

Mysterious Role of Code in the Formation of Pre-Pixels in the U.S.

An Essay for the Indianapolis Literary Club

by James William Brown¹

“Do you know anything about that wonderful invention of the day, called the Daguerreotype? . . . Think of a man sitting down in the sun and leaving his facsimile in all its full completion of outline and shadow, steadfast on a plate, at the end of a minute and a half! . . . It is not merely the likeness which is precious in such cases—but the association and the sense of nearness . . . the fact of the very shadow of the person lying there fixed forever!”

–From a letter of Elizabeth Barrett, the poet, to Mary Russell Mitford, the novelist, 1843 (Jensen 1998)



¹ The author acknowledges helpful suggestions from Maggie Hillery.

Introduction

What's a Pixel Anyway?

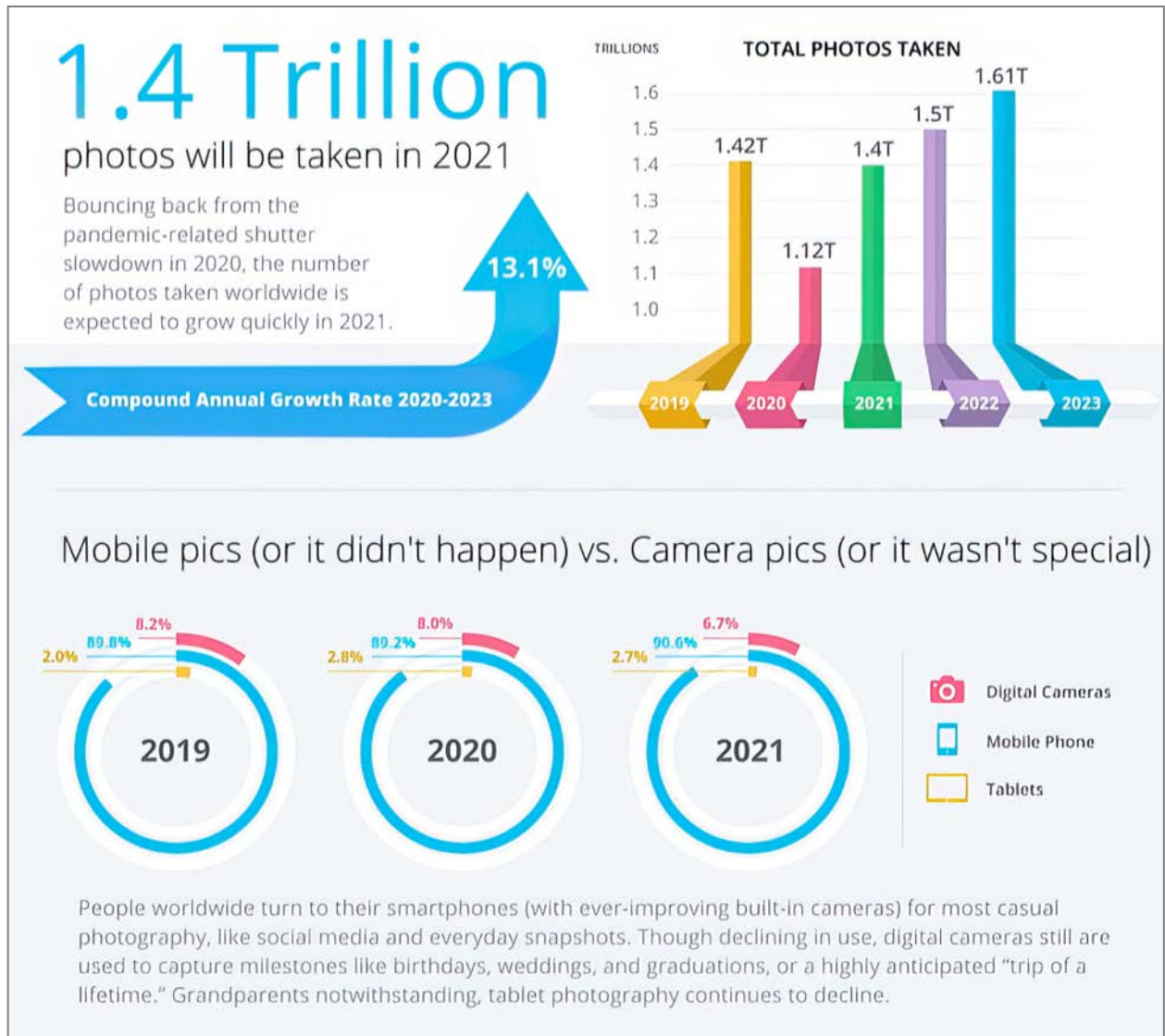
A pixel (abbreviation of picture element) is the smallest unit of a digital image or graphic. It is typically a small square or rectangle assigned a specific color value. Pixels are arranged in a grid pattern to form the complete image, and the density of pixels in the grid determines the resolution of the image. In simpler terms, a pixel is a tiny dot used to create an image on a digital screen.

Pixels are the fundamental units of digital elements. The pre-pixel era in the U.S. then comprises all image-making in the analog age, roughly from cave drawings to the late 1900s. Our concern in this essay will be with the developments in photography leading from experimenters and inventors to a massive industry providing both equipment and materials for visual communication.

Just as important as the role of technical innovation is the change of the practice of photography from skilled operators of complex processes to a process so simple that any person can make an image.

Image Statistics

An incomprehensible number of 1.6 trillion images are projected to be captured in 2023. Ninety percent will be taken with cell phones. Another 2.7 percent will be made with tablets. It is often said the best camera is the one you have with you, and for most of us it is the smart phone we have in our pocket. A Canon technical representative told me a few years ago that the market for their high-end cameras was no longer photojournalists as I had assumed. It is birders. High-end cameras suitable for sports photography are equally suited for photographing birds in flight.



1 Data Source: Rise Above Research, "2021 Worldwide Image Capture Forecast: 2020-2025" Copyright 2021 MYLIO Development, LLC

Did Steve Jobs and the Apple iPhone invent the smartphone features we rely on to today that have promulgated cell phones as the dominant camera?

Although Jobs was a marketing genius, the iPhone was not the first phone to incorporate a camera. The Sharp J-SHO4 launched in 2000 and included a camera. (Eagan 2917) Apple introduced the iPhone in 2007, and it made the concept of a smartphone, literally a computer with multiple functions, popular. That first iPhone had only a 2-megapixel rear-facing camera so

selfies were not yet possible. Now in 2023, the iPhone can make videos in which the focus may be shifted in a single shot in post-production software.



2 Zoe Snoeks, a 33-year-old Belgian woman, fell 100 feet to her death in 2021 in Luxembourg. The photo was made by her husband just before she fell.



