Lenny Lipton

THE CINEMA IN FLUX

The Evolution of Motion Picture Technology from the Magic Lantern to the Digital Era

Springer

L. Lipton, *The Cinema in Flux*
https://doi.org/10.1007/978-1-0716-0951-4_10

10. Muybridge and Anschütz

Lenny Lipton[1]
(1) Los Angeles, CA, USA

Eadweard Muybridge (1830–1904), whose given name was Edward Muggeridge, was born in England. He found success in the United States as a photographer and lecturer, achieving fame with his equine locomotion studies, projections of apparent motion, and publishing collections of photographs of the phases of motion. He moved to California in 1855, after which he returned to England where he mastered the wet-collodion process. Back in the United States in 1867, he photographed the American West, specializing in stereography and panoramas using the non-de-lumière Helios. He cultivated the image of a flamboyant wizard; in later life he could have passed for Tolkien's Gandalf, but there was substance to his self-promotion. He is one of the most influential figures in the history of cinema technology, having directly inspired the work of Anschütz, Marey, and Edison (Hendricks 1975). His reputation as a photographer led to his being approached, in 1872, by Leland Stanford, former governor of California, railroad mogul, and race horse owner, to settle the question: do all four feet of a racehorse, in this case a trotter, lift off the ground while it is racing?

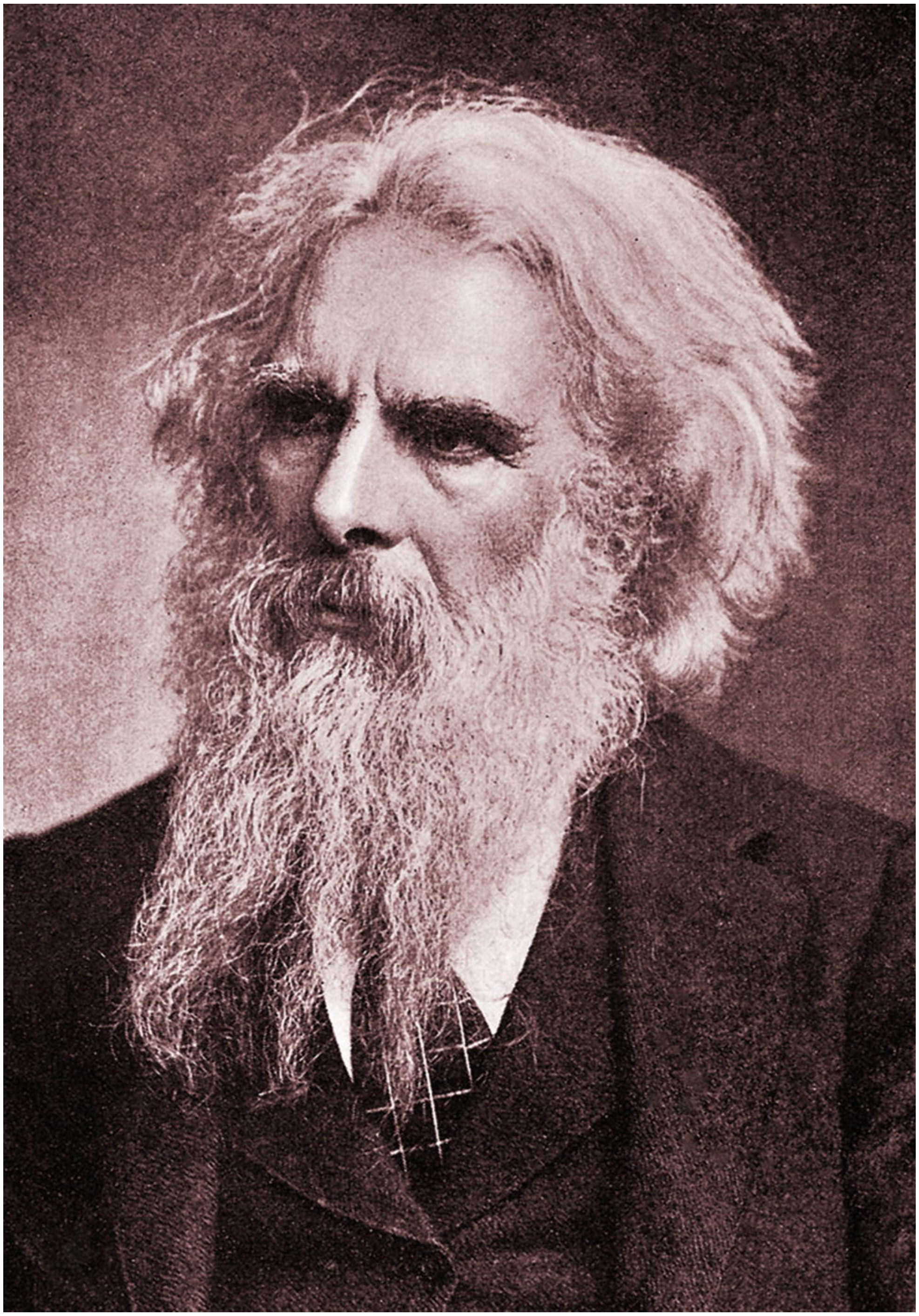
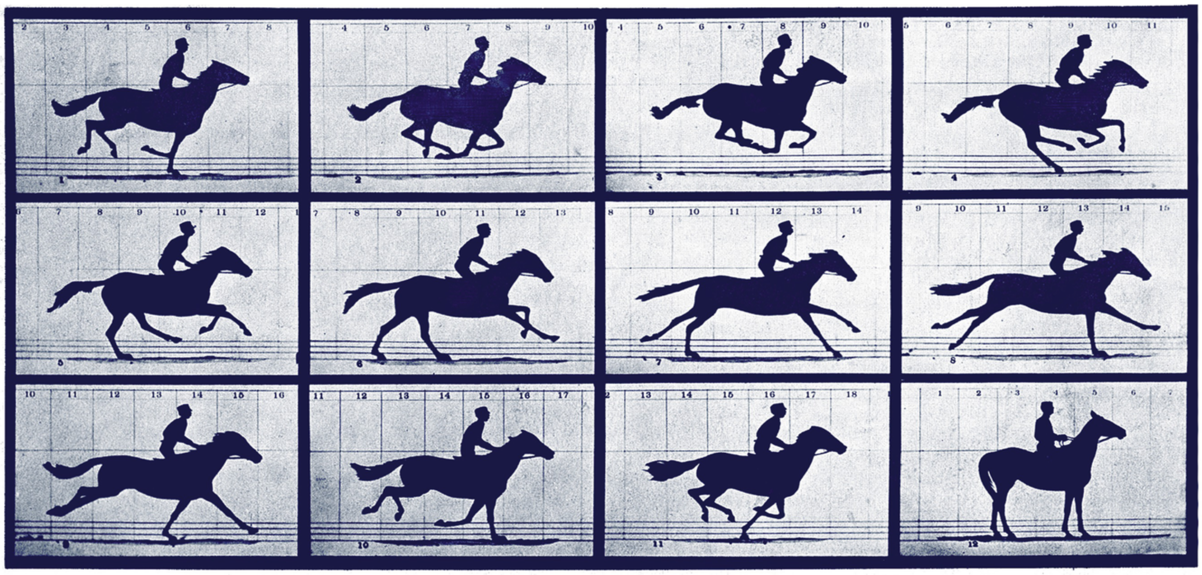


