure 66). Although Galton still relies on the analogy between the photographic plate and the human mind, here his explanation of how exactly the brain synthesizes mental images is less mechanical than it is creative. The conventional image of the moving horse is not a "generic portrait stamped on the brain by the successive impressions made by its component images," but a "hybrid monster" that cannot be accounted for by the simple action of direct registration alone.

In the second article, titled "a Rapid-View Instrument for Momentary Attitudes," Galton deals again with the relationship between Muybridge's photographs and mental images. Galton explains that, contrary to popular opinion, the "sensitivity [of the eye] is

⁴¹⁶ Galton, "Conventional Representation of the Horse in Motion," 229.

vastly superior to that of a so-called ‘instantaneous’ photographic plate when exposed in a camera.”⁴¹⁷ He contends that every sensorial image is the sum of a series of infinitesimally small impressions. Given his experiments with composite photographs, this argument is unsurprising. Yet, the conclusion he draws is quite different. Galton explains that it is not our faulty or insensitive sensory apparatus that limits perception. Rather, the problem lies in the limited analytical ability of our mind—our neural system simply cannot transmit and process sensory inputs fast enough. Thus, while our eyes do, in fact, register the phases of movement captured in Muybridge’s photographs, we do not consciously perceive these images. In Galton’s schema, then, there is a sharp divide between the photochemical recording of visual stimuli—a process that can be objectively measured—and our subjective perception of these stimuli.

To prove this theory, Galton constructs what he calls a “rapid view device,” which is a small box with an aperture at one end and a spring-loaded shutter at the other (Figure 67). By peering at a moving object and releasing the shutter, the user briefly “exposes the eye...leaving a sharply-defined image...that can be drawn from visual memory, which in some persons is very accurate and tenacious.”⁴¹⁸ Thus, Galton’s rapid-view device in effect turns the retina into one of Muybridge’s instantaneous photographic plates. It isolates and imprints upon the retina a single image from the constant stream of visual stimuli—an image, moreover, that we would otherwise never see. By doing so, the device proved that perception and the physical registration of stimuli were two very different processes, and that mental images and visual impressions alike are “hybrid monsters.”

⁴¹⁷ Galton, “A Rapid-View Instrument for Momentary Attitudes,” 246.

⁴¹⁸ “A Rapid-View Instrument for Momentary Attitudes,” 250.

Although an argument for direct causation is difficult, these explorations of Muybridge's photographs certainly influenced Galton to reconsider his mechanical model of the human sensorium and the relationship between perception and the mind. When Galton mentions "visual memory" in his second article, he is alluding to several interrelated investigations into individual difference, mental imagery and association that he carried out in the early 1880s. Galton collected and summarized these experiments in *Inquiries into Human Faculty and its Development*, first published in 1883. For Galton, these experiments suggested the variability of cognitive and perceptual processes. They demonstrated "how impossible it is in a general way for two grown-up persons to lay their minds side by side together in perfect accord."⁴¹⁹ Although Galton would experiment with photographic composites on and off for decades, in no article or book written after 1883 does Galton present the composite photograph as a model for the workings of the mind or for the process of concept formation.

Galton's investigations greatly influenced many of the new experimental psychologists who, beginning in the mid-1880s, began to define the parameters, subjects, and methodologies of their field. In particular, Galton's work had a profound effect on James McKeen Cattell.⁴²⁰ Cattell briefly worked alongside Galton at the University of Cambridge after he received his PhD under Wilhelm Wundt, one of the German scientists who, as we saw in Chapter 2, took part in Zoellner's spiritualist investigations.⁴²¹ Upon returning to the United States in 1887, Cattell was appointed Professor of Psycho-Physics

⁴¹⁹ Francis Galton, *Inquiries into Human Faculty and its Development* (London: MacMillan and Company, 1883), 195.

⁴²⁰ Galton's influence on Cattell is discussed in Michael Sokal, "Psychology at Victorian Cambridge: The Unofficial Laboratory of 1887-1888," *Proceedings of the American Philosophical Society* 116, no. 2 (April 17, 1972), 145-147; Sokal, *The Education and Psychological Career of James McKeen Cattell*, 304-323.

⁴²¹ For Cattell's education under Wundt in Leipzig, see Sokal, *The Education and Psychological Career of James McKeen Cattell*, 39-249.

at the University of Pennsylvania, a position funded through the Seybert bequest. Cattell thus arrived at the university less than a year after the publication of *Animal Locomotion*. At the university, Cattell taught courses in experimental psychology that complemented classes taught by George Fullerton, who was one of the Seybert Commission members, on “those regions of Psychology which border on the theory of knowledge.”⁴²²

Moreover, Cattell founded the country’s first experimental psychology laboratory, where he hoped to establish experimental psychology as a legitimate science in the United States. To advance his objective of applying “scientific methods to the study of mind,” Cattell rejected introspection or rigorous self-observation, which Wundt and Galton both viewed as fundamental to psychology, as inadequately objective and systematic.⁴²³ Instead, he relied exclusively on apparatuses that he had used in Germany and England. But by eliminating the subjectivity of introspective methods, Cattell also differentiated experimental psychology from both philosophy, which had long been viewed as the rightful domain of all academic studies of the mind and cognition, and spiritualism and psychic research, which also claimed mental phenomena as its primary subject. In Chapter 2, I argued that Fullerton, like the other Seybert Commission members, was motivated to investigate spiritualism for just this reason: by exposing spiritualists as frauds, he also asserted his authority as a “scientific expert[] of the mental realm.”⁴²⁴ Indeed, the ways in which Cattell defined his professional practice and

⁴²² James McKeen Cattell, “Psychology at the University of Pennsylvania,” *The American Journal of Psychology* 3, no. 2 (April, 1890), 281.

⁴²³ Cattell, “Psychology at the University of Pennsylvania,” 283. Michael Sokal has provocatively argued that Cattell did not use introspective methods because he was psychologically or even cognitively incapable of introspection. Michael Sokal, “Scientific Biography, Cognitive Deficits, and Laboratory Practice: James McKeen Cattell and Early American Experimental Psychology, 1880-1904,” *Isis*, 101, no. 3 (September 2010), 531-554.

⁴²⁴ Coon, “Testing the Limits of Sense and Science,” 147. Cattell also contributed to the assault on spiritualism. James McKeen Cattell, “Mrs. Piper, the Medium” *Science* 7 no. 172 (1898), 534-535.

positioned the methods and objects of experimental psychology in relation to other fields closely parallels the attempts by scientific professionalizers to define the boundaries of their disciplines and lay claim to professional authority. As I demonstrated, for Mitchell precision instruments—including Muybridge’s photographs—exemplified the disciplined and near super-human vision that scientists claimed as their professional prerogative. In a similar way, Cattell’s chronoscopes, kymographs, and tachistoscopes were emblematic of his professional practice and identity.

Together, Cattell and Fullerton measured individual differences in perception. They published their results in 1892 under the title *On the Perception of Small Differences*. After he left the University of Pennsylvania in 1890, Cattell expanded upon these experiments to investigate the perception of movement—the same subject that Galton explored through Muybridge’s photographs.⁴²⁵ Cattell begins “On Relations of Time and Space in Vision,” which was published in 1900, by evoking the analogy between the retina and the photographic plate only to immediately destabilize it. He writes, “in the ordinary vision of daily life, the eyes, the head and the whole body are in continual movement. There are no distinct and lasting images on the retina; the physical conditions are those of the photographic plate when the camera is constantly moved hither and thither.”⁴²⁶ Any psychological explanation for perception must therefore account for two problems: why, as we move through the world, we experience the world as distinct and unchanging rather than as a blurred photograph and, conversely, why we experience moving objects as unified wholes, rather than as a succession of positions “as

⁴²⁵ George Fullerton and James McKeen Cattell, *On the Perception of Small Differences* (Philadelphia: University of Pennsylvania Press, 1892).

⁴²⁶ James McKeen Cattell, “On Relations of Time and Space in Vision,” *The Psychological Review* 7 no. 4 (July 1900), 325.

instantaneous photography would exhibit them.”⁴²⁷ In an earlier article that briefly examines this same phenomenon, Cattell clarified that “instantaneous photographs (as those by Muybridge) show the positions of animals when moving, and these are such as no one could have perceived by looking at the animal.”⁴²⁸

To examine how subjects perceived moving objects, Cattell put his subjects through several batteries of tests using three different instruments. In one iteration, Cattell placed pieces of red and green paper on a wheel chronoscope and the chronoscope behind a black screen. The subject sitting on the other side of the screen viewed the color wheel through a small window. Cattell spun the wheel at such a rate that each color was only visible for 1/20 of a second—too fast for the eyes to register and respond to the moving colors. Cattell’s experiment revealed that, rather than seeing the moving colors as a temporal succession—as, for instance, green, followed by a mixture of green and red, followed by red—the subjects perceived them simultaneously as a variegated color field. Thus, Cattell concludes, “a process physically and physiologically in time is given in perception as a spatial continuum.”⁴²⁹

For Cattell, however, the true import of these experiments lay in the fact that every subject perceived this spatial continuum differently. Muybridge’s photographs compelled Galton to conclude that his mechanical model of the human sensorium could not wholly account for the differences between the phases of motion captured in Muybridge’s images and the conventional mental image of motion. Cattell’s experiments, in contrast, severed vision from the world. For Cattell, both instantaneous photographs

⁴²⁷ Cattell, “On Relations of Time and Space in Vision,” 330.

⁴²⁸ James McKeen Cattell, “The Perception of Light,” in *System of the Diseases of the Eye*, vol. 1, ed. William F. Norris and Charles A. Oliver (Philadelphia: J.B. Lippincott Company, 1897), 536.

⁴²⁹ Cattell, “On Relations of Time and Space in Vision,” 343.

and his own research challenged the very assumption that “perception is in any way a copy of the physical world or the correlate of a simple physiological process.” His experiments, he concludes, “may lead us to consider that there may be more individual variation in the perception of the same physical world than we commonly assume.”⁴³⁰ Galton and Cattell’s experiments suggest that for nineteenth-century viewers Muybridge’s images entailed a new understanding of the mind in relation to sense perception. As the psychologist George Van Ness Dearborn wrote of Cattell’s experiments, they proved the “visual mechanism...to be no mere organic machine mechanically photographing objects upon a sensorium, but rather a vital, mental instrument by which in part each personality constructs for itself its own objective world.”⁴³¹

⁴³⁰ Cattell, “On Relations of Time and Space in Vision,” 340.

⁴³¹ George V. N. Dearborn, “On Relations of Time and Space in Vision” (Review), *The Journal of Nervous and Mental Disease* 28 no. 3 (March, 1901), 179.

Bibliography

Archives

Muybridge Animal Locomotion Cyanotypes. National Museum of American History, Washington, DC.

Department of Physical Education. Records of the Department of Physical Education: Anthropometric Measurements of Harvard students, 1860-1920. Harvard University Archives, Cambridge, MA.

Eadweard Muybridge Notebooks. Notebook 2, negatives 524–1084, June 2–August 4, 1885; Notebook 3, negatives 1322–1540, September 15–October 28, 1885. George Eastman House, International Museum of Photography and Film, Rochester, NY.

Records of the Philadelphia Neurological Society. College of Physicians of Philadelphia, Philadelphia, PA.

Silas Weir Mitchell Papers, 1788-1949. College of Physicians of Philadelphia, Philadelphia, PA.

William Pepper Papers. Kislack Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania, Philadelphia, PA.

Seybert Commission for Investigating Modern Spiritualism Records, 1884-1922. Kislack Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania, Philadelphia, PA.

Eadweard Muybridge Collection, 1870-1981. University Archives and Records Center, University of Pennsylvania, Philadelphia, PA.

General Administration Records, 1820-1930. University Archives and Records Center, University of Pennsylvania, Philadelphia, PA.

Committee to Produce Greek Play, *The Acharnians* by Aristophanes, Records 1886. University Archives and Records Center, University of Pennsylvania, Philadelphia, PA.

Books and Articles

- Abney, William de Wiveleslie. "Are Instantaneous Photographs True?" *International Annual of Anthony's Photographic Bulletin* 2 (1889): 285-287.
- Adams, Charles Francis. *A College Fetich: An Address Delivered before the Harvard Chapter of the Fraternity of the Phi Beta Kappa, in Sanders Theatre, Cambridge, June 28, 1883*. Boston: Lee and Shepard, 1883.
- Allen, Harrison. "Materials for a Memoir on Animal Locomotion." In *Animal Locomotion: The Muybridge Work at the University of Pennsylvania. The Method and the Result*. Philadelphia: J.B. Lippincott Company, 1888: 35-101.
- Armstrong, Carol. *Scenes in a Library: Reading the Photograph in the Book, 1843-1875*. Cambridge: MIT Press, 1998.
- Baltzell, Edward Digby. *Philadelphia Gentlemen: The Making of a National Upper Class*. New York: Free Press, 1958.
- Barkan, Elazar and Ronald Bush, ed. *Prehistories of the Future: the Primitivist Project and the Culture of Modernism*. Stanford: Stanford University Press, 1995.
- Beach, Mark. "Was There a Scientific Lazzaroni?" In *Nineteenth-Century American Science: A Reappraisal*, ed. George H. Daniels. Evanston: Northwestern University Press, 1972: 115-132.
- Beard, George Miller. "Neurasthenia, or Nervous Exhaustion." *Boston Medical and Surgical Journal* 80 (April 29, 1869): 217-221.
- . "The Scientific Study of Human Testimony," part I. *Popular Science Monthly* 13 (May 1878): 54-64.
- . "The Scientific Study of Human Testimony," part II. *Popular Science Monthly* 13 (June 1878): 173-183.
- . "The Scientific Study of Human Testimony," part III. *Popular Science Monthly* 13 (July 1878): 328-338.
- . *American Nervousness: Its Causes and Consequences*. New York: G.P. Putnam's Sons, 1881.
- Bederman, Gail. *Manliness and Civilization: A Cultural History of Gender and Race in the United States, 1880-1917*. Chicago: University of Chicago Press, 1995.
- Berger, John. *Ways of Seeing*. London: Penguin Books, 1972.

- Berger, Martin A. *Man Made: Thomas Eakins and the Construction of Gilded Age Manhood*. Berkeley, CA: University of California Press, 2000.
- Blaikie, William. *How to Get Strong and How to Stay So*. New York: Harper & Brothers, Publishers, 1879.
- . *How to Get Strong and How to Stay So*. New York: Harper & Brothers, Publishers, 1899.
- du Bois-Reymond, Emil. "On the Relation of Natural Science to Art." *Nature* 45 no. 1157 (January 1892): 200-204.
- Bozeman, Theodore Dwight. *Protestants in as Age of Science: The Baconian Ideal and Antebellum American Religious Thought*. Chapel Hill: University of North Carolina Press, 1977.
- Braddock, Alan C. "Eakins, race, and ethnographic ambivalence." *Winterthur Portfolio* 33, no. 2-3 (Summer-Autumn, 1998).
- Braude, Ann. *Radical Spirits: Spiritualism and Women's Rights in Nineteenth Century America*. Boston: Beacon University Press, 1989.
- Braun, Marta. "Muybridge's Scientific Fictions." *Studies in Visual Communication* 10, no. 3 (Summer 1984): 2-22.
- . *Picturing time: The work of Etienne-Jules Marey (1830-1904)*. Chicago: University of Chicago Press, 1992.
- . "The Expanded Present: Photographing Movement." In *Beauty of Another Order: Photography in Science*, ed. Ann Thomas. New Haven: Yale University Press, 1997: 150-184.
- . and Elizabeth Whitcombe, "Marey, Muybridge and Londe: The Photography of Pathological Locomotion." *History of Photography* 23, no. 3 (Autumn 1999): 218-224.
- . "Fragmentation as Narration: The Case of Animal Locomotion." In *Stop Motion, Fragmentation of Time: Exploring the Roots of Modern Visual Culture*, ed. François Albera, Marta Braun, and André Gaudreault. Lausanne: Editions Payot, 2002: 151-170.
- . "Chronophotography: Leaving Traces." In *Moving Pictures: American Art and Early Film, 1880-1910*, ed. Nancy Mowll Mathews. Manchester: Hudson Hills Press/Williams College Museum of Art, 2005: 95-99.

- . “Muybridge/Technology.” In *Zeitschrift für Medien und Kulturforschung*, ed., Lorenz Engell and Bernhard Siegert. Hamburg: Felix Meiner, 2010: 51-62.
- . “Animal Locomotion.” In *Helios: Eadweard Muybridge in a Time of Change*, ed. Philip Brookman. Göttingen: Steidl/Washington: Corcoran Gallery of Art, 2010: 74-76.
- . *Eadweard Muybridge*. London: Reaktion Books, 2010.
- Britten, Emma Hardinge. “Rules for the formation and conduct of the spirit circle.” In *On the Road or the Spiritual Investigator. A Complete Compendium of the Science, Religion, Ethics, and Various Methods of Investigating Spiritualism*. Melbourne: George Robertson, 1878: 33-39.
- Brookman, Philip. “Helios: Eadweard Muybridge in a Time of Change.” In *Helios: Eadweard Muybridge in a Time of Change*, ed. Philip Brookman. Göttingen: Steidl/Washington: Corcoran Gallery of Art, 2010: 23-109.
- Brown, Elspeth H. “Racialising the Virile Body: Eadweard Muybridge’s Locomotion Studies 1883-1887.” *Gender & History* 17, no. 3 (2005): 627-656.
- Brubacher, John S. and Willis Rudy, *Higher Education in Transition: a History of American Colleges and Universities*. New Brunswick: Transaction Publishers, 2004.
- Brunet, François. “Visual Semiotics Versus Pragmaticism: Peirce and Photography.” In *Peirce's Doctrine of Signs: Theory, Applications, and Connections*, ed. Vincent Michael Colapietro et al. New York: Water de Gruyter & Co., 1995: 295-313.
- . “‘A Better Example is a Photograph’: On the Exemplary Value of Photographs in C.S. Peirce’s Reflection on Signs.” In Robin Kelsey and Blake Stimson, eds., *The Meaning of Photography*. New Haven: Yale University Press, 2008: 34-49.
- Burgess, John W. *The American University. When Shall It Be? Where Shall It Be? What Shall It Be? An Essay*. Boston: Ginn, Heath and Company, 1884.
- Burns, E. Bradford. *Eadweard Muybridge in Guatemala, 1875: The Photographer as Social Recorder*. Berkeley: University of California Press, 1986.
- Burns, Sarah. *Inventing the Modern Artist: Art and Culture in Gilded Age America*. New Haven: Yale University Press, 1996.
- Carnes, Mark. *Secret Ritual and Manhood in Victorian America*. New Haven: Yale University Press, 1989.
- Cattell, James McKeen. “Mrs. Piper, the Medium.” *Science* 7 no. 172: 534-535.

- . “Psychology at the University of Pennsylvania,” *The American Journal of Psychology* 3, no. 2 (April 1890): 281-283.
- . “The Perception of Light.” In *System of the Diseases of the Eye*, vol. 1, ed. William F. Norris and Charles A. Oliver. Philadelphia: J.B. Lippincott Company, 1897: 505-538.
- . “On Relations of Time and Space in Vision.” *The Psychological Review* 7 no. 4 (July 1900): 325-343.
- . *James McKeen Cattell: Man of Science, 1860-1944*, 2 vol. ed. A.T. Poffenberger. Lancaster: Science Press, 1947.
- Chamberlain, Joshua Lawrence. *The University of Pennsylvania: its History, Influence, Equipment and Characteristics*, vol. 1. Boston: R. Herndon Company, 1902.
- Champney, J. Wells. “Fifty Years of Photography.” *Harper’s New Monthly Magazine* 79 no. 471 (August 1889): 357-362.
- Charcot, Jean-Martin. *Lectures on the Diseases of the Nervous System* 3, trans. Thomas Savill. London: The New Sydenham Society, 1889.
- Clegg, Brian. *The Man Who Stopped Time: The Illuminating Story of Eadweard Muybridge—Pioneer Photographer, Father of the Motion Picture, Murdered*. Washington: Joseph Henry Press, 2007.
- Cohen, Michael David. *Reconstructing the Campus: Higher Education and the American Civil War* Charlottesville: University of Virginia Press, 2012.
- Cook, James W. *The Arts of Deception: Playing with Fraud in the Age of Barnum*. Cambridge: Harvard University Press, 2001.
- Cooke, Josiah Parsons. “Scientific Culture.” In *Scientific Culture and Other Essays*. New York: D. Appleton and Company, 1881: 5-44.
- Coon, Deborah J. “Testing the Limits of Sense and Science: American Experimental Psychologists Combat Spiritualism, 1880-1920.” *American Psychologist* 47, no. 2 (February 1992): 143-151.
- Crary, Jonathan. *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*. Cambridge: MIT Press, 1990.
- . *Suspensions of Perception: Attention, Spectacle, and Modern Culture*. Cambridge: MIT Press, 2001.