3 Edgar Garay, 27, from Indiana, dies after falling from Puerto Rico cliff while filming a TikTok video.

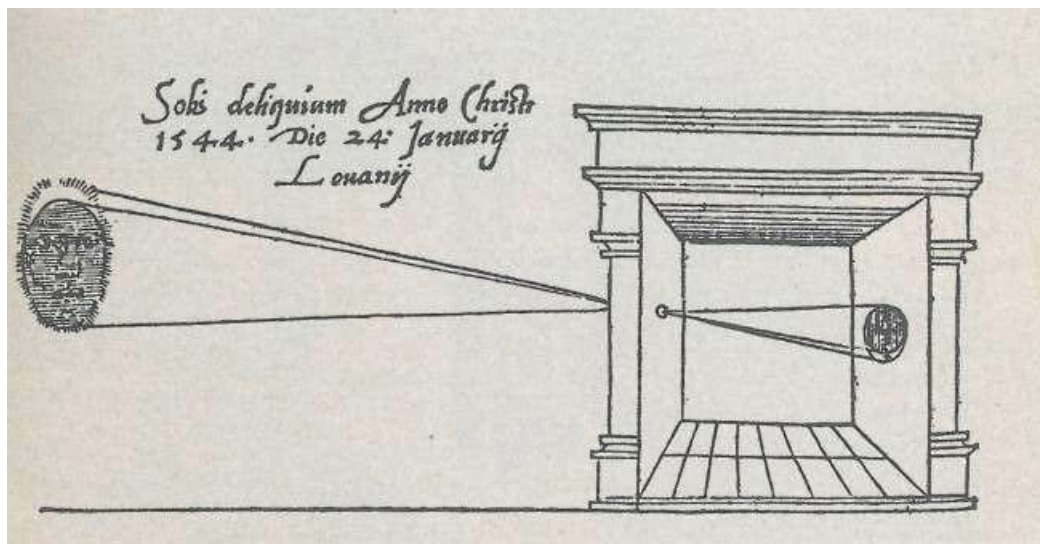
The shift of image-making from professionals to every person has generated the social media “selfie” that has become a public health problem. People use telescoping sticks holding a cell phone or simply pose for others to make pictures that will give them more “likes” in social media. In a global study from 2011 to 2017, 259 people died making pictures of themselves in risky places. Males accounted for 72.5 percent of selfie deaths. (Bansal, Garg et al. 2018)

Edgar Garay, 27, from Indiana, adds to the total. (Sottile 2023)

Pre-Photography History

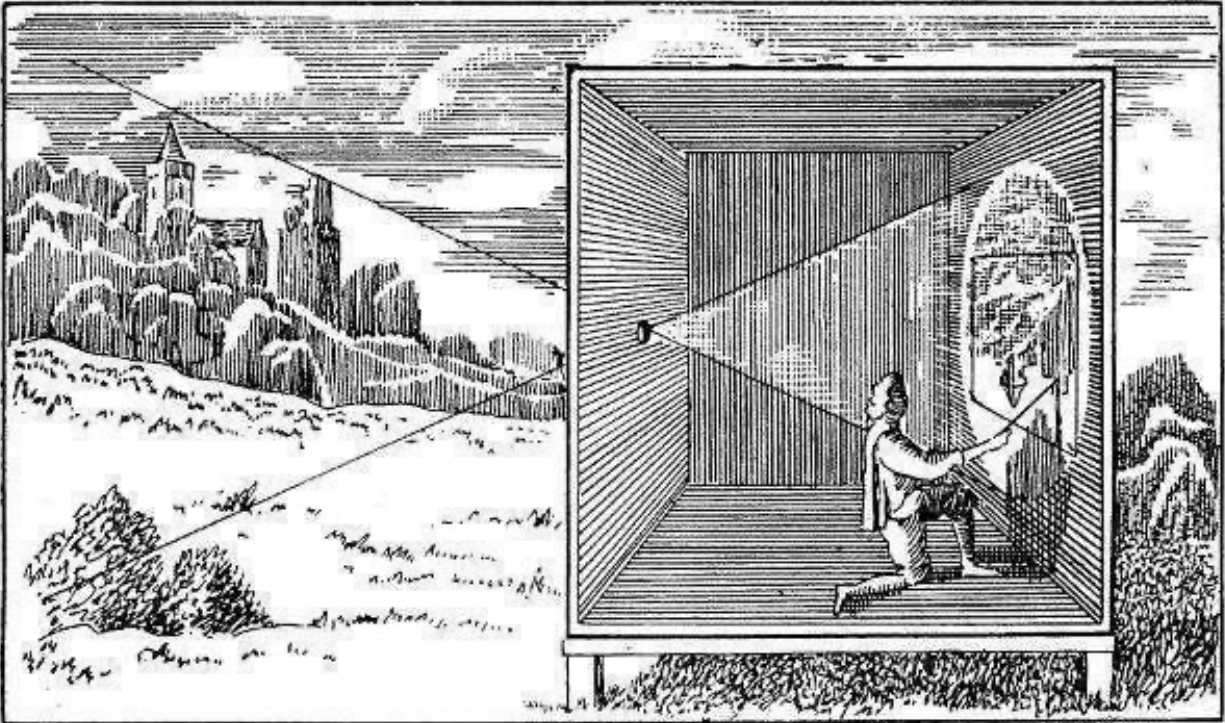
What technologies led to the development of the camera?

The camera obscura (from Latin meaning dark room) was developed centuries before the daguerreotype, the first practical process of photography. A pinhole allowing light into a darkened room projected an upside-down image of the outside world on the opposite wall. The first known illustration of a camera obscura was drawn in 1544.



4 First published illustration of a camera obscura, which is registering a solar eclipse of January 24, 1544. (Pollack 1969)

Camera obscuras were used as drawing aids. Artists drew using the projected image as a guide. Leonardo da Vinci had a drawing of a camera obscura in his notebooks.