Fig. 10.1 Eadweard Muybridge

The story that Stanford hired Muybridge to settle a bet to that effect is apocryphal and it has been conjectured that the original impetus for the project was suggested by the animal motion studies of Marey, but this is doubtful since Marey's studies were, up until that time, dependent on measurement (chronography) and not photography; moreover, Marey's *La Machine Animale* was published in France in 1873 and Muybridge's experiments began in 1872. However, Marey's influence helped to rekindle the Stanford equine project after its hiatus. In April 1873, using a dual lens camera with a 1/500 second shutter, Muybridge captured a silhouette photograph of Stanford's horse, Occident, which seemed to have settled the matter, since all of Occident's legs were shown to be momentarily lifting off the ground. Concerns arose with regard to the legitimacy of the heavily retouched photo and the loss of the negative itself. Therefore, Stanford wanted Muybridge to repeat the study, but years were lost before he returned to the project because Muybridge was arrested for having shot dead his wife's lover, George Harry Larkins, who was the probable father of his child. Despite pleading guilty to murder, the jury found him to be not guilty by reason of justifiable homicide. Muybridge's confession and hysterical fit "horrifying in its contortions as convulsion succeeded convulsion," in the courtroom after having been let off might have ruined another man, but this only heightened his allure as an outlier and added to his flamboyant legend (Hendricks 1975, pp. 65–77).

Stanford's request that Muybridge return to the study in 1877 was triggered by his learning of the work of physiologist Étienne-Jules Marey, and Muybridge set about to design a better method to analyze equestrian locomotion. This was the true beginning of his interest in apparent motion photography and its projection. As a result of Stanford's commission, Muybridge, on June 11, 1878, in Palo Alto, California, using 12 equidistanced cameras arrayed in a line, was able to successfully photograph the phases of motion of a horse, the trotter Abe Eddington, as it raced against a background of white sheets (Mannoni 2000, p. 308). The cameras' 1/2000th of a second focal plane drop shutters, of Muybridge's devising, were electrically activated by means of switches that were tripped as the racing horse broke cotton or silk threads. The technique is described in USP 212,865, *Method and Apparatus for Photographing Objects in Motion*, filed June 27, 1879. Later on Muybridge substituted a clockwork mechanism for tripping the shutters, which he used for his renowned locomotion studies in later years. The results of his photography, on that day in June, revealed what the human eye could not perceive: when racing all four hoofs of a horse momentarily leave the ground. Given the layout of the camera array, the photographs progress through both time and space and comprise cinema's first tracking shot.