- Cresswell, Tim. *On the Move: Mobility in the Modern Western World*. New York, NY: Routledge, 2006.
- Daniels, George. *American Science in the Age of Jackson*. New York: Columbia University Press, 1968.
- . “The Process of Professionalization in American Science: The Emergent Period, 1820-1860,” *Isis* 58 (1967): 151-166.
- Danly, Susan and Cheryl Leibold, eds. *Eakins and the Photograph: Works by Thomas Eakins and his Circle in the Collection of the Pennsylvania Academy of the Fine Arts*. Washington: Published for the Pennsylvania Academy of the Fine Arts by the Smithsonian Institution, 1994.
- Daston, Lorraine and Peter Galison. *Objectivity*. New York: Zone Books, 2007.
- Dearborn, George V. N. “On Relations of Time and Space in Vision” (Review). *The Journal of Nervous and Mental Disease* 28 no. 3 (March, 1901): 179-181.
- Dercum, Francis X. and Andrew J. Parker, “On the Artificial Induction of Convulsive Seizures,” *Journal of Mental and Nervous Disease* 9 no. 4 (October 1884), 579-588.
- . “A Study of Some Normal and Abnormal Movements Photographed by Muybridge.” In *Animal Locomotion. The Muybridge Work at the University of Pennsylvania: The Method and the Result*. Philadelphia: J.B. Lippincott Company, 1888: 103-133.
- . “Adult Chorea.” In *International Clinics: A Quarterly of Clinical Lectures* 3. Philadelphia: J.B. Lippincott Company, 1891: 292-297.
- . “Cerebral Palsies of Childhood.” In *A Text-Book on Nervous Diseases by American Authors*, ed. Francis X. Dercum. Philadelphia: Lea Brothers & Co., 1895: 506-520.
- Dermer, Rachelle A. *Photographic Objectivity and the Construction of the Medical Subject in the United States*. PhD Dissertation. Boston University, 2002.
- Didi-Huberman, Georges. *Invention of Hysteria: Charcot and the Photographic Iconography of the Salpêtrière*, trans. Alisa Hartz. Cambridge: The MIT Press, 2003.
- Doane, Mary Ann. *The Emergence of Cinematic Time: Modernity, Contingency, and the Archive*. Cambridge, MA: Harvard University Press, 2002.
- Drinka, George Frederick. *The Birth of Neurosis: Myth, Malady and the Victorians*. New York: Simon and Schuster, 1984.

- Edwards, Elizabeth. "Photographic 'Types': The Pursuit of Method." *Visual Anthropology* 3, nos. 2-3 (July 1990): 235-58.
- Elkins, James, ed. *Photography Theory*. New York: Routledge, 2007.
- Ellenbogen, Josh. *Reasoned and Unreasoned Images: The Photography of Bertillon, Galton, and Marey*. University Park: Penn State Press, 2012.
- Emerson, Peter Henry. *Naturalistic Photography for Students of the Art*. London: Sampson Low, Marston, Searle and Rivingston, 1889.
- Figuier, Louis. *Les Mystères de la Science Aujourd'Hui*. Paris: Librairie Illustrée, 1887.
- Foster, Kathleen A. *Thomas Eakins Rediscovered: Charles Bregler's Thomas Eakins Collection at the Pennsylvania Academy of the Fine Arts*. New Haven: Yale University Press; Philadelphia: Pennsylvania Academy of the Fine Arts, 1997.
- Foucault, Michel. *Birth of the Clinic*, trans. Alan M. Sheridan. New York: Routledge, 1973.
- Fullerton, George and James McKeen Cattell. *On the Perception of Small Differences*. Philadelphia: University of Pennsylvania Press, 1892.
- Furness, Horace Howard. "Address at the Commencement Exercises of the University of Pennsylvania." *University Medical Magazine* 6 (August, 1894): 737-746.
- Galton, Francis. *Hereditary Genius: An Inquiry into its Laws and Consequences*. London: MacMillon and Company, 1869.
- . "Composite portraits made by combining those of many different persons into a single figure." *Nature* 18 (May 23, 1878): 97-100.
- . "Composite Portraits." *Journal of the Anthropological Institute* 8 (1879): 132-144.
- . "Generic Images." *Proceedings of the Royal Institution* 9 (1879): 161-170.
- . "Conventional Representation of the Horse in Motion." *Nature* 26 (July 6, 1882): 228-229.
- . "A Rapid-View Instrument for Momentary Attitudes." *Nature* 26 (July 13, 1882): 249-251.
- . *Inquiries into Human Faculty and its Development*. London: MacMillan and Company, 1883.

- Gieryn, Thomas. "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists." *American Sociological Review* 48, no. 6 (1983): 781-795.
- . "Boundaries of Science." In *Handbook of Science and Technology Studies*, ed. Sheila Jasanoff et al. Thousand Oaks: Sage Publications, 1995: 393-443.
- Goetz, Christopher G. *Charcot: Constructing Neurology*. Oxford: Oxford University Press, 1995.
- . and Eric J. Pappert. "Early Professorships in Neurology." *Annals of Neurology* 40 no. 2 (August 1996): 258-263.
- Gosling, Francis G. "Neurasthenia in Pennsylvania: a Perspective on the Origins of American Psychotherapy, 1870-1910." *Journal of the History of Medicine and Allied Sciences* 40 no. 2 (Spring 1985): 188-206.
- Gordon, Sarah. *Sanctioning the Nude: Production and Reception of Eadweard Muybridge's Animal Locomotion, 1887*. PhD Dissertation. Northwestern University, 2006.
- Goubaux, Armand and Gustave Barrier. *The Exterior of the Horse*, trans. Simon J.J. Harger. Philadelphia: J.B. Lippincott Company, 1892.
- Gould, George M. "Is Medicine a Science?" *Forum* (December, 1889): 417-427.
- . *Biographic Clinics: The Origin of the Ill-Health of De Quincey, Carlyle, Darwin, Huxley, and Browning*. Philadelphia: P. Blakiston, Son & Co., 1903.
- Gould, Stephen J. *Ontogeny and Phylogeny*. Cambridge: Harvard University Press, 1977.
- Green, Harvey. *Fit for America: Health, Fitness, Sport and American Society*. Baltimore: The Johns Hopkins University Press, 1986.
- Grey, Landon Carter. "Functional Tremors." In *A Text-book on Nervous Diseases* ed. Francis X. Dercum. Philadelphia: Lea Brothers & Co., 1895: 280-287.
- Gritzer, Glenn and Arnold Arluke. *The Making of Rehabilitation: A Political Economy of Medical Specialization, 1890-1980*. Berkeley: The University of California, 1985.
- Gunning, Tom. "Phantom Images and Modern Manifestations: Spirit Photography, Magic Theater, Trick Films, and Photography's Uncanny." In *Fugitive Images: From Photography to Video*, ed. Patrice Petro. Bloomington: University of Indiana Press, 1995: 42-71.

- Haas, Robert Bartlett. *Muybridge: Man in Motion*. Berkeley: University of California Press, 1976.
- . "Muybridge and the Yosemite Valley." In Robert Bartlett Haas and Joel Snyder, *Yosemite Photographs, 1872*. Chicago: Chicago Albumen Works, 1977.
- Haller, John S. Jr. *Outcasts from Evolution: Scientific Attitudes of Racial Inferiority*. Carbondale: Southern Illinois University Press, 1971.
- Halttunen, Karen. *Confidence Men and Painted Women: A Study of Middle Class Culture in America, 1830-1870*. New Haven: Yale University Press, 1982.
- Hansell, Howard F. "General Considerations: Epilepsy; Chorea; Vertigo; Gastric Disturbances; Spasmodic Movements of the Head other than Choreiform; General Asthenopia." In *The Eye and the Nervous System*, eds. William Campbell Pose and William G. Spiller. Philadelphia: J.B. Lippincott Company, 1906: 775-827.
- Hare, Robert. *Experimental Investigation of the Spirit Manifestations, Demonstrating the Existence of Spirits and their Communion with Mortals*. New York: Partridge & Brittan, 1855.
- Hartwell, Edward Mussey. "The Rise of College Gymnasia in the United States." In *Special Report by the Bureau of Education of World's Industrial and Cotton Exposition, New Orleans, 1884-1885*. Washington: U.S. Government Printing Office, 1886: 426-436.
- Hatt, Michael. "The Male Body in Another Frame: Thomas Eakins' The Swimming Hole as a Homoerotic Image." *Journal of Philosophy and the Visual Arts* (1993): 8-21.
- . "Muscles, Morals, Mind: The Male Body in Thomas Eakins's *Salutat*." In *The Body Imaged: The Human Form and Visual Culture Since the Renaissance*, ed. Cathleen Adler and Marcia Pointon. New York: Cambridge University Press, 1993: 57-69.
- Hendricks, Gordon. "A May Morning in the Park." *Philadelphia Museum of Art Bulletin* 60, no. 285 (Spring 1965): 48-64.
- . *The Photographs of Thomas Eakins*. New York: Grossman Publishers, 1972.
- . *Eadweard Muybridge: The Father of the Motion Picture*. New York: Grossman Publishers, 1975.
- . *Eadweard Muybridge: The Father of the Motion Picture*. New York: Grossman Publishers, 1975.

- Hittell, John S. *Yosemite: Its Wonders and its Beauties*. San Francisco: H.H. Bancroft, 1868.
- Homer, William I. "Eakins, Muybridge and the Motion Picture Process," *Art Quarterly* 26 no. 2 (Summer 1963): 194-216.
- Hood, Mary V. Jessup and Robert Bartlett Haas. "Eadweard Muybridge's Yosemite Valley Photographs, 1867-1872." *California Historical Society Quarterly* 42 (March 1963): 5-26.
- Hooton, Earnest Albert. *Up from the Ape*. New York: The Macmillan Company, 1932.
- Hotaling, Edward. *The Great Black Jockeys: The Lives and Times of the Men who Dominated America's First National Sport*. Rocklin: Forum, 1999.
- James, William. "Great Men and Their Environment." In *The Will to Believe and Other Essays in Popular Philosophy*. New York: Longmans, Green and Company, 1897: 216-254.
- Jewett, Andrew. *Science, Democracy and the American University: From the Civil War to the Cold War*. New York: Cambridge University Press, 2012.
- Kasson, John F. *Houdini, Tarzan and the Perfect Man: The White Male Body and the Challenge of Modernity in America*. New York: Hill and Wang, 2001.
- Keane, James R. "Strabismus Surgery for Neurological Illness: The Stevens Commission 1887-1889." *History of Neurology* 46 no. 3 (March 1989): 323-324.
- Keeney, Elizabeth B. *The Botanizers: Amateur Scientists in Nineteenth Century America*. Chapel Hill: University of North Carolina Press, 1992.
- Keller, Corey, ed. *Brought to Light: Photography and the Invisible, 1840-1900*. New Haven: Yale University Press, 2008.
- Kemp, Martin. "'A Perfect and Faithful Record': Mind and Body in Medical Photography before 1900," in *Beauty of Another Order: Photography in Science*, Ann Thomas, ed. New Haven, CT: Yale University Press, 1997, 120-150.
- Kimball, Bruce A. *The "True Professional Ideal" in America: A History*. Cambridge: Blackwell Publishers, 1992.
- Kimmel, Michael. *Manhood in America: A Cultural History*. New York: Simon and Schuster, 1996.
- . "Consuming Manhood: The Feminization of American Culture and the Recreation of the Male Body, 1832-1920." In *The History of Men: Essays on the*

- History of American and British Masculinities*. Albany: State University of New York Press, 2005: 37-59.
- Krauss, Rosalind. "Photography's Discursive Spaces." *Art Journal* 42 no. 4 (Winter 1982): 311-319.
- Lamprey, J. H. "On a Method of Measuring the Human Form, for the Use of Students in Ethnology." *Journal of the Ethnological Society* 1 (1869): 84-85.
- Lankester, E. Ray. "A Spirit-Medium." *The Times*, September 16, 1876.
- . "The Muybridge Photographs." *Nature* 40 (May 23, 1889): 78-80.
- Lanska, Douglas J. "The Role of Technology in Neurologic Specialization in America." *Neurology* 48 (1997): 1722-1727.
- . "Nineteenth-Century Contributions to the Mechanical Recording of Postural Sway." *Archives of Neurology* 58 no. 7 (July 2001): 1147-1150.
- . "The Dercum-Muybridge Collaboration for Sequential Photography of Neurological Disorders." *Neurology* 81 (October 22, 2013), 1550-1554.
- Lears, T.J. Jackson. *No Place of Grace: Antimodernism and the Transformation of American Culture*. Chicago: University of Chicago Press, 1981.
- Leidy, Joseph. *Valedictory Address to the Class of Medical Graduates of the University of Pennsylvania, Delivered at the Commencement, March 27, 1858*. Philadelphia: Collins, 1858.
- Leja, Michael. *Looking Askance: Skepticism in American Art from Eakins to Duchamp*. Berkeley: University of California Press, 2004.
- Lerch, Otto. "Convulsive Tics." *American Medicine* 2, no. 8 (November 1901): 694-695.
- Lewis, Morris J. "Neural Disorders of Writers and Artisans." In *A System of Practical Medicine by American Authors*. Vol. 5, *Diseases of the Nervous System*, ed. William Pepper. Philadelphia: Lea Brothers and Co., 1886: 504-543.
- Livingston, David N. "Science and Society: Nathaniel S. Shaler and Racial Ideology." *Transactions of the Institute of British Geographers* 9, no. 2 (1984): 181-210.
- Lloyd, James Hendrie. "Cretinism: Cases Presenting Tremor as a Symptom with the Exhibition of a Patient Showing Symptoms of Paramyoclonus Multiplex." *The Medical and Surgical Reporter* 58 no. 20 (May 19, 1888): 621-625.

- Lucier, Paul. "The Professional and the Scientist in Nineteenth-Century America." *Isis* 100, no. 4 (December 2009): 699-732.
- Lutz, John. *American Nervousness, 1930: An Anecdotal History*. Ithaca: Cornell University Press, 1991.
- Macdonald, Kevin. *Eadweard Muybridge, the Man who Invented the Moving Picture*. Boston, MA: Little Brown, 1972.
- Machlup, Fritz. *Knowledge: its Creation, Distribution and Economic Significance*, vol. II. Princeton: Princeton University Press, 1982.
- Madeira, Percy. "Not so fast." *Saturday Evening Post*, July 11, 1936: 16-17; 77-80.
- Marable, Darwin. "Photography and Human Behaviour in the Nineteenth Century." *History of Photography* 9 (April/June 1985): 141-47.
- Marks, William Denis. "The Mechanism of Instantaneous Photography," in *Animal Locomotion: The Muybridge Work at the University of Pennsylvania. The Method and the Result*. Philadelphia: J.B. Lippincott Company, 1888: 9-33.
- Masteller, Richard M. "Western Views in Eastern Parlors: The Contribution of the Stereograph Photographer to the Conquest of the West." *Prospects* 6 (1981): 55-71.
- Mattison, H. *Spirit Rapping Unveiled! An Expose of the Origin, History, Theology and Philosophy of Certain Alleged Communications from the Spirit World*. New York: Mason Brothers, 1853.
- McCauley, Anne. "'The Most Beautiful of Nature's Works': Thomas Eakins's Photographic Nudes in their French and American Contexts." In Susan Danly and Cheryl Leibold, eds., *Eakins and the Photograph: Works by Thomas Eakins and his Circle in the Collection of the Pennsylvania Academy of the Fine Arts*. Washington: Published for the Pennsylvania Academy of the Fine Arts by the Smithsonian Institution, 1994: 36-45.
- McCurdy, J. H. *A Bibliography of Physical Training*. Springfield: Physical Directors' Society of the Young Men's Christian Associations of North America, 1905.
- Meyerson, Martin and Dilys Pegler Winegrad. *Gladly Learn and Gladly Teach: Franklin and His Heirs at the University of Pennsylvania, 1740-1976*. Philadelphia: University of Pennsylvania Press, 1978.
- Mileaf, Janine A. "Poses for the Camera: Eadweard Muybridge's Studies of the Human Figure." *American Art* 16, no. 3 (2002): 30-53.

- Miller, Howard Smith. *Dollars for Research: Science and its Patrons in Nineteenth Century America*. Seattle: University of Washington Press, 1970.
- Miller, Dickinson S. "Fullerton and Philosophy." In *Philosophical Analysis and Human Welfare: Selected Essays and Chapters from Six Decades*. Dordrecht: D. Reidel, 1975: 39-46.
- Mills, Charles K. "Hysteria." In *A System of Practical Medicine by American Authors*. Vol. 5, *Diseases of the Nervous System*, ed. William Pepper. Philadelphia: Lea Brothers and Co., 1886: 205-287.
- . "A History of the Department of Neurology of the Medical School of the University of Pennsylvania." In *Contributions from the Department of Neurology and the Laboratory of Neuropathology for the Years 1911 and 1912*. vol. VI. Philadelphia: University of Pennsylvania, 1912: 1-20.
- Mitchell, Silas Weir. *Wear and Tear, or Hints for the Overworked*. Philadelphia: J.B. Lippincott Company, 1871.
- . *Nurse and Patient and Camp Cure*. Philadelphia: J.B. Lippincott Company, 1877.
- . "Clinical Lecture on Nervousness in the Male." *The Medical News and Library* 35 (1877): .
- . *Doctor and Patient*. Philadelphia: J.B. Lippincott Company, 1888.
- . *The Early History of Instrumental Precision in Medicine: An Address Delivered before the Second Congress of American Physicians and Surgeons*. New Haven: Tuttle, Morenouse and Taylor, Printers, 1892.
- . *Clinical Lessons on Nervous Diseases*. Philadelphia: Lea Brothers, 1897.
- . and J.H. Wallace Rhein. "A Clinical Examination of the Motor-Symptoms of Chorea." *Philadelphia Medical Journal* 1, no. 4 (January 22, 1898): 153-156.
- . and William G. Spiller. "A Case of Uncomplicated Hysteria in the Male Lasting Thirty Years, with Post-Mortem Examination." *Transactions of the Association of American Physicians* 19 (1904): 433-45.
- Moore, Robert Laurence. *In Search of White Crows: Spiritualism, Parapsychology, and American Culture*. New York: Oxford University Press, 1977.
- Morgan, Jayne. "Eadweard Muybridge and W. S. Playfair: An Aesthetics of Neurasthenia." *History of Photography* 23, no. 2 (1999): 225-231.

- Morton Prince, "General Affections." In *A Text-Book on Nervous Diseases by American Authors*, ed. Francis X. Dercum. Philadelphia: Lea Brothers & Co., 1895: 556-611.
- Mozley, Anita Ventura. *Eadweard Muybridge: The Stanford years, 1872-1882*. Stanford: Stanford University Department of Art and Architecture, 1972.
- . "Introduction to the Dover Edition." In *Muybridge's Complete Human and Animal Locomotion*, vol. 1 (New York: Dover, 1979): vii-xxxviii.
- Muybridge, Eadweard. "Leland Stanford's Gift to Art and Science, Mr. Muybridge's Invention of Instant Photography and the Marvelous Zoögyroscope," *San Francisco Examiner*, 6 February 1881. Reprinted in Anita Ventura Mozley. *Eadweard Muybridge: The Stanford years, 1872-1882*. Stanford: Stanford University Department of Art and Architecture, 1972.
- . *The Attitudes of Animals in Motion: A Series of Photographs Illustrating the Consecutive Positions Assumed by Animals in Performing Various Movements*, 1881.
- . "The Attitudes of Animals in Motion." *Journal of the Society for Arts* 30, no. 1544 (June 23, 1882): 838-843.
- . *Prospectus of a New and Elaborate Work Upon The Attitudes of Man, the Horse and Other Animals in Motion*. New York: Scovill Manufacturing, 1883.
- . *Animal Locomotion: An Electrophotographic Investigation of Consecutive Phases of Animal Movement*. Philadelphia: University of Pennsylvania, 1887.
- . *Animal Locomotion: An Electrophotographic Investigation of Consecutive Phases of Animal Movements: Prospectus and Catalogue of Plates*. Philadelphia: J.B. Lippincott Company, 1887.
- . *Descriptive Zoopraxography, or the Science of Animal Locomotion Made Popular*. Chicago: The Lakeside Press, 1893.
- Noakes, Robert. "Natural Causes? Spiritualism, Science, and the Supernatural in Mid Victorian Britain." In *The Victorian Supernatural*, eds. Nicola Bown, Carolyn Burdett, and Pamela Thurschwell. Cambridge: Cambridge University Press, 2009: 23-43.
- O'Boyle, Lenore. "Learning for Its Own Sake: The German University as Nineteenth Century Model." *Comparative Studies in Society and History* 25, no. 1 (Jan., 1983): 3-25.