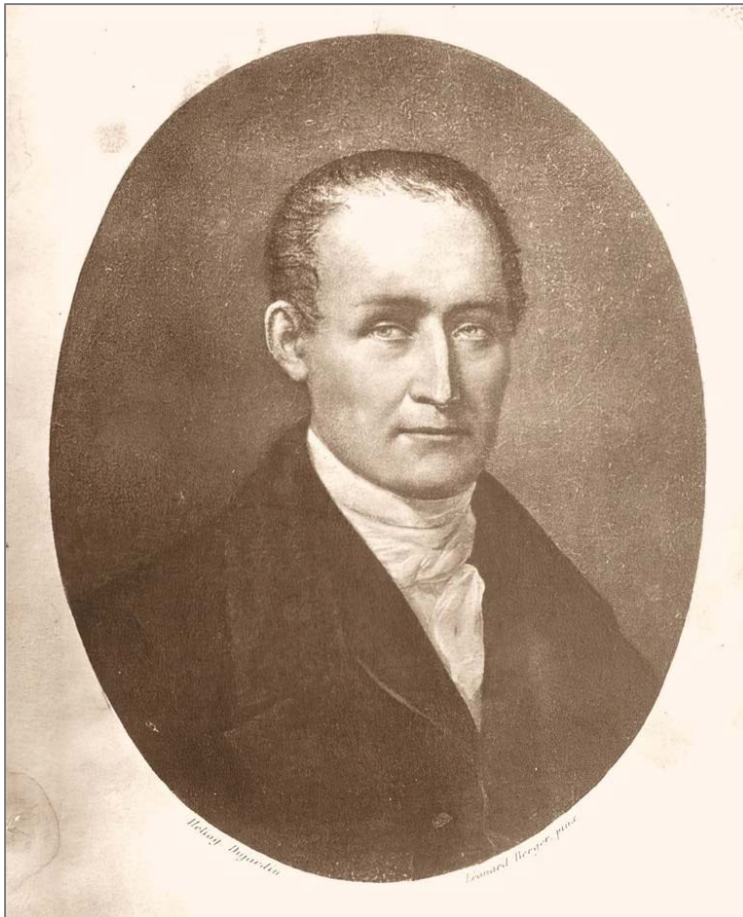


5 Illustration of an artist using a camera obscura as a drawing aid.

In the late 1800s, camera obscuras were means of entertainment. A rotating turret held the lens on the top of the camera obscura and an angled mirror projected an image of the outside world on a white table. As entertainment, perhaps it was just the novelty of the device. After all, the viewer could simply step outside the camera obscura and see exactly what the projected image showed. I have been inside the camera obscura at the University of North Carolina-Chapel Hill. I must admit it was a thrill to me, much less so to my wife.

Beyond drawing aids, the camera obscura when miniaturized was the foundation of the camera needed for the Daguerre process and those that followed.

Photography



6 *Joseph Nicéphore Niépce*

Joseph Nicéphore Niépce (1765-1823) was the first person to make a photographic image permanent. Consequently, it was Niépce who invented photography. Without realizing it, he had discovered the elements that Louis Jacque Mandé Daguerre (1787-1851) went on to perfect.

Alois Senefelder invented lithography in 1796. Artists could draw with a greasy crayon on thick, Bavarian limestone. Oil-based ink was applied to the dampened limestone. The ink adhered to the greasy drawing and was repelled by the wet limestone. Paper was applied,

under pressure, and a print was made. Copies could be made by repeating the inking process.

Niépce was concerned with improving the new and impressive lithography process. He used a sheet of tin and had his son draw images with a greasy crayon. Niépce made images using a camera obscura, which he called “points de vie.” He also made an engraving on paper transparent by oiling it and printed it by contact on his light-sensitive plate, which he called “copies de gravure.” He referred to the products of both processes as “heliographs,” which means “sun drawing.”

Niépce dissolved bitumen of Judea in lavender oil, a solvent that he coated on a sheet of tin. He had noticed that the bitumen coating was light sensitive and became less soluble with exposure to the sun. After exposure,



7 Cardinal d'Ambroise. Print pulled from a heliograph engraving made in 1826.

the unhardened coating could be dissolved and the plate could be etched with acid. The remaining coating served as an acid resist. (Pollack 1969)

Niépce improved his method by exposing the plate to iodine fumes, which he sometimes coated on glass to make a transparency. Apparently, it did not occur to him to make multiple copies of the image on glass. That discovery goes to Henry Fox Talbot who is credited with inventing camera negatives on sensitized paper. Multiple copies of Talbot's image could be made by contact with the dried, paper negative.

Daguerre had written Niépce inquiring about his research.

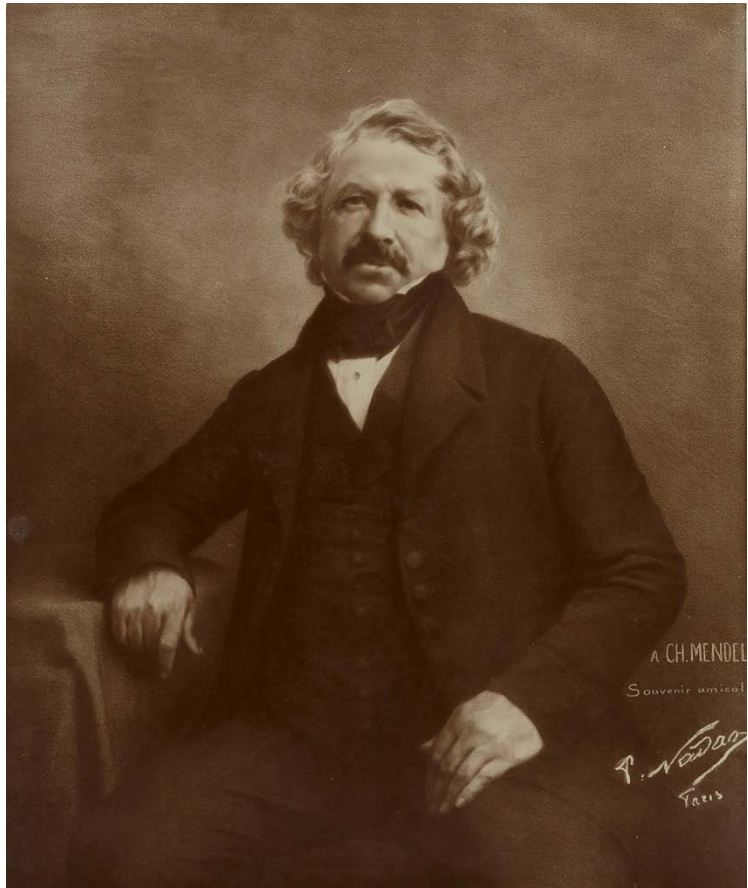
Niépce replied, warily, a year later. In 1829, they became partners in what Niépce hoped would improve the heliographic process. At first the partnership was uneven. Niépce had all of knowledge of what was known about photography. According to Peter Pollack,

“Niépce sent Daguerre a detailed description of his process, a note on heliography, completely explaining the preparation of silver, copper, or glass plates, the proportions of the various mixtures, the solvents used in developing the image, the washing and fixing procedures, and the application of his latest experiments with the heliograph — using iodine vapors to blacken the image.”(Pollack 1969)

Niépce died in 1833. It was Daguerre who continued his research and made Niépce's process work as practical photography.