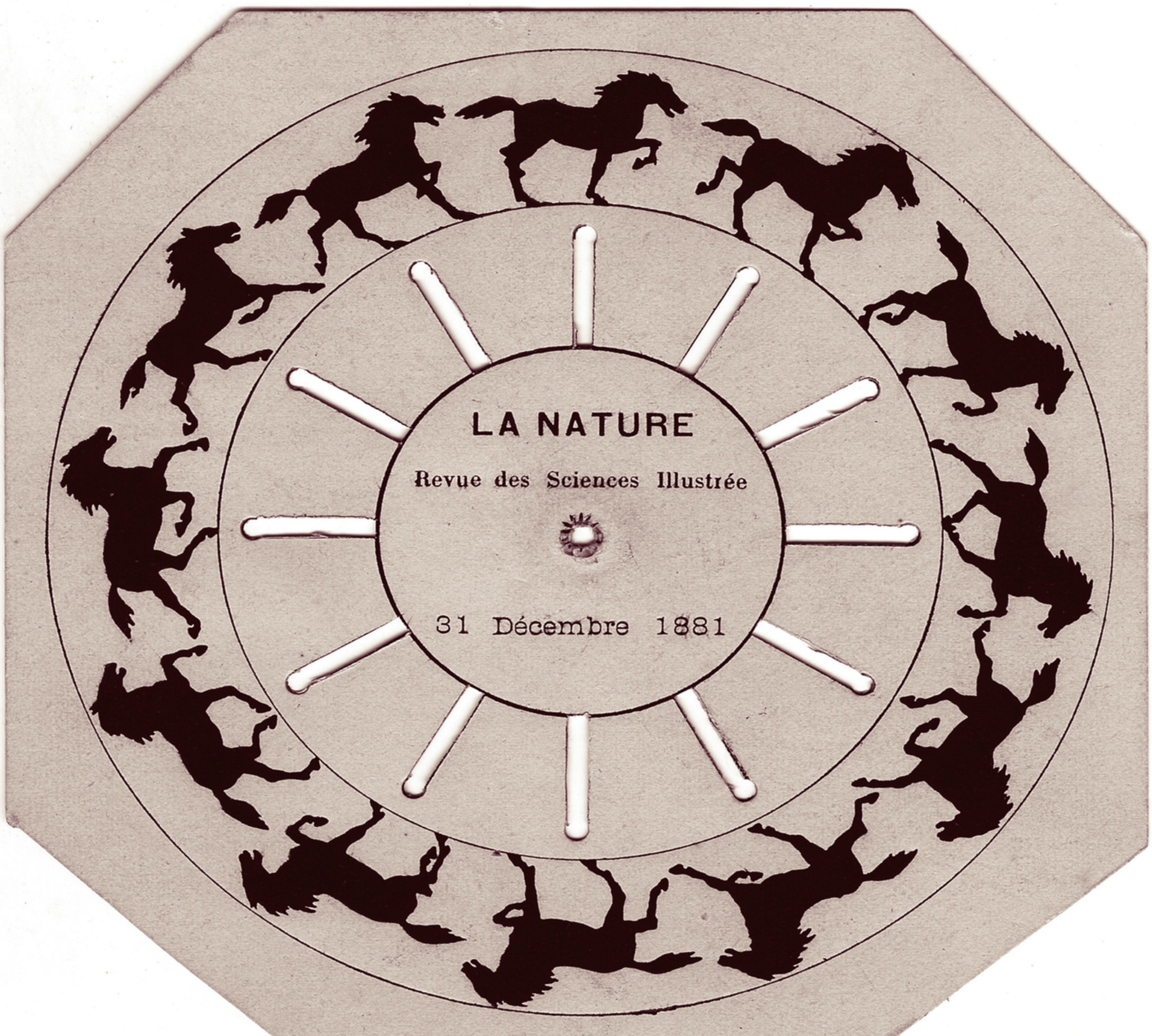

LA NATURE
Revue des Sciences Illustrée
31 Décembre 1881

Fig. 10.2 Top: Leland Stanford's Sallie Gardner, photographed by Muybridge in Palo Alto, on June 19, 1878. Bottom: A Phenakistoscope disk based on Muybridge's studies. (Cinémathèque Française)