- Ott, John. *Manufacturing the Modern Patron in Victorian California: Cultural Philanthropy, Industrial Capital, and Social Authority*. Burlington: Ashgate, 2014.
- Palmquist, Peter. "Photographing the Modoc Indian War: Louis Heller versus Eadweard Muybridge." *History of Photography* 2, no. 3 (July 1978): 187-205.
- Park, Roberta J. "Physiologists, Physicians, and Physical Educators: Nineteenth-Century Biology and Exercise, Hygienic and Educative." In *Sport and Exercise Science: Essays in the History of Sports Medicine*, ed. Jack W. Berryman and Roberta J. Park. Urbana: University of Illinois Press, 1992: 137-182.
- . "Muscles, Symmetry and Action; 'Do you Measure Up? Defining Masculinity in Britain and America from the 1860s to the early 1900s.'" *The International Journal of the History of Sport* 22 no. 3 (May 2005): 1604-1636.
- . "Biological Thought, Athletics and the Formation of a 'Man of Character.'" *The International Journal of the History of Sport* 24 no. 12 (December 2007): 1543-1569.
- Parry, Ellwood C. "Thomas Eakins's Naked Series Reconsidered: Another Look at the Standing Nude Photographs Made for the Use of Eakins's Students." *American Art Journal* 20, no. 2 (1988): 53-77.
- Paulinetti and Robert L. Jones. *The True Art and Science of Hand Balancing*. ed. and foreward by Logan Christopher, 2007.
- Pearcy, Lee T. "Aristophanes in Philadelphia: The "Acharnians" of 1886." *The Classical World* 96, no. 3 (Spring, 2003): 299-313.
- Peirce, Charles Sanders. "What is a Sign?" In *The Essential Peirce: Selected Philosophical Writings, Volume 2 (1893-1913)*. ed. the Peirce Edition Project. Indianapolis: Indiana University Press, 1998: 4-10.
- de la Peña, Carolyn. *The Body Electric: How Strange Machines Built the Modern American*. New York: New York University Press, 2003.
- Pepper, William. *The Relation of Undergraduate to Post-Graduate Curricula: an address read before the National Educational Association at Saratoga, July 12, 1892*. Philadelphia: Allen, Lane and Scott, 1892.
- . "Note." In *William Dennis Marks, Harrison Allen, and Francis X. Dercum, Animal Locomotion: The Muybridge Work at the University of Pennsylvania. The Method and the Result*. Philadelphia: J.B. Lippincott Company, 1888: 5-7.

- Peterson, Frederick. "Systemic Affections." In *A Text-Book on Nervous Diseases by American Authors*, ed. Francis X. Dercum. Philadelphia: Lea Brothers & Co., 1895: 661-666.
- Pettit, Michael. *The Science of Deception: Psychology and Commerce in America*. Chicago: The University of Chicago Press, 2013.
- Phillips, Paul C. "Photography in Anthropometry." In *Report of the Ninth Annual Meeting of the American Association for the Advancement of Physical Education*. New Haven: Clarence H. Ryder, 1894: 17-25.
- Pierson, George W. "Apostles of Physical Culture." *Yale Alumni Magazine* (1973): 11-17.
- Pimple, Kenneth D. "Ghosts, Spirits, and Scholars: The Origins of Modern Spiritualism." In *Out of the Ordinary: Folklore and the Supernatural*, ed. Barbara Walker. Logan: Utah State University Press, 1995: 75-89.
- Prodder, Phillip. *Time Stands Still: Muybridge and the Instantaneous Photography Movement*. New York: The Iris & B. Gerald Cantor Center for Visual Arts at Stanford University in association with Oxford University Press, 2003.
- Pursell, Carroll. *The Machine in America: A Social History of Technology*. Baltimore: The Johns Hopkins University Press, 1995.
- Pyne, Kathleen. *Art and the Higher Life: Painting and Evolutionary Thought in Late Nineteenth-Century America*. Austin: University of Texas Press, 1996.
- Rabinbach, Anson. *The Human Motor: Energy, Fatigue and the Origins of Modernity*. Berkeley: University of California Press, 1992.
- Ramsay, Terry. *A Million and One Nights: A History of the Motion Picture Through 1925*. New York: Simon & Schuster, 1926.
- Ranney, Ambrose Loomis. *Lectures on Nervous Diseases: From the Standpoint of Cerebral and Spinal Localization, and the Latter Methods Employed in the Diagnosis and Treatment of These Affections*. Philadelphia: F.A. Davis, 1888.
- Reuben, Julie A. *The Making of the Modern University: Intellectual Transformation and the Marginalization of Morality*. Chicago: University of Chicago Press, 1996.
- Reynolds, Joshua. "Discourse III." In *The Discourses of Sir Joshua Reynolds*. London: James Carpenter, 1842: 36-51.
- Roberts, Jon H. and James Turner. *The Sacred and the Secular University*. Princeton: Princeton University Press, 2000.

- Robinson, Henry Peach. *Pictorial Effect in Photography*. London: Piper & Carter, 1869.
- . "Fog or Focus?" *International Annual of Anthony's Photographic Bulletin* 2 (1889): 196-198.
- . "Hints on Posing and Management of the Sitter: Chapter II—the Head Vignette." *Photographic Times and American Photographer* 14 no. 48 (December 5, 1884): 633-636.
- Rockwell, A.D. "Editor's Preface." In George M. Beard, *A Practical Treatise on Nervous Exhaustion (Neurasthenia) its Symptoms, Nature, Sequences, Treatment*. ed. A.D. Rockwell. New York: E.B. Treat, 1888: 3-4.
- Rodgers, Daniel T. *The Work Ethic in Industrial America, 1850-1920*. Chicago: University of Chicago Press, 2014.
- Rogers, Fairman. "The Zootrope: Action of Animals in Motion." *Scientific American Supplement* 7 no. 188 (August 9, 1879): 2991.
- Rosen, Geroge. *The Specialization of Medicine with Particular Reference to Ophthalmology*. New York: Froben Press, 1944.
- Rosenberg, Charles E. "The Place of George M. Beard in Nineteenth-Century Psychiatry." *Bulletin of the History of Medicine* 36 (May-June 1962): 245-259.
- . *No Other Gods: on Science and American Social Thought*. Baltimore: Johns Hopkins University Press, 1976.
- . Introduction to *Pictures of Health: A Photographic History of Health Care in Philadelphia*, ed. Janet Golden and Charles E. Rosenberg. Philadelphia: University of Pennsylvania Press, 1991.
- Rothstein, William G. *American Physicians in the Nineteenth Century: from Sects to Science*. Baltimore: Johns Hopkins University Press, 1972.
- Rotundo, Anthony. *American Manhood: Transformations in Masculinity from the Revolution to the Modern Era*. New York: Basic Books, 1993.
- Royce, Josiah. "Present Ideals of American University Life." *Scribner's Magazine* 10 (September 1891): 376-388.
- Ryan, James. *Picturing Empire: Photography and the Visualization of the British Empire*. Chicago: University of Chicago Press, 1997.

- Sala, George A. "Echoes of the Week." *The Illustrated London News*, 18 March 1882.
Reprinted in Sala, George A. *Living London*. London: Remington and Co., 1883:
102-103.
- Salazar, James B. *Bodies of Reform: The Rhetoric of Character in Gilded Age America*.
New York: New York University Press, 2010.
- Sargent, Dudley Allen. *An Anthropometric Chart, Showing the Relation of the Individual
in Size, Strength, Symmetry and Development to the Normal Standard*.
Cambridge, 1886.
- . "The Physical Proportions of the Typical Man." *Scribner's Magazine* 2 no. 1 (July
1887): 3-17.
- . "The Physical Characteristics of the Athlete." *Scribner's Magazine* 2 no. 5
(November, 1887): 541-561.
- . "The System of Physical Training at the Hemenway Gymnasium." In
*Physical Training: A Full Report of the Papers and Discussions of the Conference
Held in Boston in November, 1889*, ed. Isabel C. Barrows. Boston: Press of
George H. Ellias, 1890: .
- . *Physical Education*. Boston: Ginn & Company, 1906.
- Sekula, Allan. "The Body and the Archive." *October*, Vol. 39 (Winter, 1986), 19-23.
- Shimamura, Arthur. "Muybridge in Motion: Travels in Art, Emotion, and Neurology,"
History of Photography 26 no. 4 (Winter 2002): 341-350.
- Shortt, S.E.D. "Physicians, Science, and Status: Issues in the Professionalization of
Anglo-American Medicine in the Nineteenth Century." *Medical History* 27
(1983): 51-68.
- Smith-Rosenberg, Carroll. *Disorderly Conduct: Visions of Gender in Victorian America*.
New York: Oxford University Press, 1985.
- Snyder, Joel and Neil Walsh Allen. "Photography, Vision, and Representation." *Critical
Inquiry* 2, no. 1 (Autumn 1975): 143-169.
- . "Picturing Vision." *Critical Inquiry* 6, no. 3 (Spring 1980): 499-526.
- Sokal, Michael. "Psychology at Victorian Cambridge: The Unofficial Laboratory of
1887-1888," *Proceedings of the American Philosophical Society* 116, no. 2 (April
17, 1972): 145-147.

- . *The Education and Psychological Career of James McKeen Cattell, 1860-1904*. PhD. Dissertation, Case Western Reserve University, 1980.
- . “Scientific Biography, Cognitive Deficits, and Laboratory Practice: James McKeen Cattell and Early American Experimental Psychology, 1880-1904.” *Isis*, 101, no. 3 (September 2010): 531-554.
- Solnit, Rebecca. *River of Shadows: Eadweard Muybridge and the Technological Wild West*. New York: Viking Press, 2003.
- Solomon-Godeau, Abigail. *Male Trouble: A Crisis in Representation*. New York: Thames and Hudson, 1997.
- Spencer, Frank. “Some Notes on the Attempt to Apply Photography to Anthropometry During the Second Half of the Nineteenth Century.” In *Anthropology and Photography 1860-1920* ed. Elizabeth Edwards. New Haven: Yale University Press, 1992: 99-107.
- Spencer, Herbert. *Herbert Spencer on the Americans and the Americans on Herbert Spencer*. New York: D. Appleton and Company, 1883.
- Spiller, William G. “A Case of Malaria Presenting the Symptoms of Disseminated Sclerosis, with Necropsy.” *American Journal of the Medical Sciences* 20, no. 6 (December 1900): 629-647.
- Starr, Paul. *The Social Transformation of American Medicine*. New York: Basic Books, 1982.
- Stedman, Edmund Clarence. “The Nature and Elements of Poetry. VI: Truth.” *Century Magazine* 44 no. 4 (August, 1892): 613-622.
- Stevens, George S. *Functional Nervous Diseases: Their Causes and Their Treatment*. New York: D. Appleton and Company, 1887.
- Stillman, J. D. B. *The Horse in Motion as Shown by Instantaneous Photography, With a Study on Animal Mechanics Founded on Anatomy and the Revelations of the Camera in which is Demonstrated the Theory of Quadrupedal Locomotion*. Boston: J.R. Osgood and Company, 1882.
- Stuart, Nancy Rubin. *The Reluctant Spiritualist: The Life of Maggie Fox*. Orlando: Harcourt, 2005.
- Sturges, Octavius. “Chorea.” In *Chorea and Whooping Cough: Five Lectures*. London: Smith, Elder and Co., 1877: 1-25.

- Tadd, J. Liberty. *New Methods in Education: Art, Real Manual Training, Nature Study*. New York: Orange Judd Company, 1899.
- Tagg, John. *The Burden of Representation: Essays on Photographies and Histories*. Amherst: University of Massachusetts Press, 1988.
- . *Grounds of Dispute: Art History, Cultural Politics and the Discursive Field*. London: Macmillan Educational, Ltd, 1992.
- Thornton, Tamara Plakins. *Handwriting in America: A Cultural History*. New Haven: Yale University Press, 1996.
- Thorpe, Francis Newton. *William Pepper, M.D., LL.D.* Philadelphia: J.B. Lippincott Company, 1904.
- Thurs, Daniel Patrick. *Science Talk: Changing Notions of Science in American Popular Culture*. New Brunswick: Rutgers University Press, 2007.
- Trachtenberg, Alan. *The Incorporation of America: Culture and Society in the Gilded Age*. New York: Hill and Wang, 2007.
- Trowbridge, John. "Photography." *Scribner's Magazine* 5 no. 5 (May 1889): 605-619.
- Tucker, Jennifer. *Nature Exposed: Photography as Eyewitness in Victorian Science*. Baltimore: Johns Hopkins University Press, 2005.
- Tuttle, Jennifer. "S. Weir Mitchell, Medicine Man: Race, Gender, and Medical Authority in Mitchell's West Cure." *Transactions & Studies of the College of Physicians of Philadelphia* 20 no. 5 (December 1998): 31-37.
- University of Pennsylvania. *Catalogue of the University of Pennsylvania, 1871-1872*. Philadelphia: Collins, 1872.
- . *Catalogue of the University of Pennsylvania, 1872-1873*. Philadelphia: Collins, 1873.
- . *Catalogue of the University of Pennsylvania, 1882-1883*. Philadelphia: Collins, 1883.
- . *Catalogue of the University of Pennsylvania, 1883-1884*. Philadelphia: Collins, 1884.
- . *Catalogue of the University of Pennsylvania, 1884-1885*. Philadelphia: Collins, 1885.
- . *Catalogue of the University of Pennsylvania, 1885-1886*. Philadelphia: Collins, 1886.

- . *Annual Report of the Provost of the University of Pennsylvania including Reports of Departments and Abstract of the Treasurer's Report for the Year ending October 1, 1887*. Philadelphia: Collins Printing House, 1887.
- . *Catalogue of the University of Pennsylvania, 1902-1903*. Philadelphia: Collins, 1903.
- Vertinsky, Patricia. "Embodying Normalcy: Anthropometry and the Long Arm of William H Sheldon's Somatotyping Project." *Journal of Sport History* 29 (2002): 95-133.
- Veysey, Laurence. *The Emergence of the American University*. Chicago: University of Chicago Press, 1965.
- Vidal, Leon. "On the Influence of Photography on the Vision." *The Photo-Beacon* 6 no. 54 (June, 1893): 208-211.
- Walker, Francis A. "Restriction of Immigration." *The Atlantic Monthly* 77 no. 464 (June, 1896): 822-829.
- Warner, John Harley. *The Therapeutic Perspective: Medical Practice, Knowledge, and Identity in America, 1820-1885*. Princeton: Princeton University Press, 1997.
- . *Against the Spirit of System: The French Impulse in Nineteenth-Century American Medicine*. Princeton: Princeton University Press, 1998.
- Waugh, Thomas. *Hard to Imagine: Gay Male Eroticism in Photography and Film from their Beginnings to Stonewall*. New York: Columbia University Press, 1996.
- Weinstein, Sheri. "Technologies of Vision: Spiritualism and Science in Nineteenth Century America." In *Spectral America: Phantoms and the National Imagination*, ed. Jeffrey Andrew Weinstock. Madison: University of Wisconsin Press, 2004: 124-140.
- Weisberg, Barbara. *Talking to the Dead: Kate and Maggie Fox and the Rose of Spiritualism*. San Francisco: HarperSanFrancisco, 2004.
- Weisenburg, T.H. "The Founders and Work of the Philadelphia Neurological Society." *Journal of Nervous and Mental Disease* 42 no. 6 (June 1915): 419-440.
- Weisz, George. "The Emergence of Medical Specialization in the Nineteenth Century." *Bulletin of the History of Medicine* 77 (2003): 536-575.

- White, J. William. "A Physician's View of Exercise and Athletics." *Lippincott's Monthly Magazine* 29 (June 1887): 1008-1033.
- Whitman, Sarah W. "Photography." In *The Making of Pictures: Twelve Short Talks with Young People*. Chicago: Interstate Publishing Company, 1886: 95-103.
- Will, Barbara. "The Nervous Origins of the American Western." *American Literature* 70, no. 2 (1998): 293-316.
- Williams, Linda. *Hard Core: Power, Pleasure, and the "Frenzy of the Visible."* Berkeley, CA: University of California Press, 1989.
- Williams, Talcott. "Animal Locomotion in the Muybridge Photographs." *The Century*, a 34, issue 3 (July 1887): 356-368.
- Wilson, Edward L. *Wilson's Cyclopaedic Photography: A Complete Hand-book of the Terms, Processes, Formulae and Appliances Available in Photography, Arranged in Cyclopaedic Form for Ready Reference*. New York: Edward L. Wilson, 1894.
- Winterer, Caroline. *The Culture of Classicism: Ancient Greece and Rome in American Intellectual Life, 1780-1910*. New York: The Johns Hopkins University Press, 2002.
- Wood, Horatio C. *Brain-Work and Overwork*. Philadelphia: P. Blakiston, Son & Co., 1885.
- . "The Basal Pathology of Chorea." In *Transactions of the College of Physicians of Philadelphia* 15. Philadelphia: P. Blakiston, Son & Co., 1886: 157-164..
- . *Nervous Diseases and Their Diagnosis*. Philadelphia: J.B. Lippincott Company, 1887.
- Worbel, Amy. *Thomas Eakins: Art, Medicine and Sexuality in Nineteenth-Century Philadelphia*. New Haven: Yale University Press, 2007.
- Youmans, Edward L. "A Foreign Lesson and a Domestic Application." *Popular Science Monthly* 5 (May 1874): 108-114.
- . "The College Fetich Once More." *Popular Science Monthly* 25 (September 1884): 701-704.
- . "Yale Professors on College Studies." *Popular Science Monthly* 25 (October 1884): 124-129.
- . "Is the Contrast Valid?" *Popular Science Monthly* 26 (November 1884): 126-128.

Illustrations



Figure 1. Eadweard Muybridge, “Toilet; two models, 1 disrobing 8.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 429. Boston Public Library, Rare Books and Manuscripts Department.

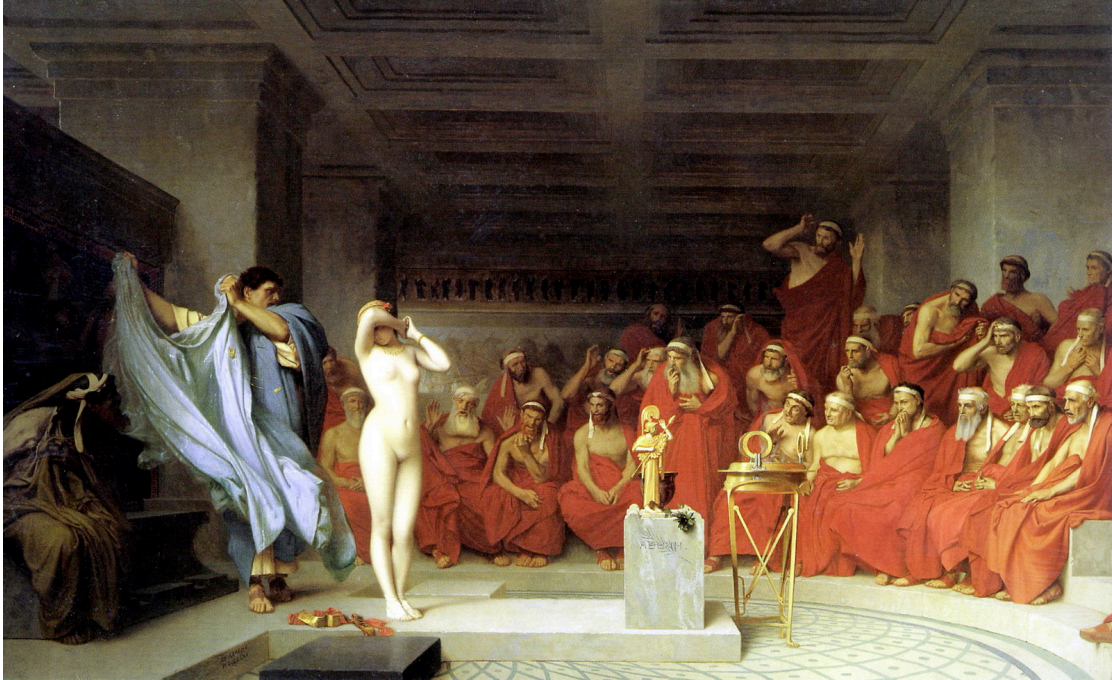


Figure 2. Jean-Léon Gérôme, *Phryné before the Areopagus*, 1861. Oil, 31 ½ x 50 ¾ in. Kunsthalle, Hamburg, Germany.