The First Practical Photographic Process

The daguerreotype was a complicated process. A copper plate was coated with silver and polished. The polishing was an involved process. The plate was then exposed to iodine fumes. This formed silver iodide, a silver salt that is light sensitive. After exposure in the camera, the plate was exposed to mercury vapor. This formed a silver-mercury amalgam that brought out the image. The light-tagged silver iodide formed small seeds of metallic silver with which the mercury could bind. The unexposed silver iodide molecules were removed with sodium thiosulfate, commonly known as “hypo.” (Daguerre 1840)



8 Portrait of Daguerre, negative 1844; print about 1875–1890, by Paul Nadar (French, 1856 - 1939)

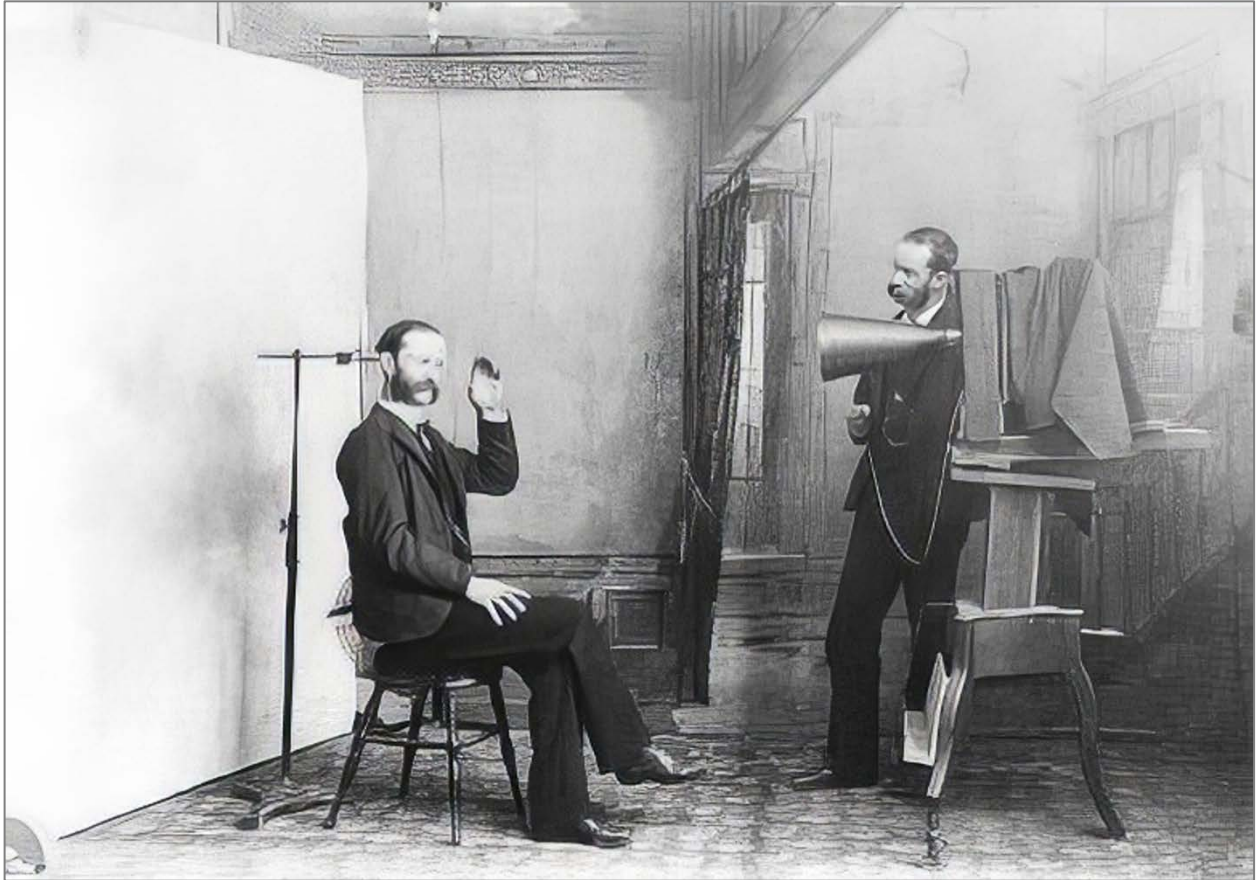


9 Daguerreotype in a protective case

The image was sensitive to the touch, so daguerreotypes were commonly put under glass in a frame, often with black velvet on the opposite side of the frame to reflect black into the image to enhance it.

This process was the beginning of photography as a means of recording portraits, events of importance and daily life.

Initial exposure times were long, so head clamps were attached to the backs of posing chairs to keep the head still during the exposure. The process was complicated so experienced photographers made images; it was not for the general population.



10 Exposure times were initially so long that clamps were used to hold the subject's head immobile.

The French government gave Daguerre and Niépce's son, Isidore, a lifetime pension and generously made the process public. The process diffused rapidly in Europe but not in Great Britain where Daguerre had taken out a patent.

Some thought the process was sacrilege. Man should not make images; only God should do so. Others thought God would have used a daguerreotype camera for a selfie if one had been available at Creation.

The quality of the images was spectacular. They were sharp and clearly defined. But there was one disadvantage other than the complicated process. The image was unique. That is, copies could not be made from a master.

Another important distinction of Daguerre's contribution over the work of Niépce was that Niépce was concerned with making copies of images that could be engraved and printed on paper. Daguerre, however, had invented a photograph, which could stand alone as a finished product. It was a new concept as described by François Brunet,

“Consequently the daguerreotype began a new logic of the image as an autonomous field of spectacle, without any relationship to the printed image, and closer to painting than to the *estampe* [print from an engraving].” (Brunet 2019)

Research on the chemical process of the daguerreotype continues in this century. In 2016, daguerreotype images were examined with an electron microscope to discover the relationship of the light-formed silver particles in forming an amalgam with mercury. (Ravines, Li et al. 2016)

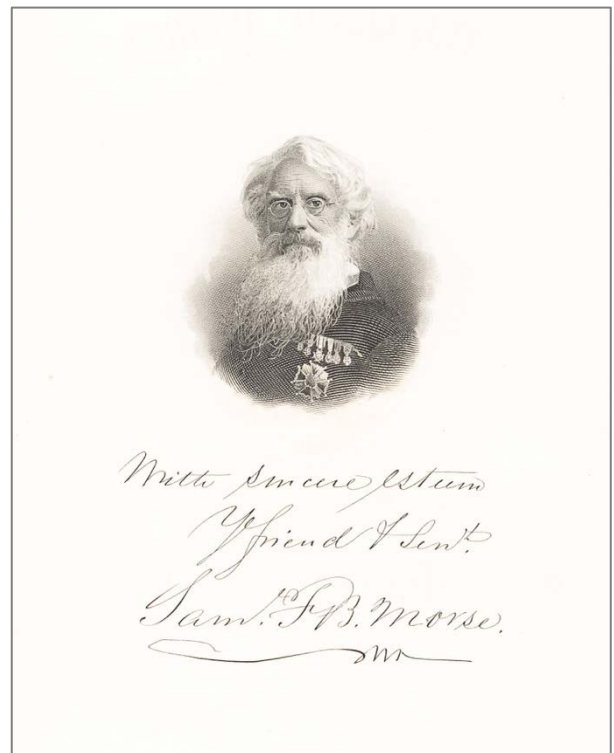
Diffusion of Daguerre's Photography Process to the United States

Here is an audible clue. Click on the icon below to play the file in “.wav” format



You will recognize the Morse code message “What hath God wrought?” sent by Samuel F. B. Morse on May 24, 1844, from Washington, D.C to Alfred Vail in Baltimore as the first telegraph message by wire.