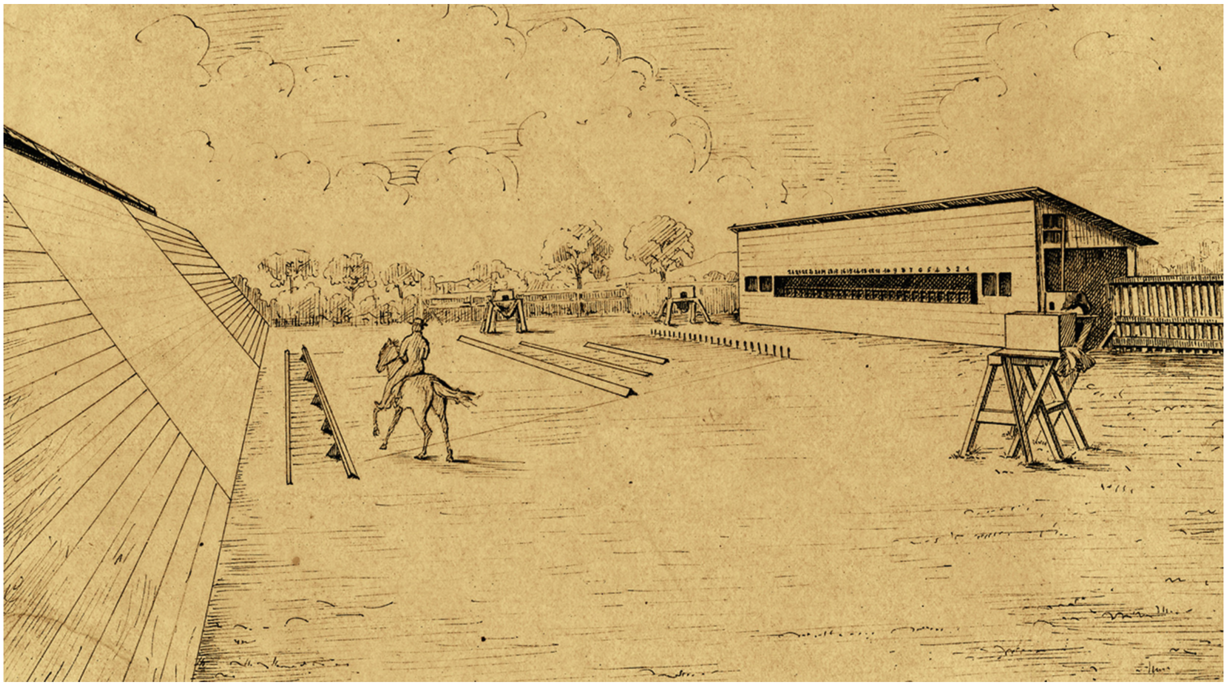


Fig. 10.3 A drawing by Jacques Demenÿ of Muybridge's battery of cameras (within the shed at the right) photographing the phases of motion of a racing horse as it breaks shutter tripping strings. The cameras were spaced 27 inches apart and their shutters operated at a two-thousandth of a second. (Cinémathèque Française)

Muybridge set out to project his results as moving images with what he called the Zoöpraxiscope (also known as the Magic Lantern Zoëtrope and the Zoögyroscope) using a magic lantern modification based on the phenakistoscope. The first of Muybridge's exhibitions was for an audience of friends and colleagues in the fall of 1879, either at Stanford's Palo Alto or San Francisco home. On January 16, 1880, at Stanford's home in San Francisco, Muybridge once again showed off his Zoöpraxiscope, a magic lantern with a disk holding glass slides that passed through the lantern's gate and a radial slit shutter that was located in front of the lens. The handcranked disk and shutter were counter-rotating, and the disk and shutter were synchronized to briefly uncover each passing image, to flash it on the screen, as it sped through the projector's gate. Muybridge resorted to drawings made from photos by his battery of cameras in order to elongate then to compensate for the anamorphic compression caused by the radial slit shutter, a phenomenon described in chapter 4. Twelve photographs of the phases of motion of a rider on horseback were turned into drawings by Erwin F. Faber (Hendricks 1975, pp. 126, 127). (Other writers state that the drawings were silhouettes.)