Diagram of the Studio at The University of Pennsylvania, and Arrangement of the Apparatus for Investigating Animal Locomotion.

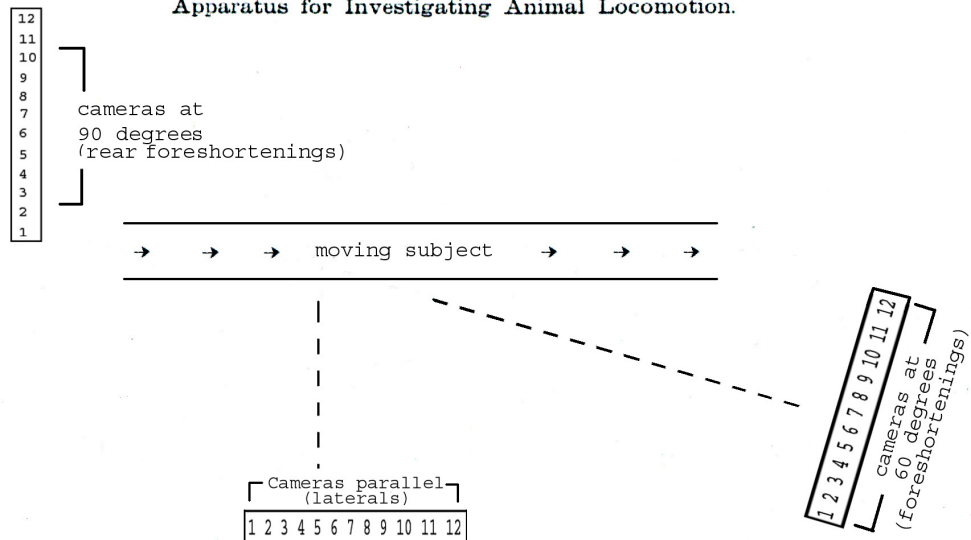


Figure 3. “Diagram of the Studio at The University of Pennsylvania, and Arrangement of the Apparatus for Investigation Animal Locomotion.” From: Eadweard Muybridge, *Descriptive Zoopraxography, or the Science of Animal Locomotion Made Popular*. Chicago: The Lakeside Press, 1893, 10.



Figure 4. Eadweard Muybridge, *Valley of the Yosemite, from Rocky Ford*. 1872, Albumen silver print from wet collodion negative, 42.9 x 54.5 cm. The J. Paul Getty Museum, Los Angeles.



Figure 5. Eadweard Muybridge, *Pi-Wi-Ack (Shower of Stars), Vernal Falls, 400 Feet, Valley of Yosemite*. 1872, Albumen print from wet collodion negative, 43.18 cm x 31.75 cm. San Francisco Museum of Modern Art.

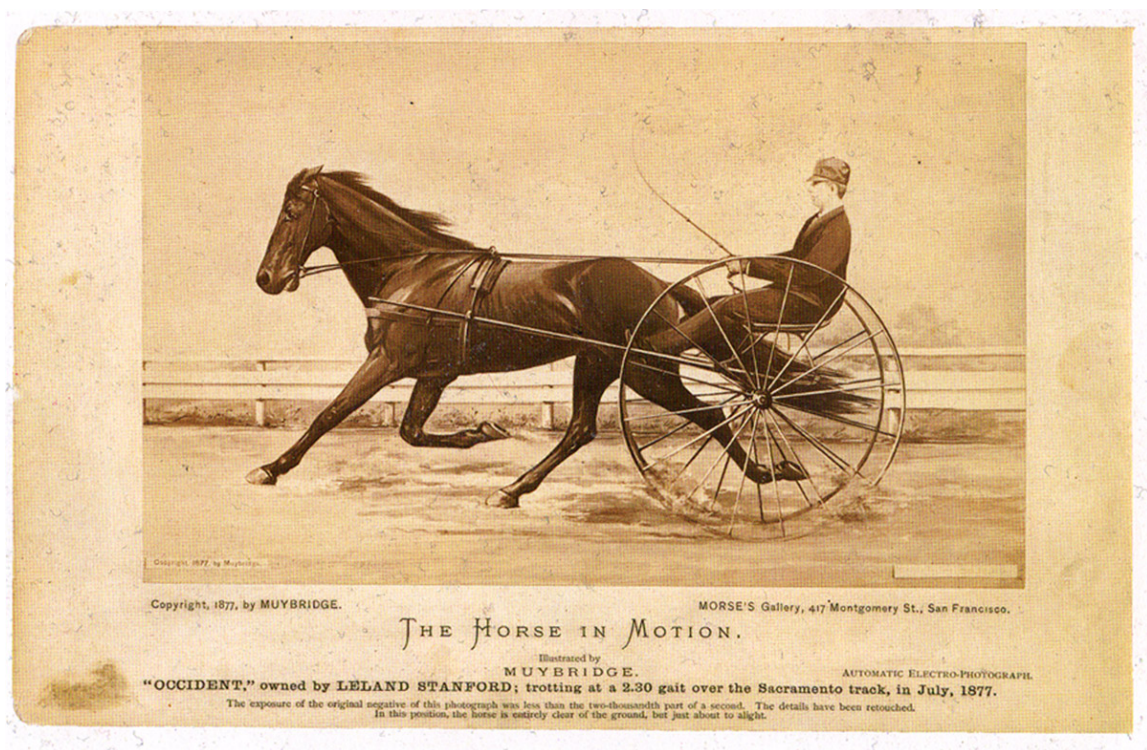


Figure 6. Eadweard Muybridge, *The Horse in Motion*: "Occident," owned by Leland Stanford: trotting at a 2:30 gait over the Sacramento Track, in July, 1877. 1877, Albumen print from wet collodion negative.

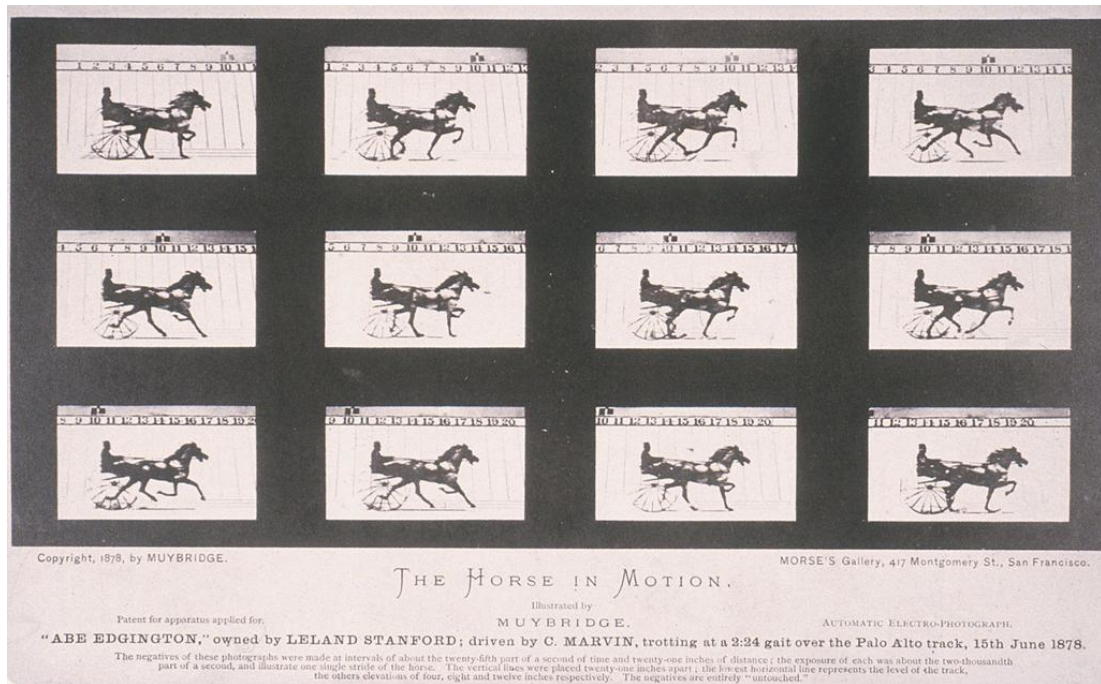


Figure 7. Eadweard Muybridge, *The Horse in Motion: 'Abe Edgington,'* owned by Leland Stanford: driven by C. Marvin, trotting at a 2:34 gait over the Palo Alto Track 18th June 1878. 1878, Albumen print from wet collodion negative, 5 ¼" x 8 ½".



Figure 8. Eadweard Muybridge, *Dancing (fancy)*. c. 1893. Zoopraxiscope disc.



Figure 9. Thomas Eakins, *A May Morning in the Park (The Fairman Rogers Four-in-Hand)*, 1879-80, oil on canvas, 23'' x 36.'' Philadelphia Museum of Art.

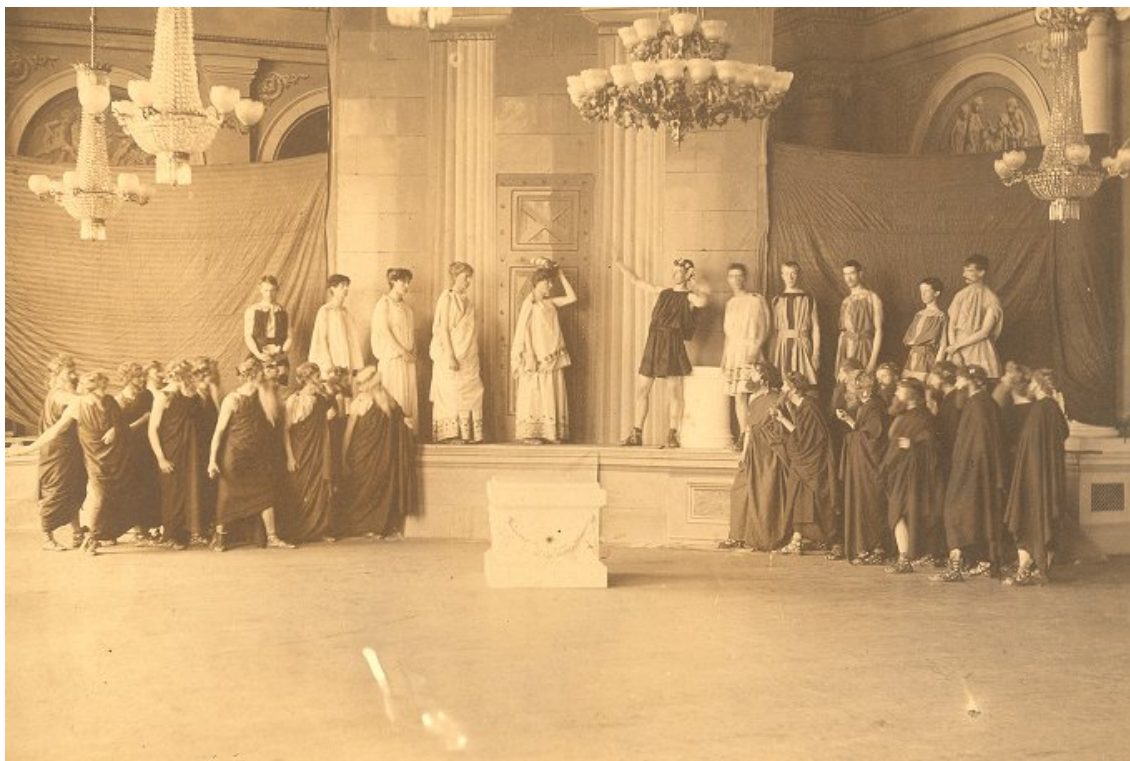


Figure 10. Eadweard Muybridge [?], [Cast of the Acharnians]. From the Collections of the University Archives, University of Pennsylvania.

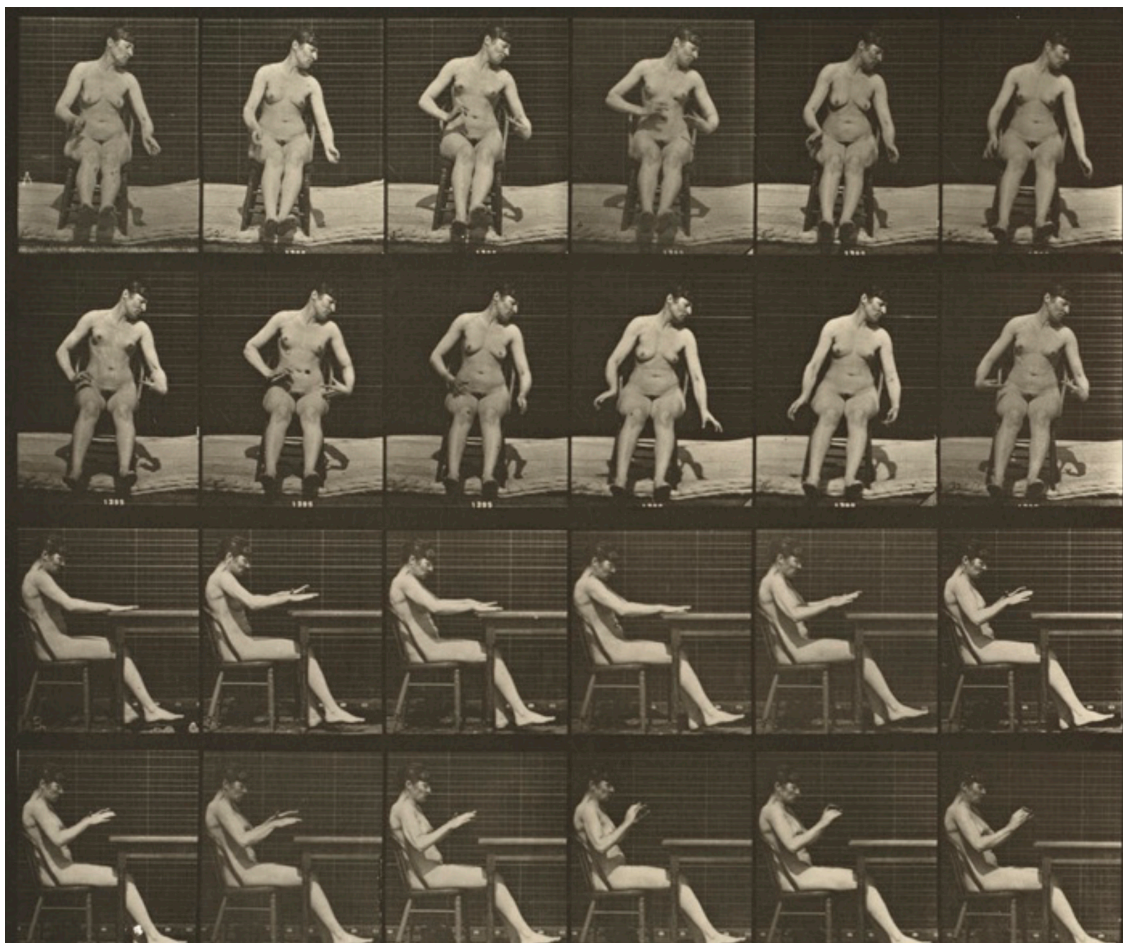


Figure 11. Eadweard Muybridge, “Artificially-Induced Convulsions; A, B, while Sitting.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 545. Boston Public Library, Rare Books and Manuscripts Department.

A CIRCLE OF SPIRIT-RAPPERS IN SESSION.



Figure 12. “A Circle of Spirit-Rappers in Session.” From: Rev. H. Mattison, *Spirit Rapping Unveiled! An Expose of the Origin, History, Theology and Philosophy of Certain Alleged Communications from the Spirit World*. New York: Mason Brothers, 1853, 56.



Figure 13. “M. Flint, a Manchester, dans une séance publique, contient les genoux de deux frappeuses.” From: Louis Figuier, *Les Mystères de la Science Aujourd’Hui*. Paris: Librairie Illustrée, 1887, 561.



Figure 14. “Table Tipping.” From: [A Searcher after the Truth], *The Rappers; or The Mysteries, Fallacies, and Absurdities of Spirit-Rapping, Table-Tipping, and Entrancement*. New York: H. Long and Brother, 1854. [frontispiece].



Figure 15. [Slates for automatic slate writing—"Mrs. Patterson."] From: Seybert Commission for Investigating Modern Spiritualism records, 1884-1922, Kislak Center for Special Collections, Rare Books and Manuscripts, University of Pennsylvania.

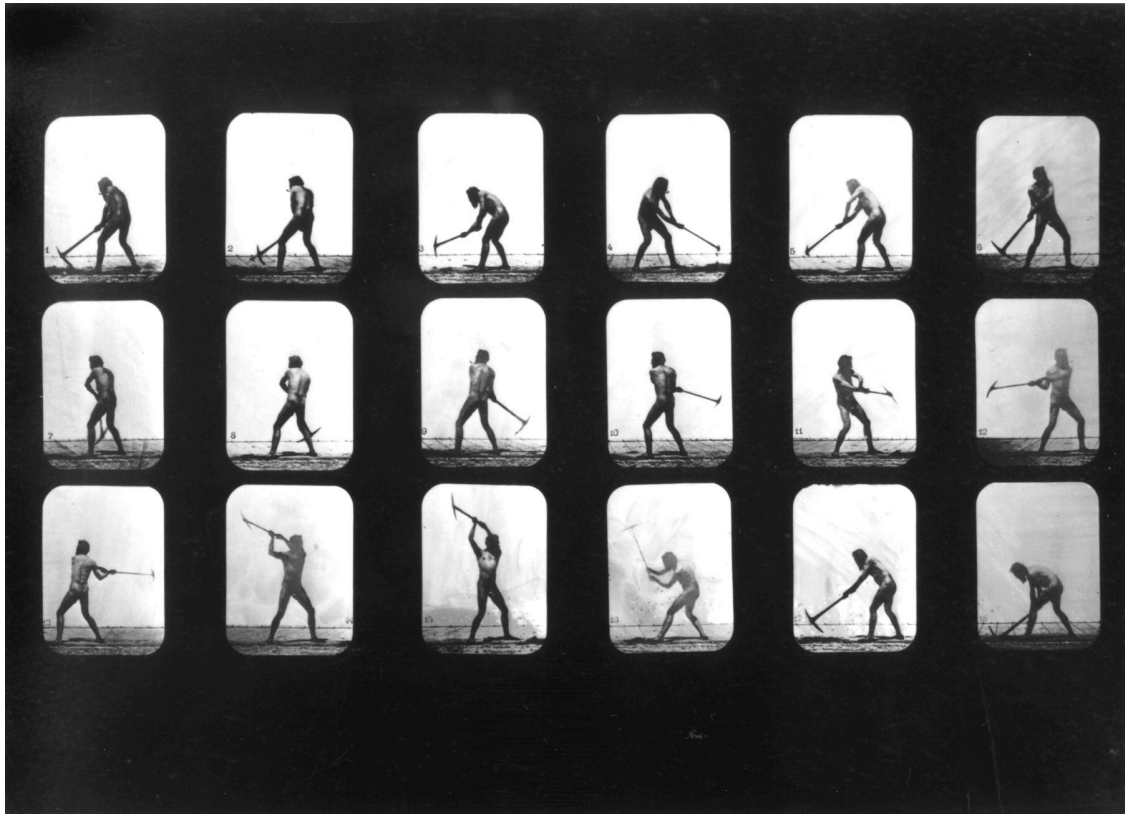
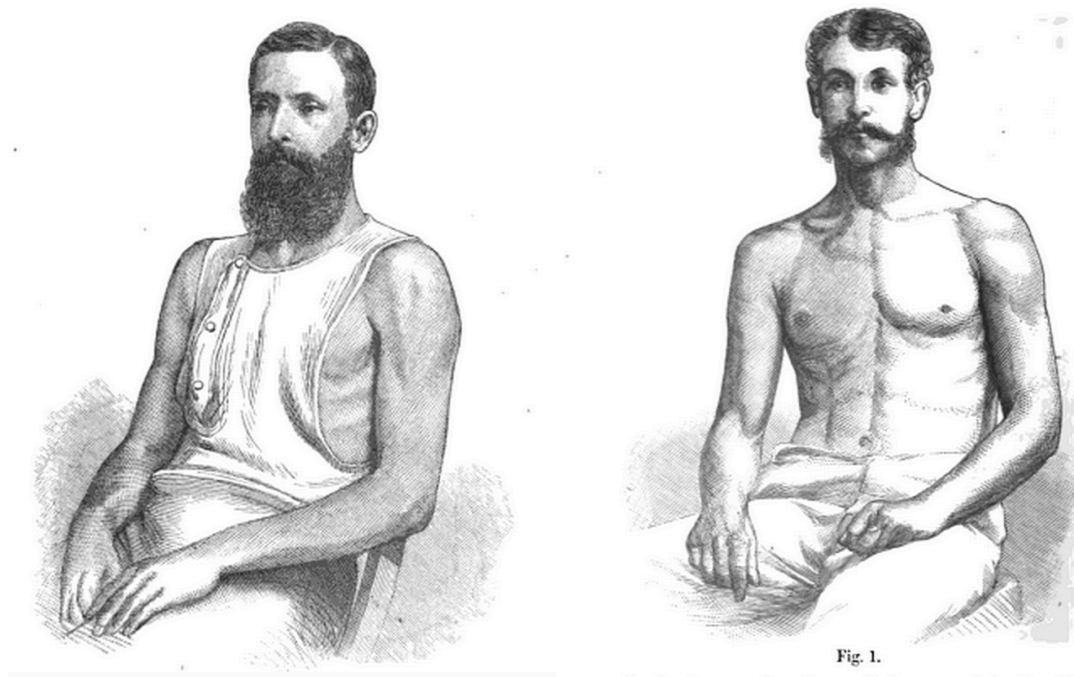


Figure 16. Eadweard Muybridge, [Athlete Swinging a Pick]. From: *Attitudes of Animals in Motion*, 1881. Plate 110.