Morse began his adult life as a portrait painter and achieved some success. He had grand ambitions to create paintings of historical importance having been influenced by his study at the Royal Academy of Arts in London. Morse



11 Samuel F. B. Morse

worked 14 hours a day for four months to create his “House of Representatives.”

The painting did not accurately portray the raucous discussion of The Slave Trade Act of 1820 and the Missouri Compromise of 1821. The House of Representatives was split into factions at that time, just as it is today. (Morse 1822)



12 House of Representatives by Samuel F. B. Morse, 1822

Morse was in France promoting the use of his telegraph apparatus. He wanted to see Daguerre because he had heard about his photo experiments and was concerned about competition for government funding. Daguerre also was a painter as Morse was.

Daguerre demonstrated his process to Morse who was fascinated by the process even describing the images as Rembrandt-perfected.

Daguerre told Morse that when the process was made public, he would let him know and he did. Morse wrote a letter to his brother, Sidney, describing the photographs Daguerre showed him including, “Boulevard du Temple, Eight o’Clock in the Morning.”



13 Boulevard du Temple, Eight o'Clock in the Morning.

Morse wrote about the photograph:

“Objects moving are not impressed. The Boulevard, so constantly filled with a moving throng of pedestrians and carriages, was perfectly solitary. Except an individual who was having his boots brushed. His feet were compelled, of course, to be stationary for some time, one being on the box of the boot-black, the other on the ground. Consequently, his boots and legs are well defined, but he is without body or head because these were in motion.” (Gillespie 2016)

Sidney Morse published his brother's letter in the *New-York Observer* on April 20, 1839. It was the first of a series of articles published on the daguerreotype process. Though not the first article on the process in America, it was the first firsthand account of the process in the United

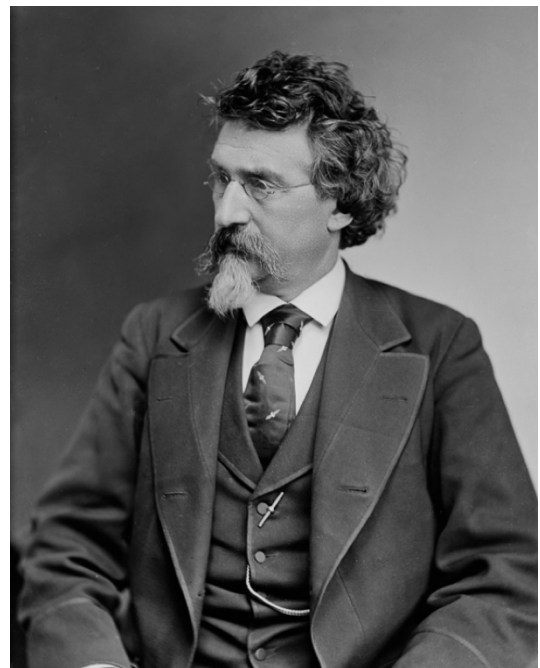
States. Sarah Gillespie in her book *The Early American Daguerreotype* writes about the distribution of Morse's account:

“It also appears to have been the most widely disseminated early account of daguerreotyping in America; within days it was reprinted in several other New York newspapers, in a Philadelphia paper, in a New Orleans paper, and in at least two Boston papers.” (Gillespie 2016)

Morse as brilliant as he was to merge technical advances and commercial opportunity, was plagued for the rest of his life by others' claims that he was not actually the inventor of the telegraph, a technology that revolutionized communication and played an instrumental role in the formation of The Associated Press. Although Morse had a lifetime of refuting claims on his invention of the telegraph, he claimed not to be the very first daguerreotypist in this country as a newspaper story suggested.

“If there is any merit in first producing these results in this country, that merit I believe belongs to Mr. D. W. Seager of this city, who for several days has had some results at Mr. Chilton's in Broadway. The specimen I showed you was my first result.” (Gillespie 2016)

Morse certainly made one of the first daguerreotype images in this country. He only practiced photography for about two years, due to various lawsuits surrounding his telegraph invention. In his practice of photography, he took in students. Important to the history of photography, one of those students was Mathew Brady, who managed the photographic documentary of the Civil War. Brady, and those who worked for him, produced wet-plate images of the war. Those images more than a hundred years later also launched the historic documentary career of Ken Burns. Burns' first documentary effort was a nine-episode series entitled *The Civil War*. When broadcast in 1990, 40 million people watched it on public



14 Mathew Brady, circa 1875

television. The series has won 40 major film and television awards, two Emmys and two Grammys. (Burns 1990) The series could not exist without Brady's documentary efforts.

Burns used motion camera techniques to add motion to Brady's still images to make them more interesting to a modern audience. By panning across a photo and zooming in or out, still photographs were enhanced in comparison with non-motion viewing. Although the techniques existed before Burns used them, Apple video-editing software, such as iMovie, calls these features for editing video the Ken Burns' effects.



15 Civil War photo tent and wagon necessary for making light-sensitive plates in the field.

The Brady photographs were made with the wet-plate process. The light-sensitive emulsion was coated on glass. The plate had to be coated in the field, exposed, and processed before the emulsion was completely dry. This necessitated photo tents and photo wagons for field photography.

Thus, Morse made a major impact on the diffusion of photography to this country as well as to the future history of photography through one of his students, Mathew Brady.

Because of the lengthy process involved, photographs by Brady and other photographerutters were

static in nature. "Death of a Rebel Sharpshooter" has been widely published and was made by Alexander Gardner, who had worked for Brady but started his own Civil War documentary.