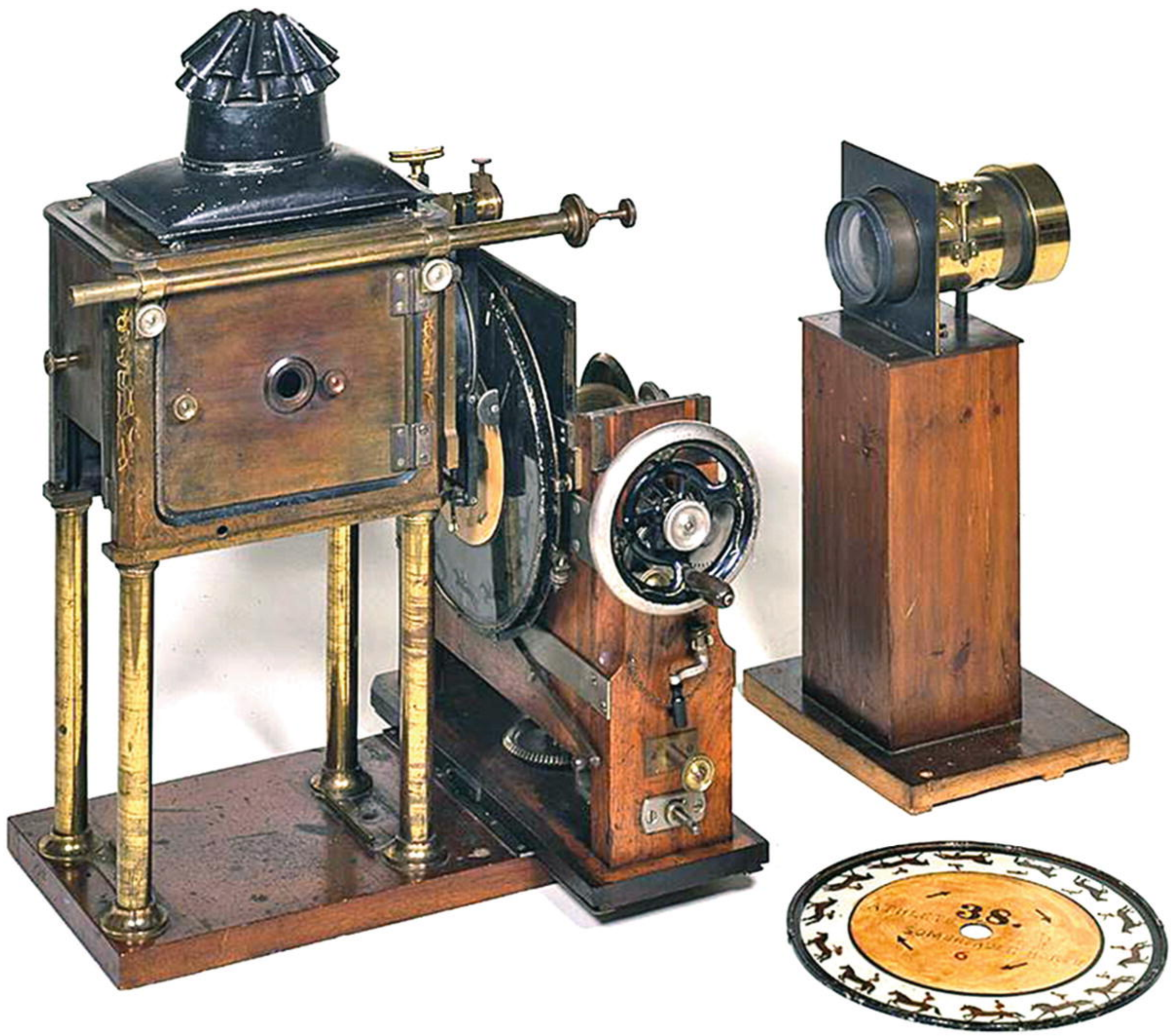


Fig. 10.4 The Zoöpraxiscope. This is a photo of the apparatus actually used by Muybridge, from the Kingston Museum. (Cinémathèque Française)

The drawings were arrayed on the periphery of a large disk following the format first described by Zahn at the close of the seventeenth century. The lamphouse used a bright oxy-hydrogen limelight, which was required because of the optical inefficiency of the rotating disk and shutter. The following is an extract of a newspaper account of a Muybridge demonstration, which ran in the February 6, 1881, *San Francisco Examiner*:

"A disc of zinc about eighteen inches in diameter has slots radiating around its outer verge (the shutter). On the outer verge of a similarly sized disc of glass (actually individual glass slides) are silhouettes of any one series of photographs. The discs are placed on the pivot of a delicately-constructed machine, which revolves them in opposite directions. A very perfect magic lantern, constructed for the purpose, cast the pictures the size of life on a prepared screen and across which the horses walk or trot, canter or gallop, even as they do in life."

Muybridge was believed by one and all to have invented the beautifully made Zoöpraxiscope; even historian Hendricks wrote that Muybridge invented it, calling it "revolutionary" and making the incorrect claim that: "These exhibitions may fairly well be said to mark the official debut of motion pictures on screen in America." However, Muybridge was preceded by almost a decade by Henry Renno Heyl's public screening of a projected photographed motion picture sequence. Heyl's demonstration was more advanced because it used stop-start intermittency and photos rather than drawings. (See chapter 9.) Muybridge had produced an interesting demonstration of apparent motion, but not the first of its kind and one that failed to establish that photography could be the source of the phases of motion because of his need to use drawings. In fact, it was no more advanced than Uchatius' demonstration before the Vienna Academy of Sciences in 1853. But whatever the projection technology that Muybridge used, he created a method for photographing live action apparent motion – his battery of cameras. It may be that the most important image he projected was that of a larger than life magician-genius whose credibility was accepted by both the public and the scientific community. This allowed him to successfully proselytize the concept of motion pictures thereby playing a pivotal and inspirational role in the creation of the celluloid cinema.

In 1881, after Stanford and Muybridge's publication of a collection of Muybridge's photographs, *The Attitudes of Animals in Motion*, Muybridge toured England and France where he was greeted as a celebrity. As an example of how highly regarded he was, he gave a Zoöpraxiscope screening for a group of some of the most renowned European savants including Hermann von Helmholtz, Jacques Arsène d'Arsonval, and Gabriel Lippmann, on September 26, 1881, which Marey organized in his new house on the Boulevard Delessert in Paris. Marey and Muybridge established a cordial relationship and Muybridge's work inspired Marey to develop improved methods for chronophotography, as described in chapter 11. Muybridge returned to the United States and continued to lecture and in August 1883 received a $40,000 grant from the University of Pennsylvania allowing him to carry on his work. At the University, using the new gelatin dry-plates, a new shutter capable of exposures of one five-thousandths of a second, and a battery of 24 cameras, he produced many studies of animals and humans, taking 20,000 photographs during 1884 and 1885, which became the basis for his book *Animal Locomotion*, published in 1887.

One unusual outcome of Dr. Muybridge's (as he was then known) University chronophotographic unsung efforts was the discovery of "the significance of the skinfolds on the trunk of the hog." (A Study of Animals… 1917, vol. 21, p. 159) Muybridge was truly both a protocinematographer and a chronophotographer, from his equine studies for Stanford to his porcine studies for the University of Pennsylvania and his collections of photographs that are considered to be works of fine art. Muybridge toured the United States with the Zoöpraxiscope and on February 27, 1888, finding his way to West Orange, New Jersey, and Thomas Edison, as described in chapter 12. His multi-camera technique has been applied to modern filmmaking for a completely different effect, using still image digital cameras arranged in a circle rather than a straight line, with simultaneous rather than sequential exposures, to create the effect of a frozen figure hovering in space as seen, for example, in the 1999 production, *The Matrix*.