Figures 17, 18. [Student oarsman and professional sculler]. From: William Blaikie, *How to Get Strong and How to Stay So*. New York: Harper Brothers, 1879, 36-37.

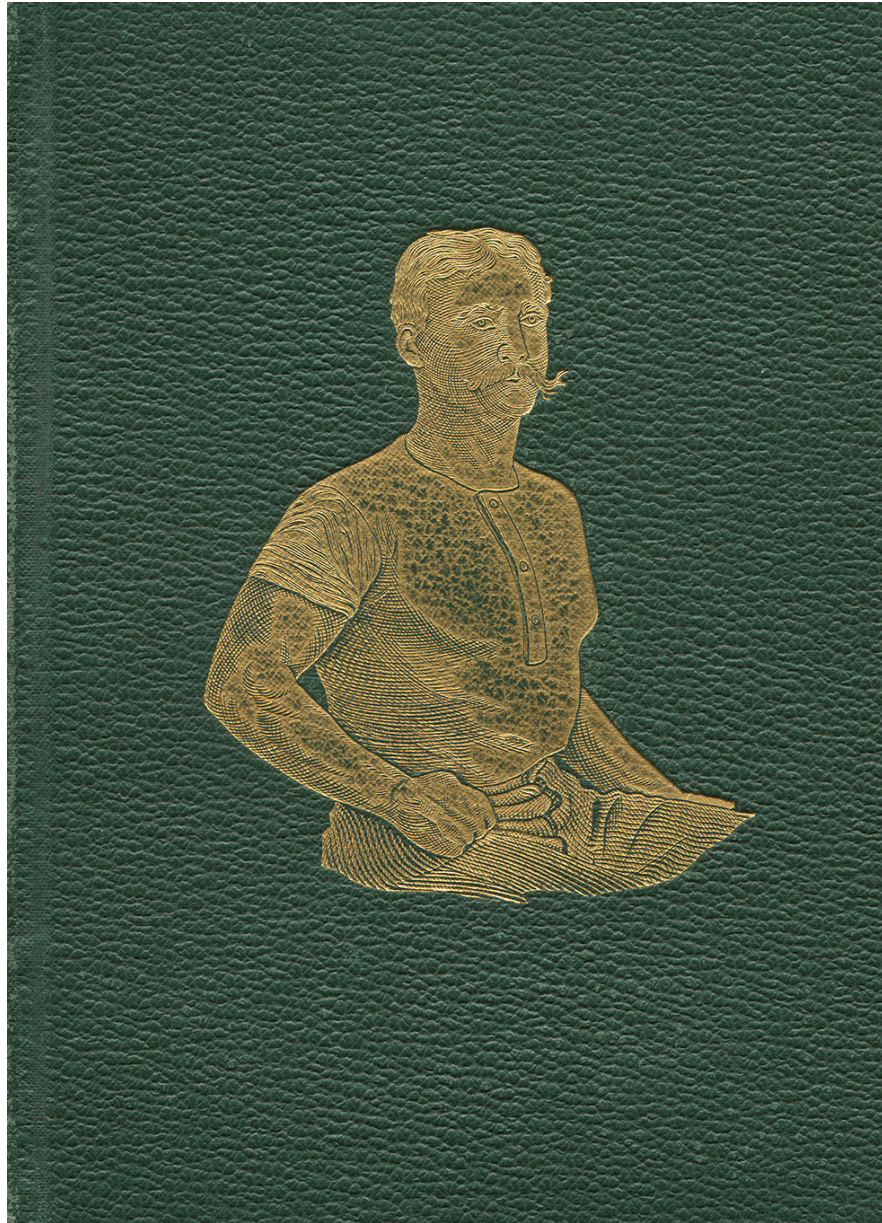


Figure 19. [Cover Illustration]. From: William Blaikie, *How to Get Strong and How to Stay So*. New York: Harper Brothers, 1879.

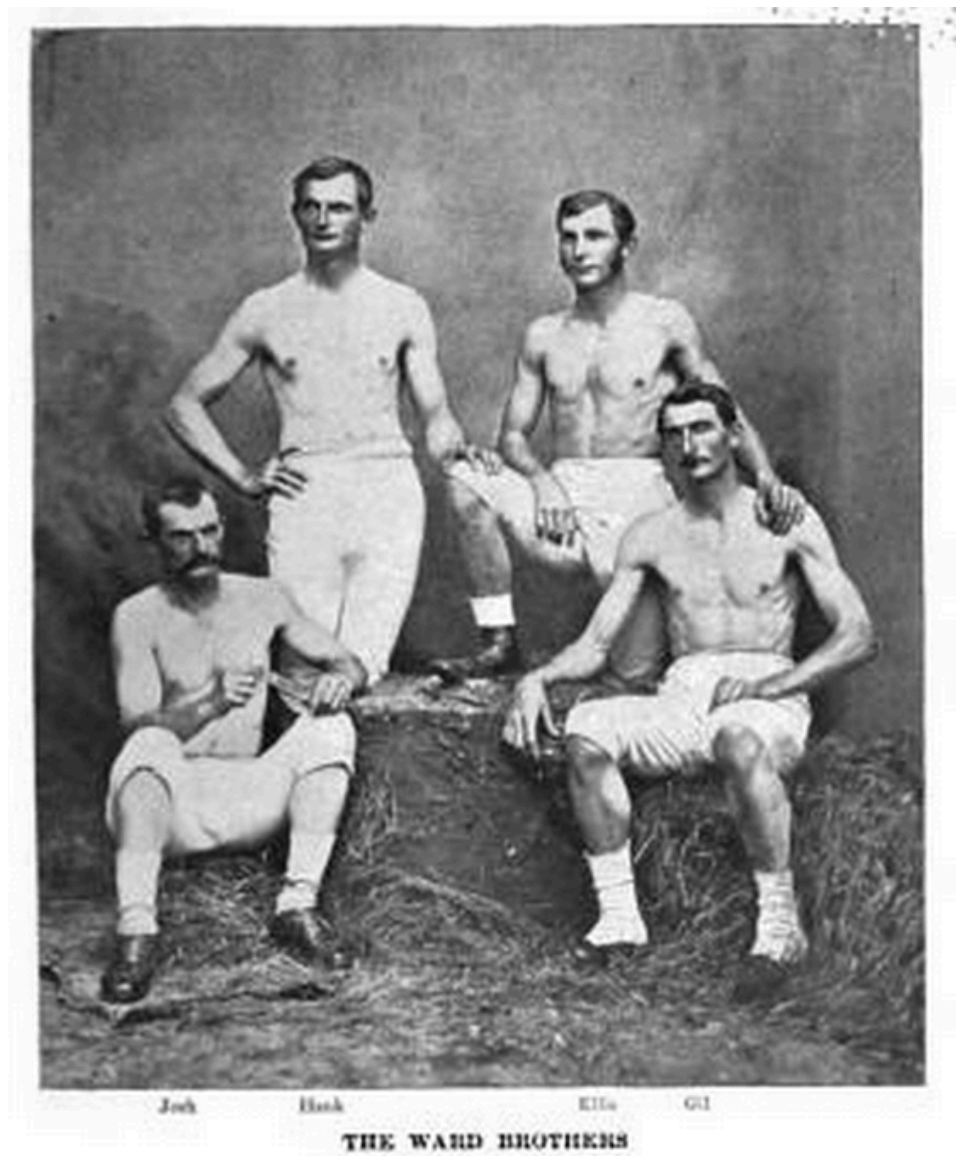


Figure 20. “The Ward Brothers.” From: William Blaikie, *How to Get Strong and How to Stay So*. New York: Harper Brothers, 1899, 20.



EDWARD HANLAN TEN EYCK
Champion Amateur Sculler

Figure 21. “Edward Hanlan Ten Eyck.” From: William Blaikie, *How to Get Strong and How to Stay So*. New York: Harper Brothers, 1899, 22.

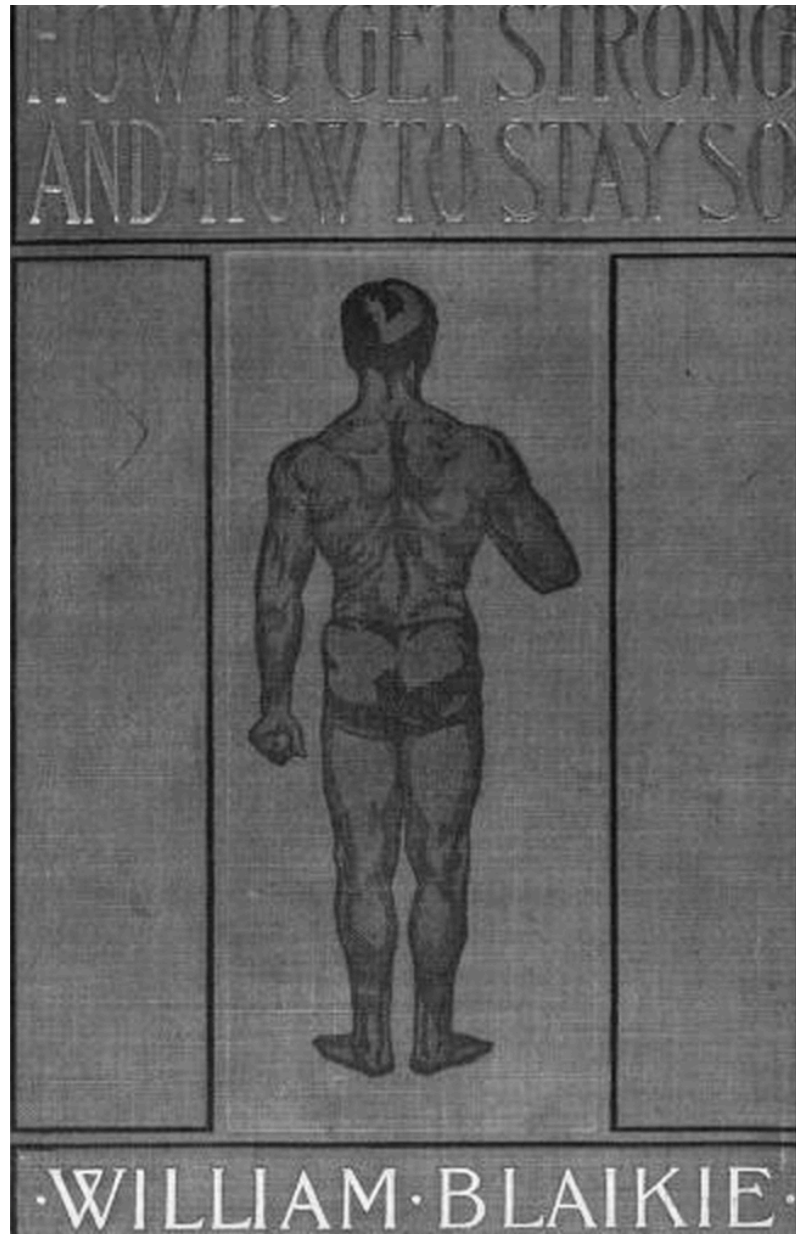


Figure 22. “Mr. Roberts” [Cover Illustration]. From: William Blaikie, *How to Get Strong and How to Stay So*. New York: Harper Brothers, 1899.

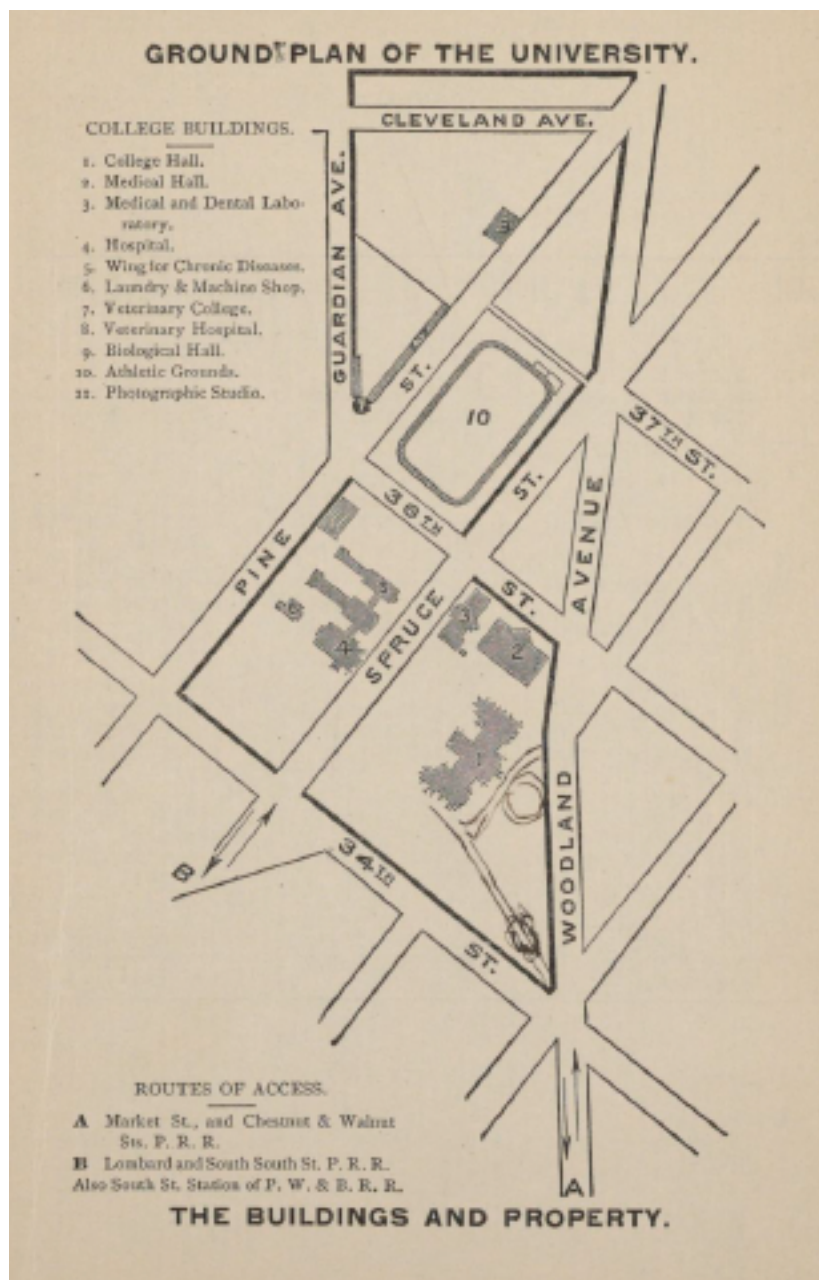


Figure 23. “Ground plan of the University.” From: University of Pennsylvania. *Catalogue of the University of Pennsylvania, 1885-1886*. Philadelphia: Collins, 1886, 3.

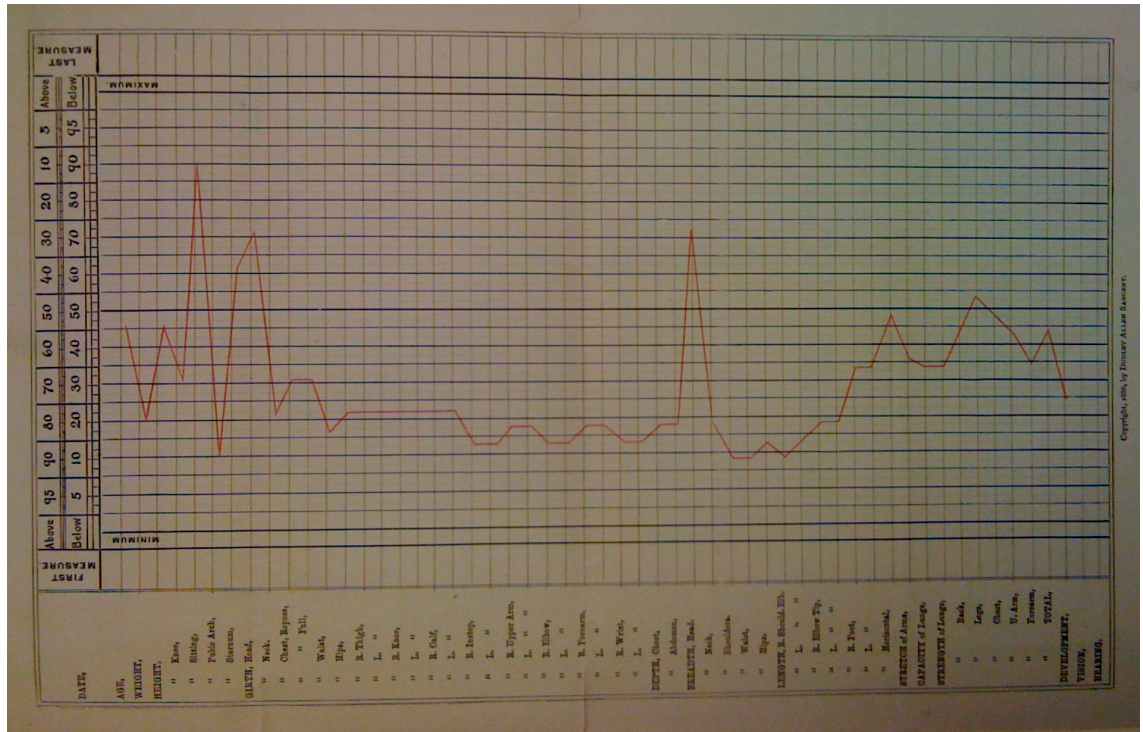


Figure 24. Dudley Allen Sargent, *An Anthropometric Chart, Showing the Relation of the Individual in Size, Strength, Symmetry and Development to the Normal Standard*. From the Collections of the University Archives, University of Pennsylvania.