16 *Camp of the 44th New York Infantry near Alexandria, Virginia. Photograph by Mathew Brady.*



17 *Rebel sharpshooter, Gettysburg. July 5, 1863. Photograph by Alexander Gardner. Gardner worked for Brady but started his own war documentary. On Nov. 19, same year, Gardner again visited this spot and found that the corpse had not been discovered by the burial squad.*

Basic Chemistry of Photography

Wet chemical processes were necessary for most of the almost 200-year history of photography. Digital photography obviated the need for chemistry. Most processes used one form or another of the silver halides: silver chloride, silver bromide or silver iodide (in order of light sensitivity from low to high).

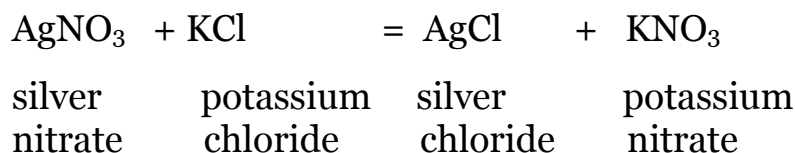
Learned men from the 18th and 19th centuries from all professions dabbled in chemistry as they sought to create something new. Much of modern chemistry was derived from this period. (Eaton 1965)

In 1727, Johann Heinrich Schulze tried to record images through stencils using coatings of chalk, silver, nitric acid. He discovered that silver chloride darkened when exposed to light. That discovery was the basis of most imaging processes prior to digital photography. A century later, another silver salt, silver iodide, was used by Louis Daguerre in the first practical process.

In 1802, Thomas Wedgwood and Humphrey Davy were trying to do what Schulze did. Paper coated with silver chloride was put in a camera obscura thus combining chemistry and optics. Non-permanent images were obtained. Rev. Joseph Bancroft Reade in 1837 discovered sodium thiosulfate could remove unexposed silver halides from the image-recording materials. Now images could achieve permanence and not continue to darken with further exposure to light.

Frederick Scott Archer created the wet-plate process by suspending silver chloride in nitrocellulose and coated it on a glass plate. The plate had to be exposed and processed while the coating was still damp.

For most photo chemical processes one or more of the silver halides must be suspended on a suitable substrate. So chemically how does this happen? Silver nitrate is combined with potassium chloride to form silver chloride (one of the light sensitive silver salts) and potassium nitrate.



In most photographic processes, the function of the developer is to reduce the light-tagged silver halides to metallic silver. Thus, in traditional wet-chemistry photography prominent in the 20th century, black and white negatives and prints were metallic silver on film or paper, respectively.

My Start in Photographic Chemistry

I was eased into what was to become a career by my father, Dr. George Earl Brown, who handed me a folding Kodak camera when I was about 10 years old. “Here,” he said, “you might have some fun taking pictures.”

Would this be more fun than shooting bullfrogs with my Red Ryder BB gun? I suspected not but over the next six months or so, I gave it a try.

Circa 1955, there were no one-hour photo processing labs; those peaked in the 1980s and are now virtually extinct.² Dad took the exposed film to his chemistry lab at Culver-Stockton College, mixed some chemistry from formulas in the appendix of the *Standard Handbook of Chemistry and Physics* and processed the film. The negative size was large enough for album-size prints and he made the prints by contact on a printer he had made. As a full-time professor and a part-time farmer to put bread on the table, he had scarce time to fuss with this. Eventually, he handed me the prints.

I was holding pictures I had shot in my hand. It was something akin to magic. I immediately asked Dad for another roll of film, which I completely exposed in the next 30 minutes. I removed the film from the camera and asked dad to immediately make the prints as if they were Polaroids, which had not yet been invented.

He could see that this new, immediate demand on his overworked schedule was not going to work for him. The solution was to teach me how to develop



18 The author's first camera given to him by his father.

² The demand for one-hour processing labs precipitously declined with the advent of digital photography and the publication of images on social media outlets.

film and make my own prints. He took me to the chem lab at the college and showed me how to use a balance to properly measure the chemicals for developer, stop bath and fixer used for processing Kodak Verichrome Pan film.

The only tricky part was the stop bath. Since developers were basic rather than acidic in nature, acetic acid was commonly used to arrest the development action in the film emulsion. Photo supply stores sold 28 percent acetic³ acid to be diluted down to 2 percent for use. Chemistry labs have glacial acetic acid (99.8 percent). So, the issue is how to you teach a 10-year-old boy how to safely mix down glacial acid to 28 percent? My dad made me repeat at least 150 times, “Always add acid to water, never add water to acid.” I got the concept after the third repetition but no matter, I continued with endless repetitions demanded by my father.

I held one end of the exposed film in each hand and dipped the bend at the bottom of a 1,000 ml beaker holding the developer. For 17 minutes at 68 degrees F, I seesawed the film in the solution. I not-so-fondly refer to this method of processing as the “Armstrong method.” It was torture for undeveloped biceps, but the result was worth it. The world as I saw it was in reverse as I held the processed film up to light. Light things in the scene were dark and darks were light.

Prints were made by contact by light passing through the negatives to photo paper. Dad had made the printer. The paper passed progressively through developer, stop bath, fixer and water wash and drying to pictures in my hands.

Now, I was the magician. I had done everything from exposure in the camera to finished print.

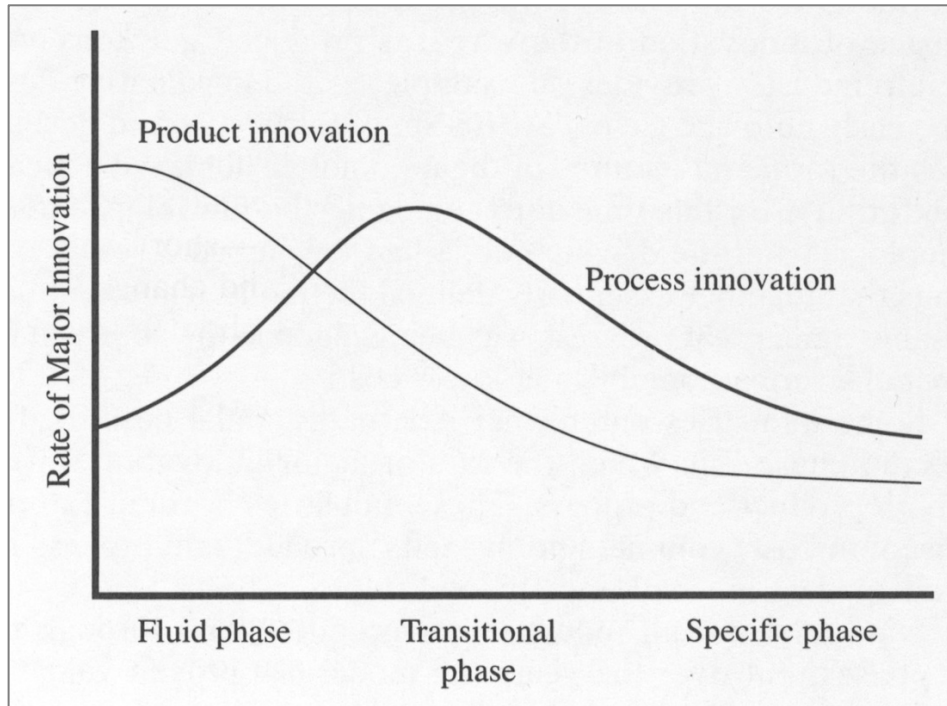
I was hooked.