Prussian photographer and inventor Ottomar Anschütz (1846–1907) used Muybridge's battery of cameras concept for capturing the phases of motion to create content for his various approaches for displaying motion, which included his Projecting Electro-Tachyscope, a masterpiece of the glass cinema that greatly surpassed the Zoöpraxiscope and produced the best looking big screen motion pictures prior to the Lumières' Cinématographe. Anschütz began with peepshow displays that he generically called Schnellseher, or Quick View, and his most advanced Electro-Tachyscope (Electrical-Swift seeing), directly influenced the experiments of Edison and Dickson. Anschütz was born in Lissa, now Leschnow, Poland, where his father began a career as a painter of decorations (decorationsmalers) but later became a photographer. The young Anschütz apprenticed with accomplished photographers and became a meticulous craftsman with Berlin as his home base. Due to the excellence of his work he gained fame in Europe and America, becoming a favorite of Crown Prince Friedrich. He was an aficionado of the phenakistoscope and zoëtrope and photographed motion sequences, as an artist for his own satisfaction who also sought an audience, with little concern for motion analysis.

Fig. 10.5 Ottomar Anschütz

His work as a photographer and protocinematographer attracted significant attention, although today he is known for the most part only by scholars. He became attracted to the art and science of apparent motion in the autumn of 1885 after learning of Muybridge's multi-camera motion studies, whereupon he put together a similar ensemble of 12 cameras. He photographed the phases of motion of people, horses, birds, and other animals, using the newly available and more convenient dry plates, with their greater sensitivity to light (Coe 1981). He devised an instrument made up of 24 integrated cameras incorporating shutters capable of exposures of 1/1000th of a second. This high-speed shutter, which he perfected in 1888, was the first reliable focal plane shutter, which remained in production for three decades by C. P. Goertz of Berlin. In 1887 Anschütz designed what he called the Wundertrummel (Miracle tunnel), based on the zoëtrope, for which he produced and sold interchangeable bands of motion views. He built a massive version of the Wundertrummel, a step toward his more advanced moving image displays, using the Zahn disk format. If all he had accomplished was to emulate Muybridge and advance the art of the apparent motion peepshow, he would be a footnote in the history of cinema technology, but he influenced the early cylinder experiments of Edison and Dickson and the design of their peepshow display, the kinetoscope; as important, his Projecting Electro-Tachyscope decisively demonstrated the concept of the projection of photographed motion.

His Electro-Tachyscope was designed to be viewed by several people at once; it used a continuously rotating disk made of steel between 4 and 5 feet in diameter that mounted 24 3.5 in × 4.7 in glass slides on its periphery, with the image sequences designed to form an endless loop. When a slide rotated into viewing position, it was momentarily backlit by a high-voltage high-brightness spiral wound Geissler gas discharge tube designed to cover the area of the slide with a flash of light on the order of 1/1000th of a second (Hopwood 1899, p. 50). The slides' flashes were triggered by electrical contacts when each moved into viewing position, an elegant arrangement that took the place of a spinning shutter which eliminated the anamorphic distortion inherent in the phenakistoscope's shutter since the entire phase of motion was illuminated and revealed to the eye simultaneously.[1] Hopwood (1899, p. 51) points out that the use an electric spark, rather than a radial shutter, to arrest a continuously moving image in such a display was suggested by Desvignes in 1860 and Donisthorpe in 1876 for his Kinesigraph. A production run of at least 100 robust Electro-Tachyscopes was built by Siemens and Halske of Berlin in 1891, entering service as coin-operated devices designed for commercial exhibition in public places (Abel 2005). The motor driven peepshow Electro-Tachyscope premiered in Berlin displaying moving images of horses, gymnasts, and other subjects, from the 19th to the 21st of March 1887, at the Kulturministerium (Ministry of Culture).