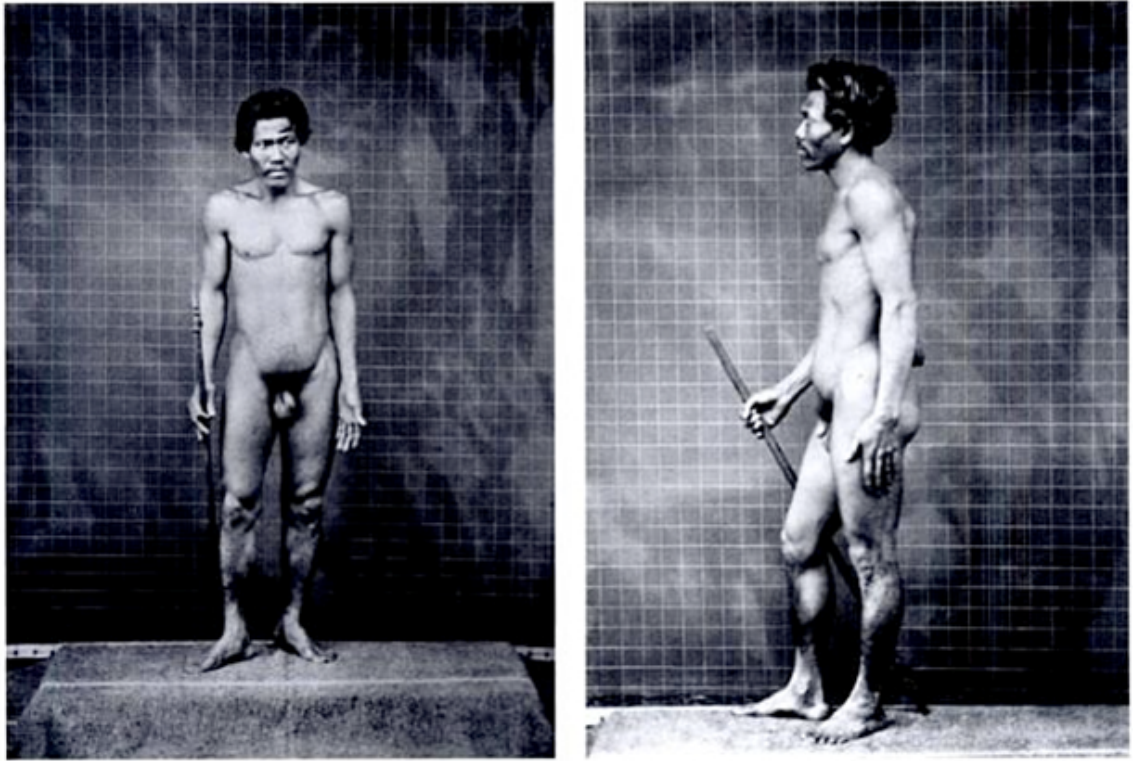


Figure 25. John Lamprey, *Front and Profile Views of a Malayan Male*, c. 1868-9. Royal Anthropological Institute.



Figure 26. Eadweard Muybridge, “Striking a Blow (Right Hand).” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 344. collotype. Boston Public Library, Rare Books and Manuscripts Department.



Figure 27. Eadweard Muybridge, “Various Poses.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 530. Boston Public Library, Rare Books and Manuscripts Department.

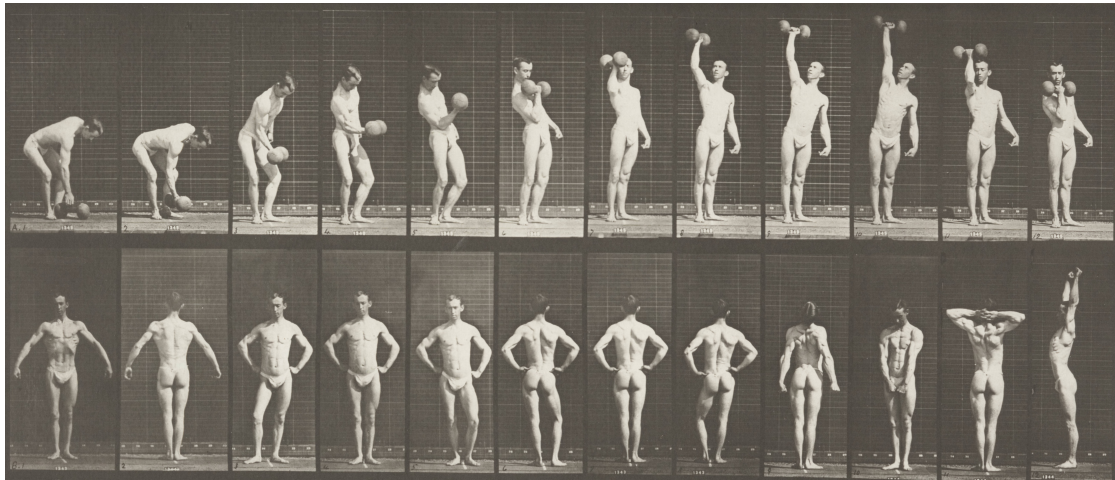


Figure 28. Eadweard Muybridge, “A, Lifting 50-lb. Dumb-Bell; B, Posing.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 321. George Eastman House.

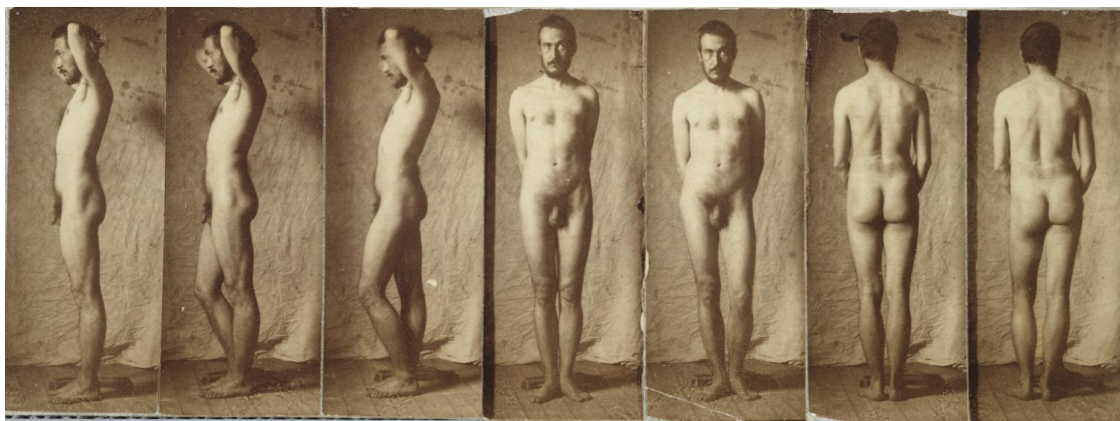


Figure 29. Circle of Thomas Eakins, *Naked Series: Thomas Eakins*. c. 1883, Albumen prints (seven) mounted on card, each approx. 3 1/6 x 8 5/16 in. Philadelphia Museum of Art.



Figure 30. Eadweard Muybridge, “Base-Ball; Batting.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 277. Boston Public Library, Rare Books and Manuscripts Department.

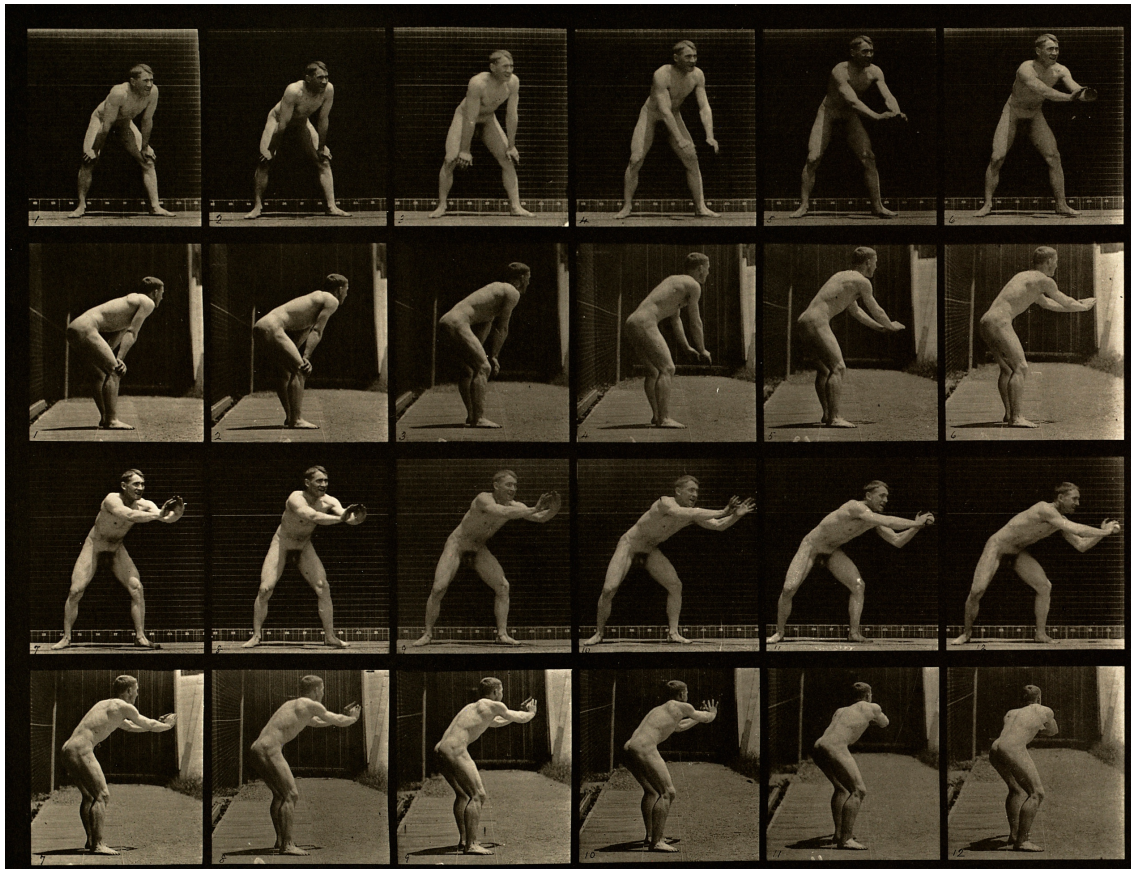


Figure 31. Eadweard Muybridge, “Base-Ball; Catching.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 280. Boston Public Library, Rare Books and Manuscripts Department.



Figure 32. Eadweard Muybridge, “Farmer, Using a Pick.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 385. Boston Public Library, Rare Books and Manuscripts Department.



Figure 33. Eadweard Muybridge, “Blacksmiths, Two Models, Hammering on Anvil.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 374. Boston Public Library, Rare Books and Manuscripts Department.

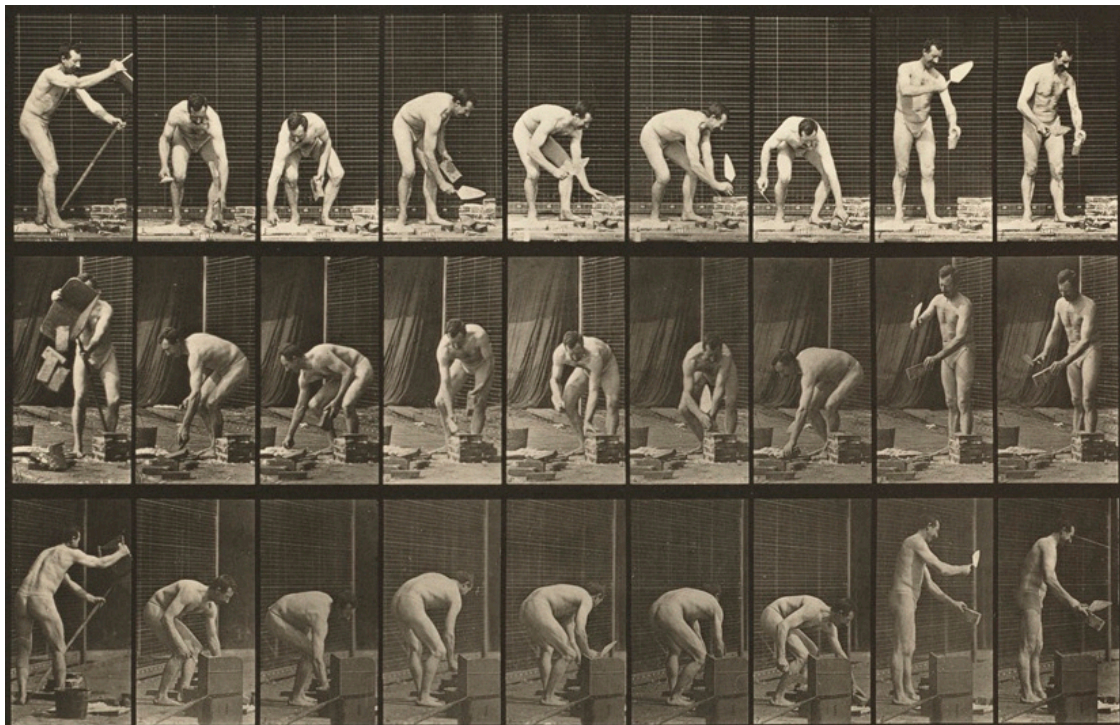


Figure 34. Eadweard Muybridge, “Bricklaying.” c. 1887, collotype. From Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 505. Boston Public Library, Rare Books and Manuscripts Department.



Figure 35. Eadweard Muybridge, “Farmer, Using a Long-Handled Shovel.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 387. Boston Public Library, Rare Books and Manuscripts Department.



Figure 36. Eadweard Muybridge, “Farmer, Scattering Seeds.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 389. Boston Public Library, Rare Books and Manuscripts Department.

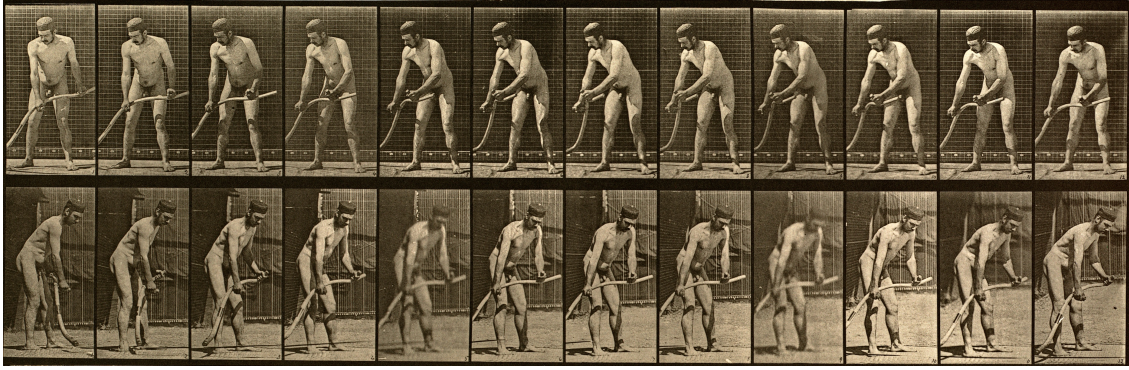


Figure 37. Eadweard Muybridge, “Farmer, Mowing Grass.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 391. Boston Public Library, Rare Books and Manuscripts Department.



Figure 38. Eadweard Muybridge, “Carrying Hod of Bricks up a Ladder.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 405. Boston Public Library, Rare Books and Manuscripts Department.

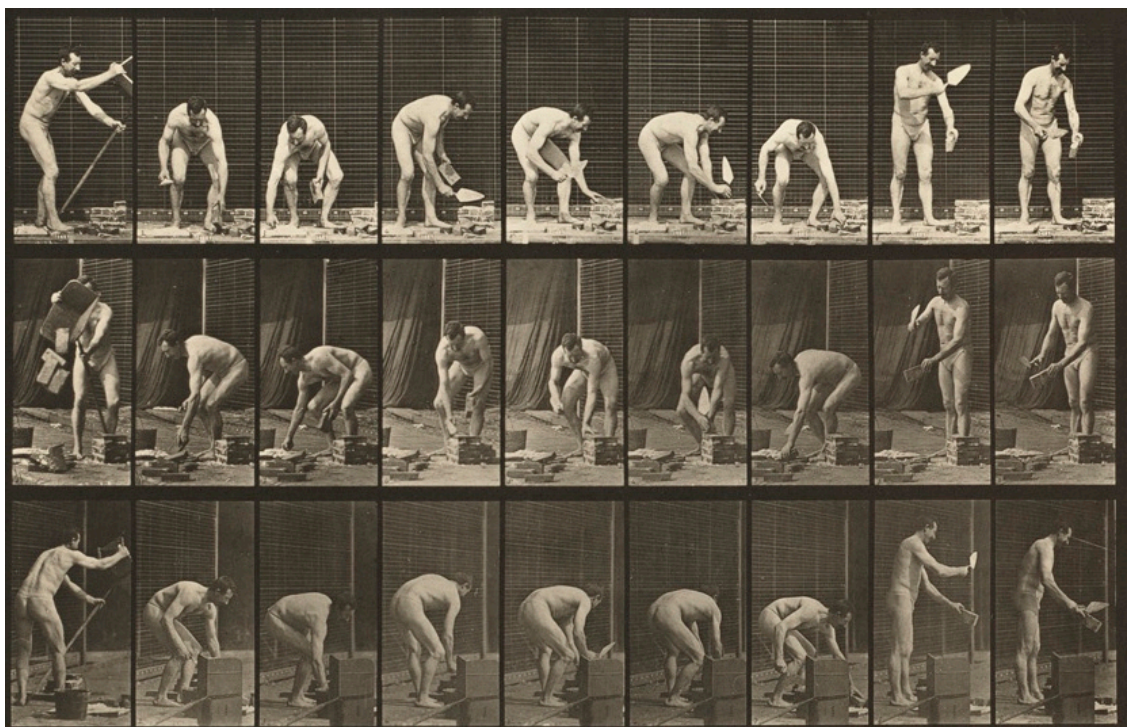


Figure 39. Eadweard Muybridge, “Bricklaying.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 505. Boston Public Library, Rare Books and Manuscripts Department.

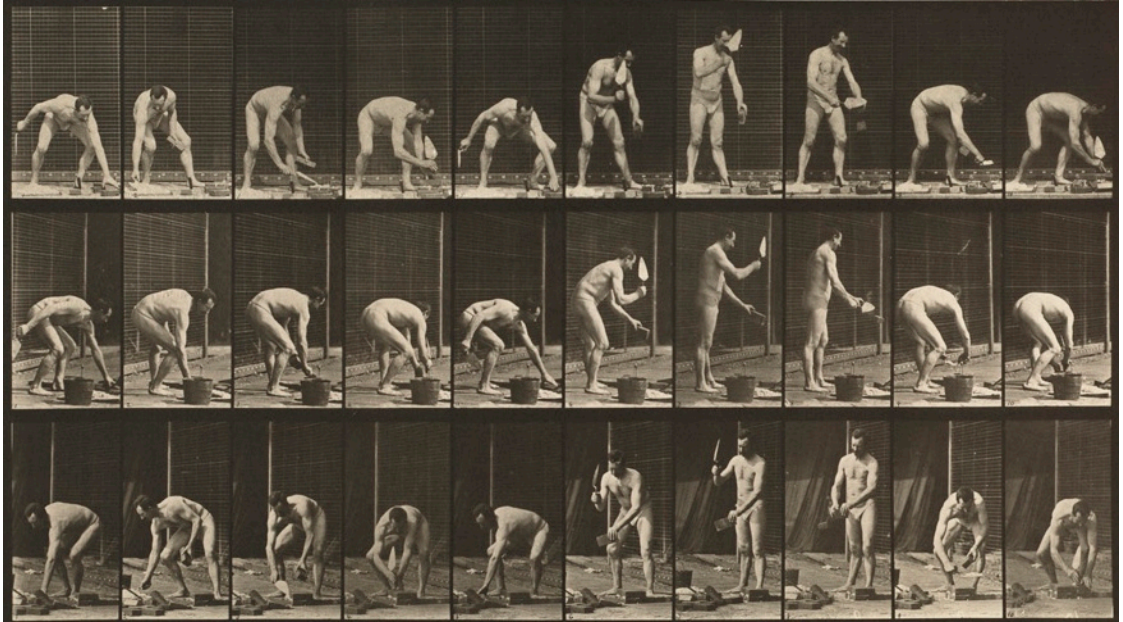


Figure 40. Eadweard Muybridge, “Bricklaying.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 506. Boston Public Library, Rare Books and Manuscripts Department.



Figure 41. Eadweard Muybridge, “Throwing a Spear.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 360. Boston Public Library, Rare Books and Manuscripts Department.