I had the added benefit of a Ph.D. chemist as a father to guide me through my learning. He taught me the purpose and action of every chemical in the process that brought the latent image to metallic silver on film and paper.

³ Vinegar is 5 to 8 percent acetic acid.

Photographic Industry

James M. Utterback and William Abernathy developed a model of the dynamics of innovation in the late 1970s. They hypothesized that “the rate of major innovation for both products and processes follows a general pattern over time, and that product and process innovation share an important relationship.” (Utterback 1994)



19 From *"Mastering the Dynamics of Innovation by James M. Utterback.*

The rate of innovation is greatest in the formative years of an industry, characterized by competitors exploring product features. The Abernathy-Utterback model called this the fluid phase of a developing industry.

As winning product features emerge as winning ones, a transitional phase emerges focused on process. As this phase develops there is less focus on the product but more on the efficiencies of production.

As the industry matures there is less innovation in both product and process. Innovation often occurs in incremental steps.

As photographers began to practice photography there was a proliferation of incremental processes as the Abernathy-Model suggest.

The photo industry had a dramatic growth in the 19th century from the daguerreotype to Eastman Kodak's roll film on celluloid. Photographers graduating from highly technical operations to equipment and processes so simple that anyone could do it formed over the same period.



20 Kodak Brownie 2, marketed from 1901-1935.

There was a trajectory from complicated platemaking to light-sensitive emulsions on celluloid that came preloaded in Kodak cameras. The user just pressed the button to make pictures and sent the camera back to Kodak for film processing and printing. It couldn't have been simpler.

In Utterback's terms there were many waves of process innovation involving both the image capturing process itself as well as substrates for holding the images. In substrates, photography went from copper plates for the daguerreotype, to paper for the calotype, to glass for wet plate and dry plates, to celluloid for both sheet and roll film. This progression of substrate evolution is important so that camera design could be innovated but perhaps more importantly the flexible film base made motion pictures possible. When Thomas Edison asked George Eastman to make film for his motion picture experiments, Eastman already had produced light sensitive emulsions on a flexible film base. All he had to do to give Edison what he needed was to add sprocket holes on one edge to drive the film past the shutter to capture motion.

Equal to innovations in substrates were enhancements in the chemical processing of images. The daguerreotype was a relatively complicated process of platemaking followed by exposure to mercury fumes, which were not healthy. The wet-plate process made images on glass plates, but the process required that the plate be made in the field and exposed and processed before the light-sensitive coating had fully dried. This was the process that Mathew Brady, and those who worked for him, used in documenting the Civil War. Photo tents and photo wagons were used to coat the glass plates and process them in the field.

This was also the process that William Henry Jackson used to make 18" x 24" glass plates used to lobby Congress to establish Yellowstone as our first national park. Imagine carting those glass plates and processing chemicals before Interstate Highways were made to what is now Yellowstone.

Dry plates meant the plate did not have to be processed in the field. They could be processed at the photographer's convenience. The basic chemical processing remained the same right up to the conversion to digital photography, an all-electronic process requiring no chemistry.

Most of the innovation in process and substrate occurred in the 19th century. Innovation in color materials and instant materials, such as a Polaroid, occurred in the 20th century. Digital developments came about in the late 1900s and continue today.

I remember seeing a wallet-size digital print circa 1990. It was noticeably pixelated, meaning that the pixels comprising the picture were so big as to appear as a miniature checkerboard. I remember saying after seeing that print that digital photography would not be practical in my lifetime.

I was emphatically wrong!

Impact of Photography on Art

Photographic Light in Vermeer's Paintings

Johannes Vermeer (1631-1675) was a Dutch painter specializing in domestic interior scenes. What set him apart from all other painters was his subtle depiction of the play of light in his paintings. Indeed, his paintings were photographic in nature. Art historians have conjectured about his



21 The Music Lesson, Woman Seated at a Virginal by Johannes Vermeer. The painting was one of the few kept by Vermeer in his home until his death in 1675. It is now in Queen's (perhaps now King's) Gallery at Buckingham Palace in London.

methods but there is no definitive record of his methods.

Tim Jenison is an inventor and highly successful innovator in computer graphics. Above all, he is not an artist. He became obsessed with the light demonstrated in Vermeer's paintings. There were also some other distinctions in his paintings that mirror a photographic effect. For example, camera lenses have limited depth of field depending on the aperture used and the distance from the subject. In most photographs objects close to the camera and objects behind the subject of

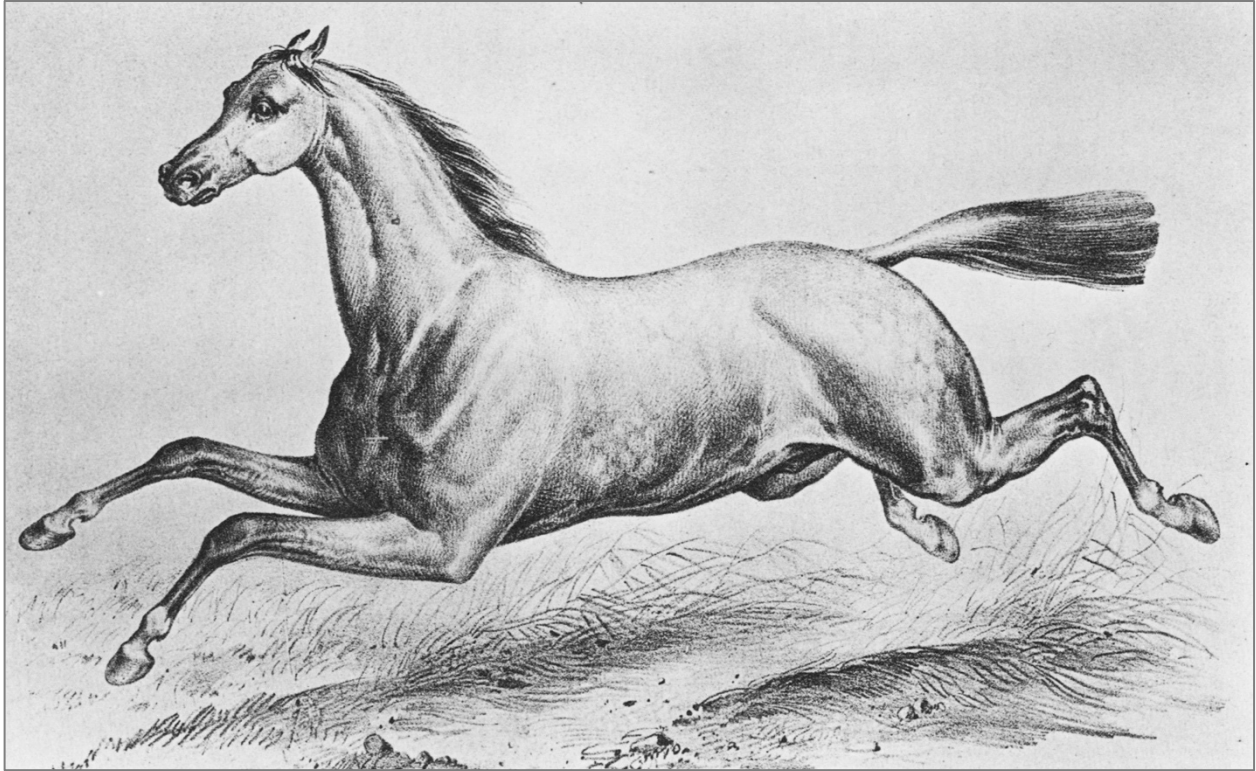
interest begin to be slightly out of focus. This is usually a very subtle change in sharpness of focus from front to back in the scene, with the subject being in the sharpest focus. Another clue was a diffuse, blueish, fringe around the