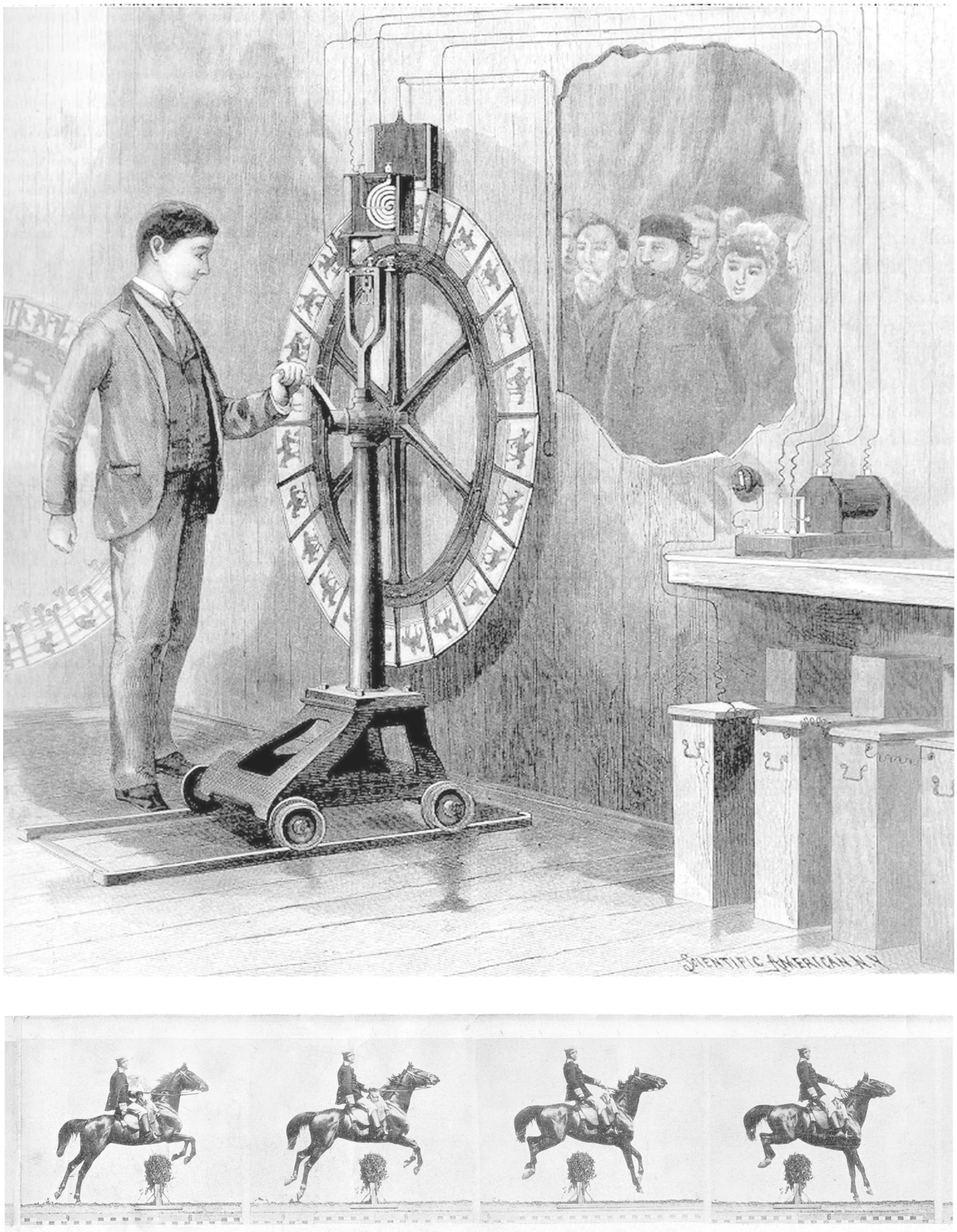


Fig. 10.6 Top: The peepshow Electro-Tachyscope. Bottom: Content that it might have shown. (Second frame from the right was partly reconstructed in Photoshop.)

(Cinémathèque Française)

Dr. Franz Stolze, a photographer and a journalist, commenting on the equine studies in *Photographisches Wochenblatt* (*Photographic Weekly Paper*), reported that: "…In all these representations (living pictures) the most wonderful and truthfulness to nature prevails. The play of muscles, the movement of the ears, the fluttering of the mane and tail, the jumping of the rider in the saddle - in short, all those little individualities are reproduced in just such an extraordinary manner" (Coe 1992, p. 35). The Electro-Tachyscope was exhibited in Europe and the United States and Thomas J. Armat, co-inventor of an important early 35 mm projector, was influenced by the device, which captivated him at the 1893 Chicago World's Fair. In the years that followed tens of thousands of people saw the Electro-Tachyscope in operation at various exhibitions and venues including New York City as early as 1889. Edison biographer, Paul Israel (1998), writes that he was influenced by Anschütz's invention, as was his assistant, W.K.L. Dickson. German physician Emil du Boise-Reymond (1892), the founder of electrophysiology, in an article in an 1892 issue of *Popular Science*, uses the terminology "instantaneous photography" (living pictures was also frequently used for what today we call motion pictures) to describe the work of Anschütz and Muybridge. Boise-Reymond was extremely well informed about Victorian cinema technology, an indication that the scientific community and members of the public, who read *Popular Science* magazine, wanted to keep up-to-date on the subject. Du Boise-Reymond describes the application of instantaneous photography to studies of nudes, animals, lightening, clouds, and the stormy surf.

Anschütz's next living pictures effort was his masterpiece, the Projecting Electro-Tachyscope. Hans Köche (1966), writing in *Bild und Ton, Zeitschrift fur Film und Fototechnick* (*Image and Sound, Journal for Film and Photo Techniques*), Volume 19, 1966, cites a letter dated July 7, 1935, from Seimens engineer Anton Verständig to German cinema pioneer Otto Meister, which describes the design of Anschütz's Projecting Electro-Tachyscope and the events surrounding its creation (Hecht 1993, entry 653). In 1894 Verständig was approached by Anschütz asking him if his peepshow disks could be used for projection. Verständig had previously designed peepshow Tachyscope models for Anschütz and suggested a fresh design using a band of film with a Maltese-cross intermittent movement. Anschütz rejected this because he thought that it would be difficult to accurately align the individual images. Although the two-disk projector described below was Verständig's design, the machine was not built by Seimens but rather by a mechanic named Bödecker (Hecht 1993, entry 396). However, Seimens supplied the 40 ampere arc lamps and other structural components, as noted by Rossell (1998).