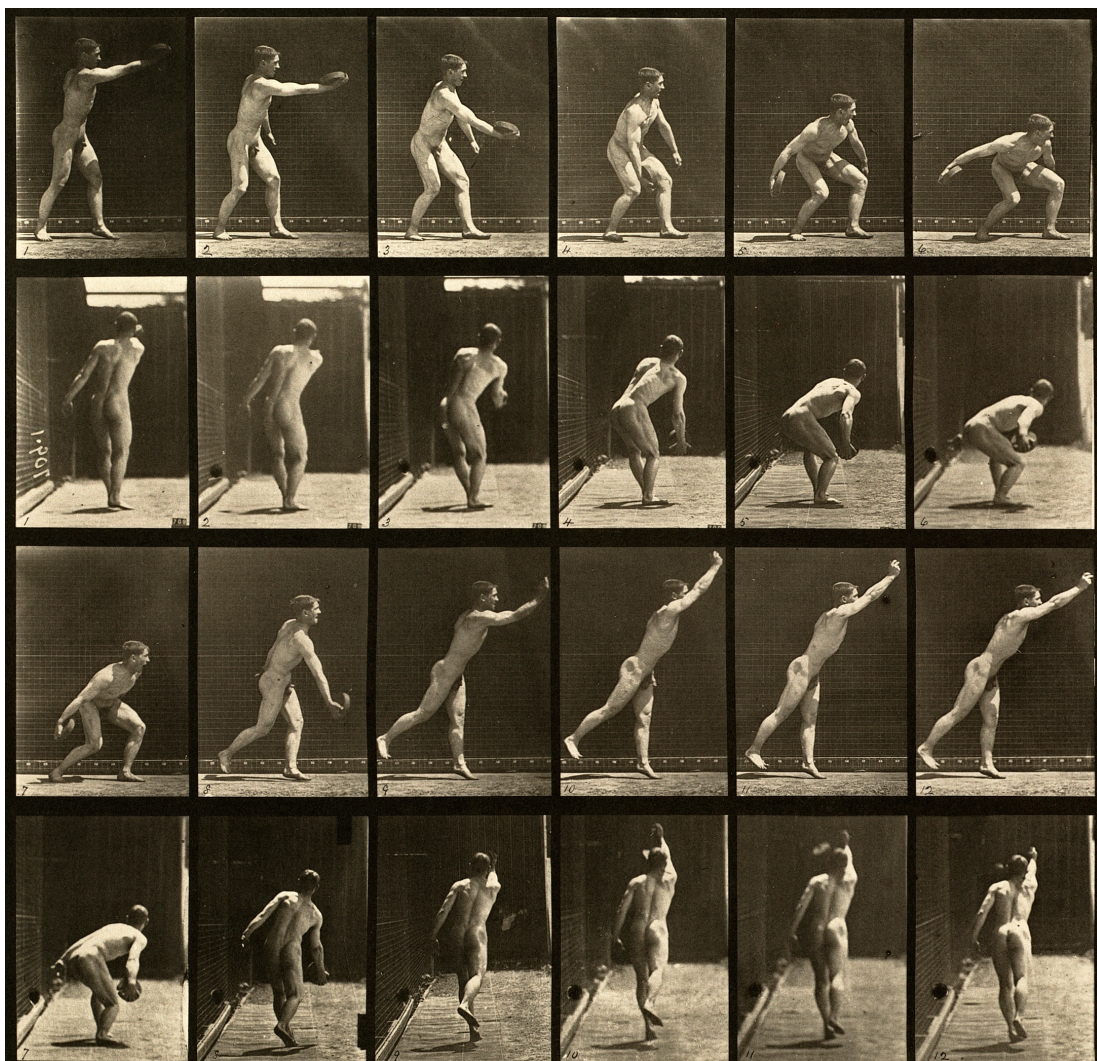


Figure 42. Eadweard Muybridge, “Throwing an Iron Disk.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 307. Boston Public Library, Rare Books and Manuscripts Department.

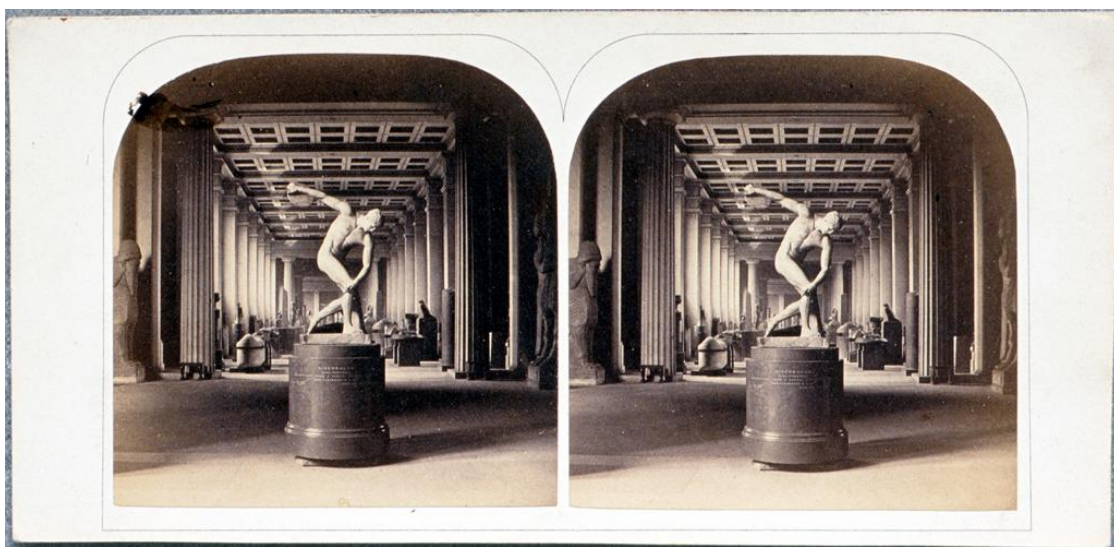


Figure 43. Roger Fenton, *Discobolus*. ca. 1860. Albumen Print, Stereograph. Sheet: 8.7 x 17.9 cm; image: 7.5 x 7.3 cm. each. Sterling and Francine Clark Art Institute. Dept. of Prints, Drawings and Photographs.

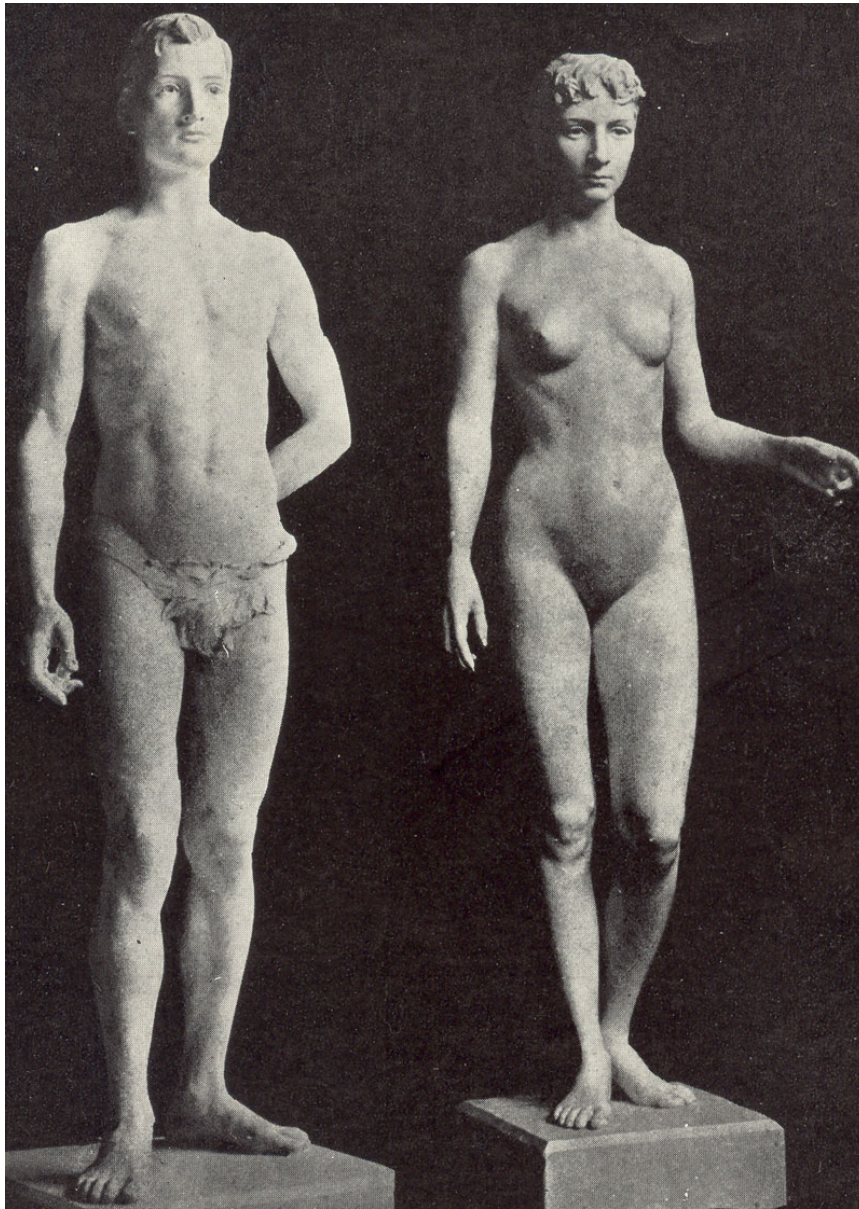


Figure 44. “Dr. Dudley A. Sargent’s composite figures of college students of the ‘Gay Nineties.’ Made from average measurements. The present generation of American students is considerably taller and more slender.” From: Earnest Albert Hooton, *Up from the Ape*. New York: The Macmillan Company, 1932. Plate 15, 258.



Figure 45. Eadweard Muybridge, “Movement of the Hand, Drawing a Circle.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 532. Boston Public Library, Rare Books and Manuscripts Department.



Figure 46. Eadweard Muybridge, “Artificially Induced Convulsions, Lying Down.” c. 1887, collotype. From: Eadweard Muybridge, *Animal Locomotion*. Philadelphia: J. B. Lippincott, 1887. Plate 544. Boston Public Library, Rare Books and Manuscripts Department.



Figure 47. [Engraving of composite drawing from *Animal Locomotion*, plate 545]. From: Francis X. Dercum, "A Study of Some Normal and Abnormal Movements Photographed by Muybridge." In *Animal Locomotion. The Muybridge Work at the University of Pennsylvania. The Method and the Result*. Philadelphia: J.B. Lippincott & Co., 1888. Figure 15, 123.

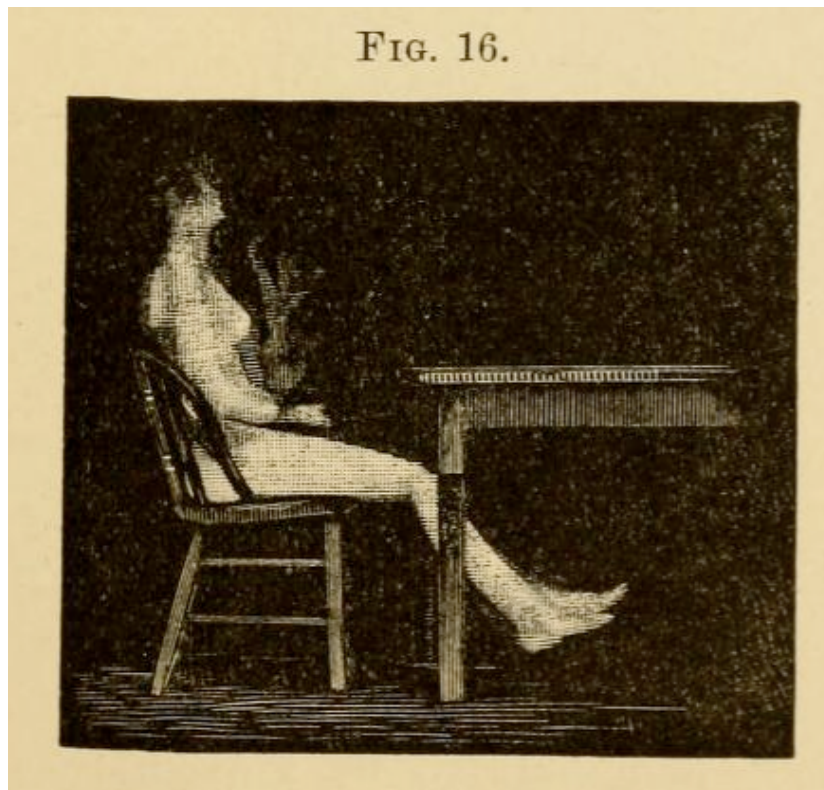


Figure 48. [Engraving of Marey wheel photograph]. 1888. From: Francis X. Dercum, "A Study of Some Normal and Abnormal Movements Photographed by Muybridge." In *Animal Locomotion. The Muybridge Work at the University of Pennsylvania. The Method and the Result*. Philadelphia: J.B. Lippincott & Co., 1888. Figure 16, 123.



Figure 49. [Engraving of composite drawing from *Animal Locomotion*, plate 545]. From: Francis X. Dercum, "A Study of Some Normal and Abnormal Movements Photographed by Muybridge." In *Animal Locomotion. The Muybridge Work at the University of Pennsylvania. The Method and the Result*. Philadelphia: J.B. Lippincott & Co., 1888. Figure 17, 124.

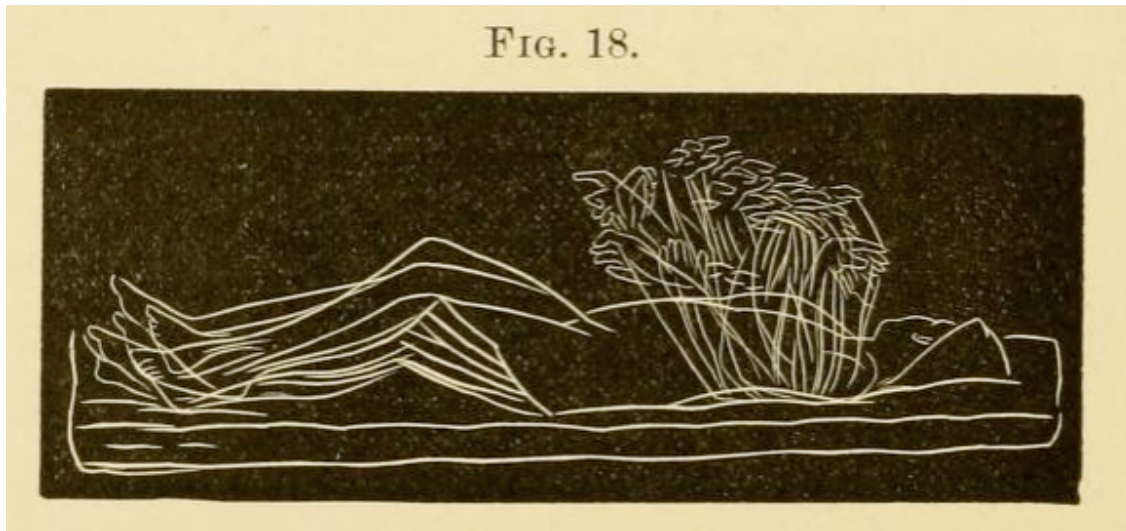


Figure 50. [Engraving of Composite drawing from *Animal Locomotion*, plate 544].
From: Francis X. Dercum, "A Study of Some Normal and Abnormal Movements
Photographed by Muybridge." In *Animal Locomotion. The Muybridge Work at the
University of Pennsylvania. The Method and the Result*. Philadelphia: J.B. Lippincott &
Co., 1888. Figure 18, 124.



FIG. 2.—Adult (Hereditary) Chorea. Showing excessive and rapid movements. The arms are blurred in the figure in consequence.

Figure 51. “Adult (Hereditary) Chorea.” From: Francis X. Dercum, “Adult Chorea,” *International Clinics: A Quarterly of Clinical Lectures* vol. 3. Philadelphia: J.B. Lippincott Company, 1891. Figure 2, [unpaginated].

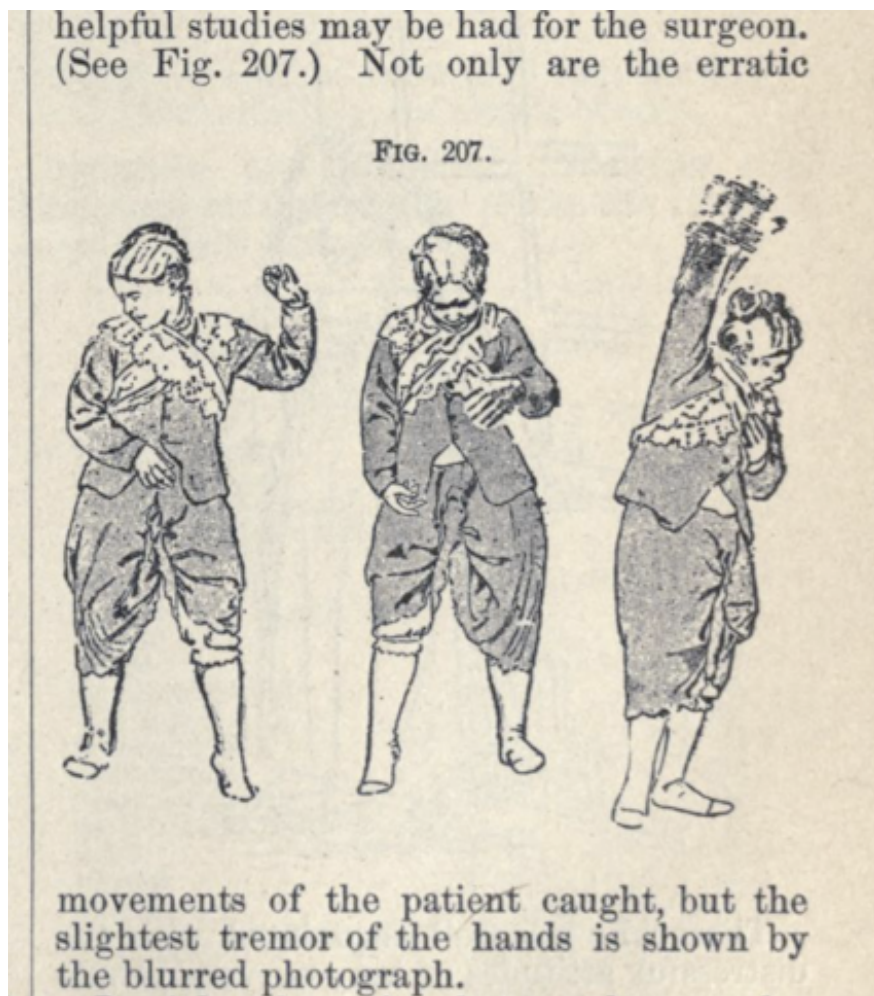


Figure 52. Albert Londe, [rhythmic chorea]. From: Edward L. Wilson, *Wilson's Cyclopaedic Photography: A Complete Hand-book of the Terms, Processes, Formulae and Appliances Available in Photography, Arranged in Cyclopaedic Form for Ready Reference*. New York: Edward L. Wilson, 1894. Figure 207, 373.

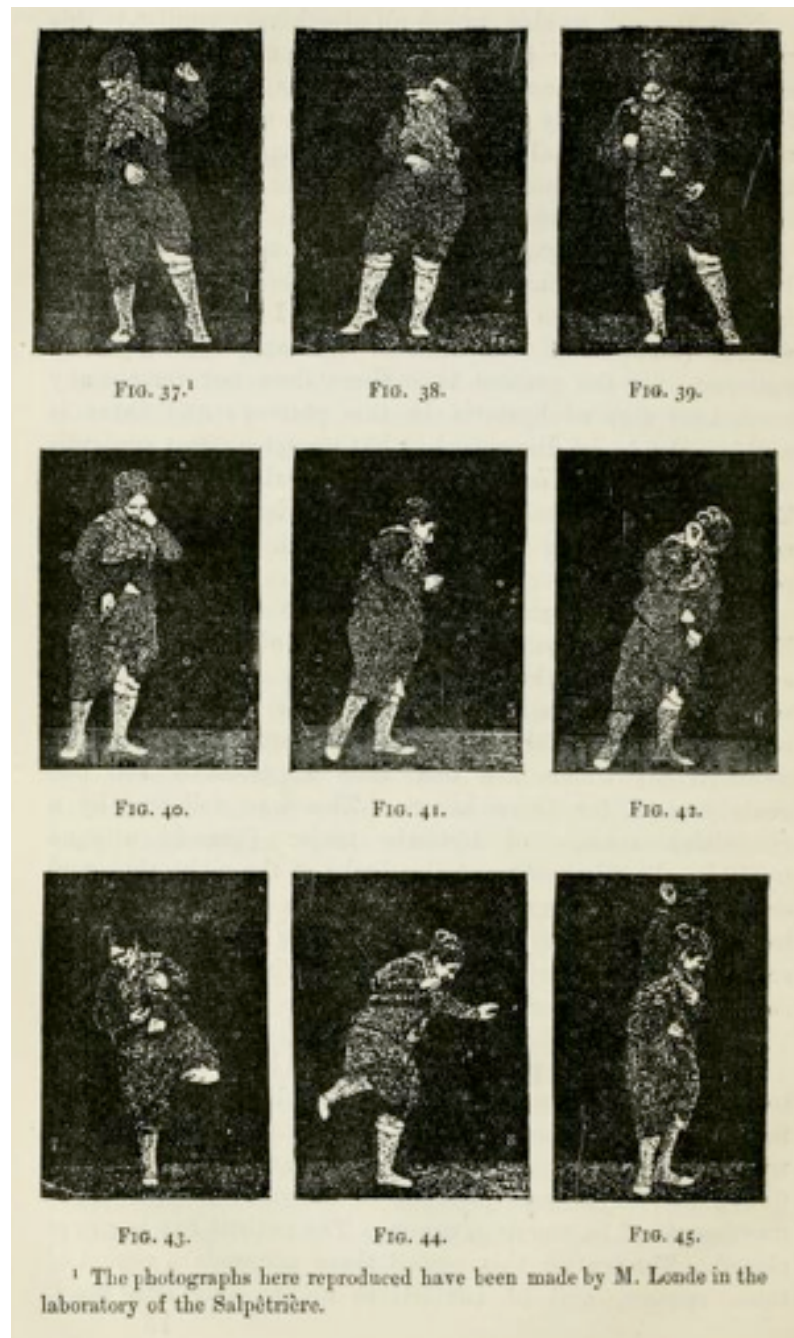
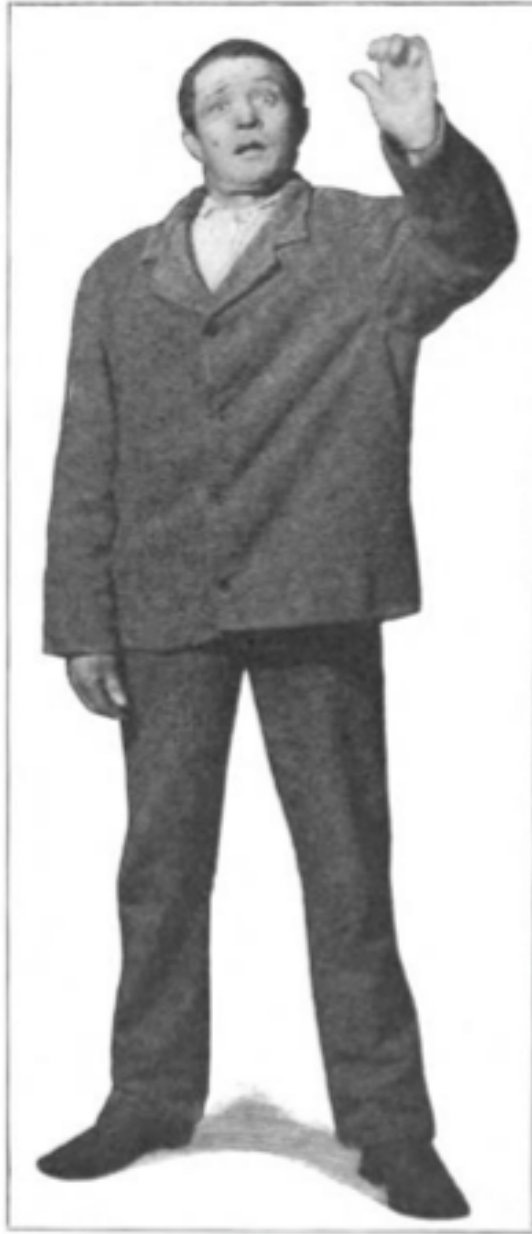


Figure 53. Albert Londe, [rhythmic chorea]. From: Jean-Martin Charcot, *Lectures on the Diseases of the Nervous System*, Vol. 3, trans. Thomas Savill. London: The New Sydenham Society, 1888. Figures 17-45, 194.

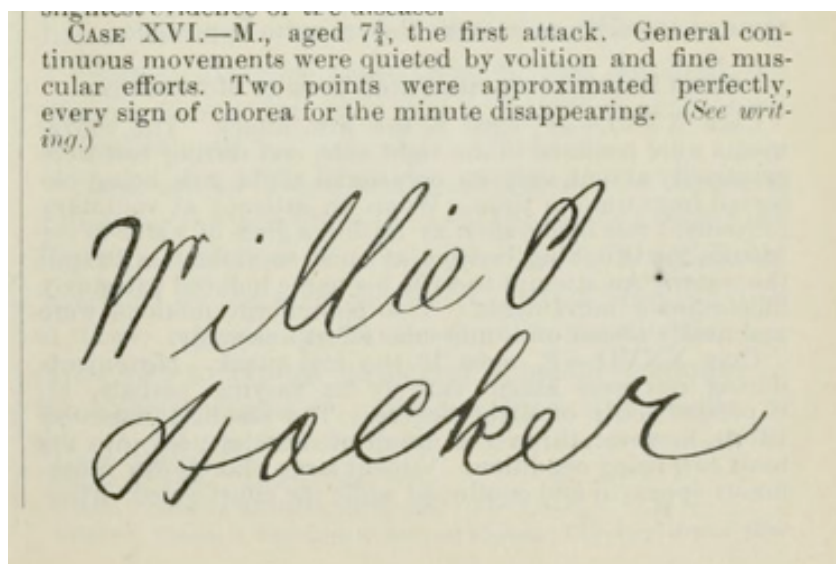
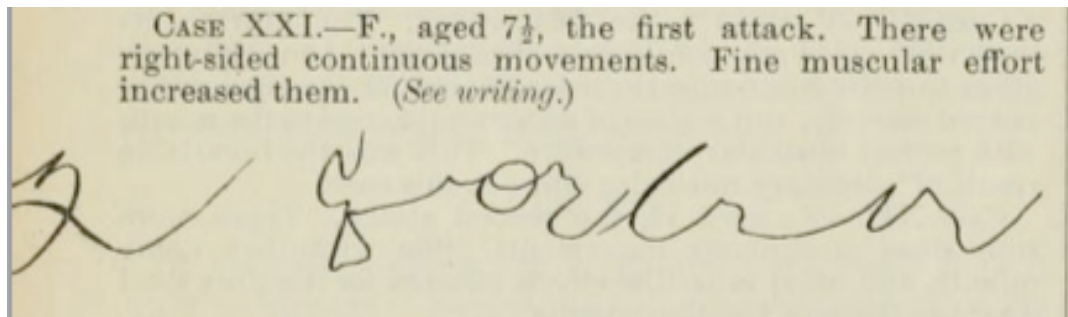


An instantaneous photograph. The left upper limb is blurred because of the tremor, but the blurring has in large measure disappeared in the reproduction. The expression of the face is striking. (Photograph obtained from Dr. F. X. DERCUM.)

Figure 54. [Photograph of a subject with Malaria Presenting the Symptoms of Disseminated Sclerosis]. 1900. From: William G. Spiller, "A Case of Malaria Presenting the Symptoms of Disseminated Sclerosis, with Necropsy," *American Journal of the Medical Sciences*, vol 20, no. 6 (Dec, 1900). Figure 2, 635.



Figure 55. [Photograph of a subject with convulsive tic]. 1901. From: Otto Lerch, "Convulsive Tic," *American Medicine* vol. 2, no. 8 (Nov. 1901), 694.



Figures 56, 57. “Case XXI” and “XVI.” From: S. Weir Mitchell and J.H. Wallace Rhein, “A Clinical Examination of the Motor-Symptoms of Chorea,” *Philadelphia Medical Journal* Vol. 1, No. 4 (January 22, 1898), 154, 153.

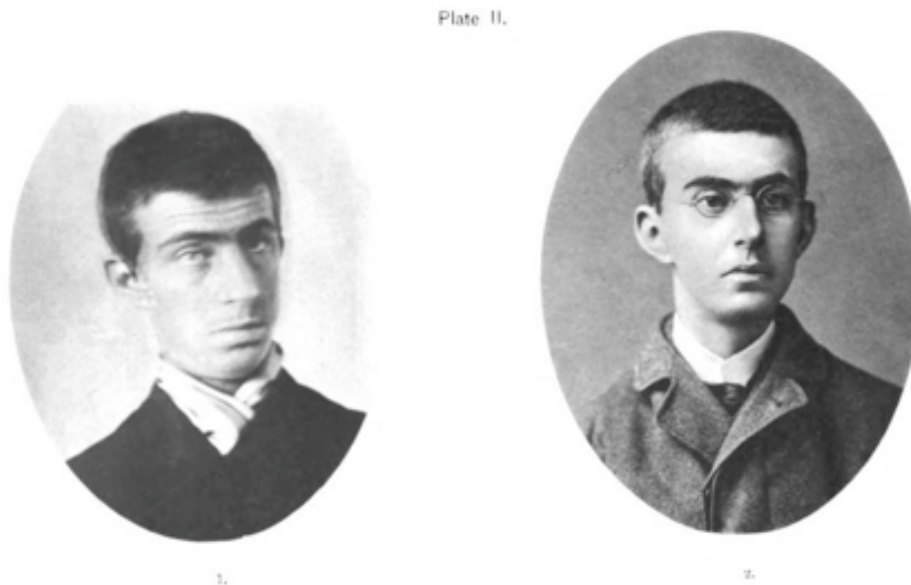


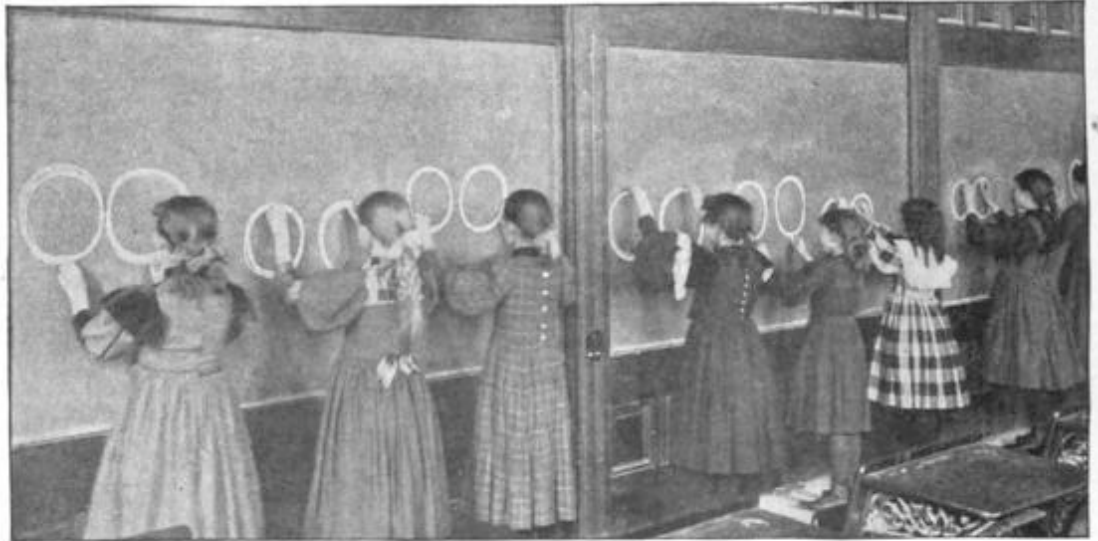
Figure 58. [Photographs of a subject before and after treatment for chorea]. 1887. George S. Stevens, *Functional Nervous Diseases: Their Causes and Their Treatment*. New York: D. Appleton and Company, 1887. Plate II, 99.



Figure 59. [Two drawings of a sitter “with the position of the eyes only altered”]. 1884. From: Henry Peach Robinson, “Hints on Posing and Management of the Sitter: Chapter II—the Head Vignette” *Photographic Times and American Photographer*, vol. XIV no. 48 (Dec. 5, 1884), 636.



Figure 60. [Photographs of a subject before and after treatment for chorea]. 1888. Ambrose Loomis Ranney, *Lectures on Nervous Diseases: From the Standpoint of Cerebral and Spinal Localization, and the Latter Methods Employed in the Diagnosis and Treatment of These Affections*. Philadelphia: F.A. Davis, 1888. Figures 1 and 2, 499.



First Exercise, Manual Training Drawing

Figure 61. “First Exercise, Manual Training Drawing.” From: J. Liberty Tadd, *New Methods in Education: Art, Real Manual Training, Nature Study*. New York: Orange Judd Company, 1899. Illustration 41, 68.

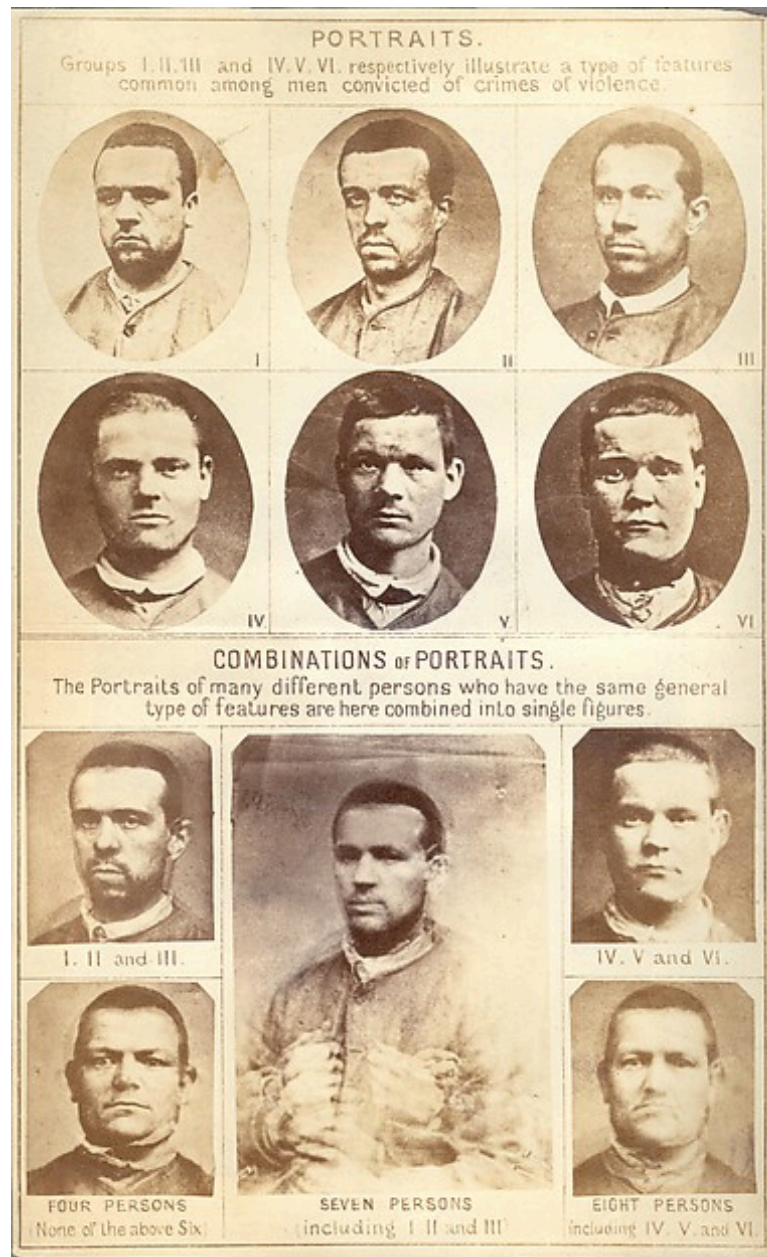
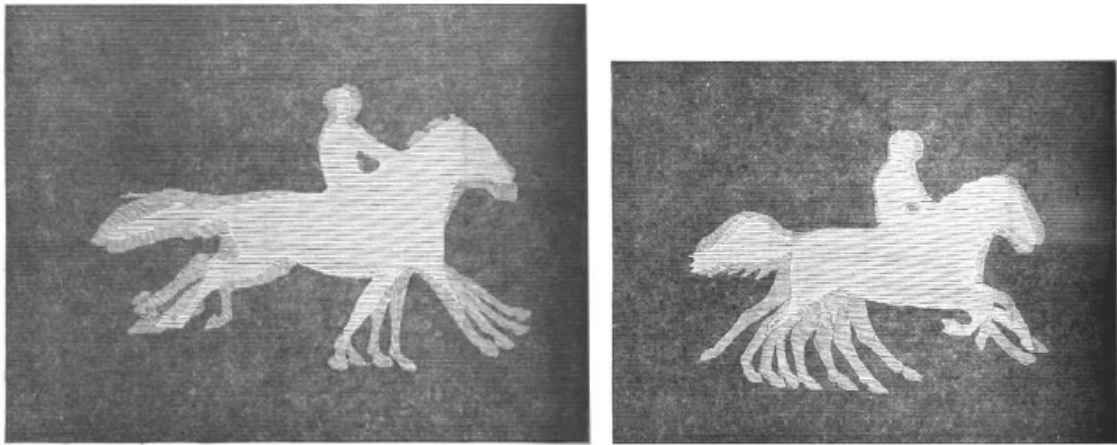


Figure 62. Francis Galton, "Composite Portraits of Criminal Types." 1877, Albumen silver print from glass negative. From: Mia Fineman, ed., *Faking it; Manipulated Photography before Photoshop*. New York: Metropolitan Museum, 2012. Cat. 92, 109.



Figure 63. Eadweard Muybridge, “Phryne L—Running, Stride, 19 ft, 9 in.” From: J.D.B. Stillman, *The Horse in Motion*. Boston: James R. Osgood and Company, 1882. Plate XVI.



Figures 64, 65. Francis Galton, [Engravings after composite photographs from Muybridge sequence]. From: Francis Galton, "Conventional Representation of the Horse in Motion." *Nature* 26 (July 6, 1882). Figures 1 and 2, 228.

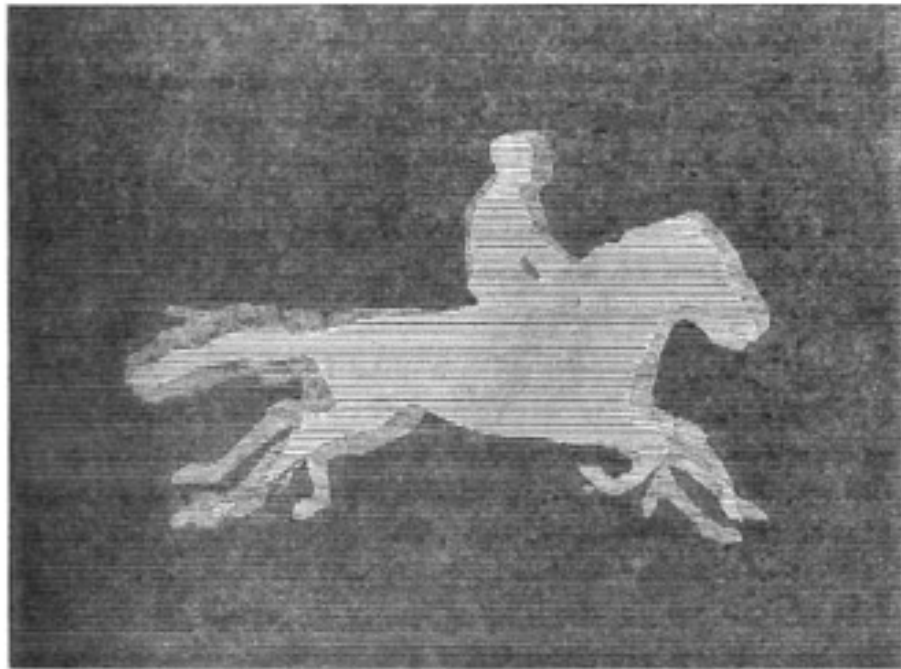


Figure 66. Francis Galton, [Engraving after composite photographs from Muybridge sequence]. From: Francis Galton, "Conventional Representation of the Horse in Motion." *Nature* 26 (July 6, 1882). Figures 3, 229.



Fig. 2.

Figure 67. Francis Galton, [Rapid view instrument]. From: Francis Galton, “A Rapid-View Instrument for Momentary Attitudes.” *Nature* 26 (July 13, 1882). Figure 2, 250.