Anschütz's Projecting Electro-Tachyscope was a dual-projector design that synchronized two disks each holding 12 glass slides projecting at 16 images per second, first one image from one projection head and then one image from the other. In order to achieve a bright image, the flashing Geissler tube was replaced by high intensity Seimens carbon arcs and mechanical shutters. Each disk of 12 slides was advanced by a Maltese-cross mechanism using a rotating shutter occluding the frames when they were in motion. The shutter had broad sectors, like the ones that would be used by the soon to be designed 35 mm projectors (they were not of the radial slit phenakistoscope design). The alternating disk-slide concept allowed Anschütz to achieve a high enough effective frame rate for a persuasive illusion of apparent motion, to mitigate flicker, and to double image brightness. The image was on the screen continuously, unlike the method that became the signature of the celluloid cinema in which image was on screen only half the time. The Projecting Electro-Tachyscope threw images on a big screen, 26.25 ft × 19.5 ft, at the Berlin Post Office Building on November 25, 29, and 30, 1894. Thereafter, from February 2, 1895, until March 30, Projecting Electro-Tachyscope movies were shown on a regular basis in a theater with a capacity of 300 paying customers at the Old Reichstag Building on Berlin's main thoroughfare, the Leipziger Strasse. According to Coe (1992, p. 37) the projector used dissolving shutters, but this doesn't seem to have been the case since; motion would have been flickerless and smooth without dissolves. A similar alternating frame concept, definitely using dissolves, but designed for celluloid film projection, was employed by the Skladanowsky Bioscop projector of 1895, as described elsewhere in these pages.

When the Berlin press first saw celluloid cinema projection in April 1896, they supposed they were seeing a new version of Anschütz's invention (Herbert 1996). His Projecting Electro-Tachyscope anticipated 35 mm celluloid cinema projection, and in that sense he leapfrogged Edison's peepshow Kinetoscope of 1894. His goal was to create a projection method the equal of his meticulous studies of the phases of motion. Toward that end, he perfected a system designed for one purpose only, to reproduce the visual world and the motion of living beings that came as close as possible, given the technology he could muster, to create the effect of absolute verisimilitude. At that moment in time, a century and a quarter ago, in a theater in Berlin, he succeeded. Anschütz's accomplishments were almost immediately overtaken by the celluloid cinema, and although he had achieved much of what he had set out to do, after 1903, according to Rossell (2001), his automat (peepshow) Schnellseher business resulted in a large debt to the manufacturer of the instruments, Siemens & Halske. Both his North American and British operations failed, but in 1894–95 he pressed ahead with the Projecting Schnellseher (Electro-Tachyscope), undoubtedly his greatest technical accomplishment. But this effort also proved to be financially draining and he abandoned his moving image efforts. He continued to take photographs that were admired in Europe and the United States and at home in Berlin, where he operated a studio for high society clientele. In 1907 he died at the age of 61 having succumbed to appendicitis.

Bibliographies

Books

Abel, Richard, ed. *Encyclopedia of Early Cinema*. Abingdon, UK/New York: Routledge, 2005.

Coe, Brian. *The history of movie photography*. Westfield, NJ: Eastview Editions, 1981.

Coe, Brian. *Muybridge & the chronophotographers*. London: Museum of the Moving Image, 1992.

Hendricks, Gordon. *Eadweard muybridge: The father of the motion picture*. New York: Grossman Publishers, 1975.

Herbert, Stephen and Luke McKernan, eds. Who's who of Victorian cinema. London: British Film Institute, 1996.

Hecht, Hermann, and Ann Hecht, ed. *Pre-cinema history, an encyclopedia and annotated bibliography of the moving image before 1896*. London: Bowker-Saur, in association with The British Film Institute, 1993.

Hopwood, Henry V. *Living pictures: Their history, photo-production, and practical working*. London: The Optician and Photographic Trades Review, 1899. Reprinted as part of the series *The Literature of Cinema* by Arno Press & *The New York Times* 1970.

Israel, Paul. *Edison: A life of invention*. New York: John, 1998.

Mannoni, Laurent, et al. *The Great Art of Light and Shadow: Archaeology of the Cinema*. Exeter: University of Exeter Press, 2000.

Rossell, Deac. *Living Pictures: The Origins of the Movies*. Albany: State University of New York, 1998.

Articles

du Bois-Reymond, Emil. Science and Fine Art II (Concluded). Popular Science Monthly 41 (May 1892).

Köche, Hans. Bild und Ton, Zeitschrift für Film- und Fototechnik Image and Sound, Journal for Film and Photo Techniques 19 (1966).

Study of Animals Led to Movie Films. The Camera: A Practical Magazine for Photographers 21, no. 3 (March 1917): 159.

Footnotes

1 Although Edison and Dickson's Kinetoscope peepshow viewer used a high-speed radial shutter for arresting its continuously moving frames rather than a Geissler tube, it's a fair assumption that its design was influenced by the Electro-Tachyscope.