edge of some objects in the paintings, which Jenison reasoned was the painting of a chromatic aberration caused by some optical aid used in creating the paintings. Jenison hypothesized that Vermeer must have used some optical/mechanical device as an aid to his painting. The result of what became an obsession is the documentary “Tim’s Vermeer” narrated and produced by Penn Jillette and directed by Teller (he goes by a single name), known for the Penn and Teller magician act. (Teller 2013) Jenison built sets, populated by people as actors, and set about to discover how Vermeer might have achieved his marvelous light on canvas. He began with the pre-photography artist’s device, the camera obscura. All the materials used were made by materials and methods available to Vermeer. Jenison even ground his own lenses for the evolution of his device. He found that by introducing a magnifying mirror, like a modern shaving mirror, that he could eliminate the dark room. By positioning a small mirror and peering over the edge to his canvas, he could create a nearly exact representation of color and tone on his canvas. Jenison then used his instrument to painstakingly paint a scene in the style of Vermeer.

He did it. His finished painting looks just like a Vermeer.

The Question of Horses’ Legs

The influence of photography allowed the famous western artist Frederick Remington to be the first artist to accurately paint and sculpt horses in motion. Prior to Remington, painters incorrectly depicted horses’ legs as shown in Conventional Positions of Quadrupeds in Motion. (Jussim 1974)

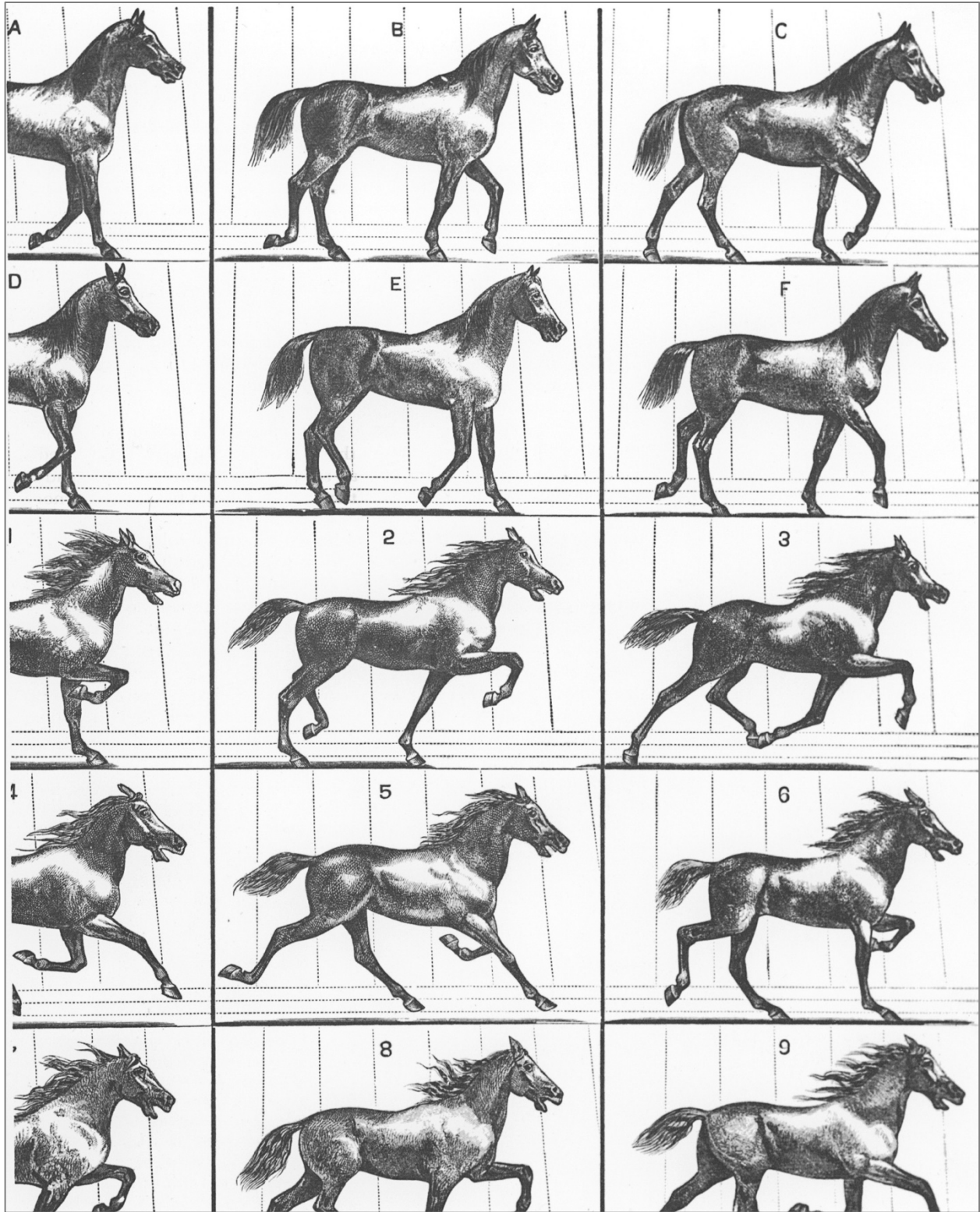


22 This illustration shows an example of incorrect position of a horse's legs.

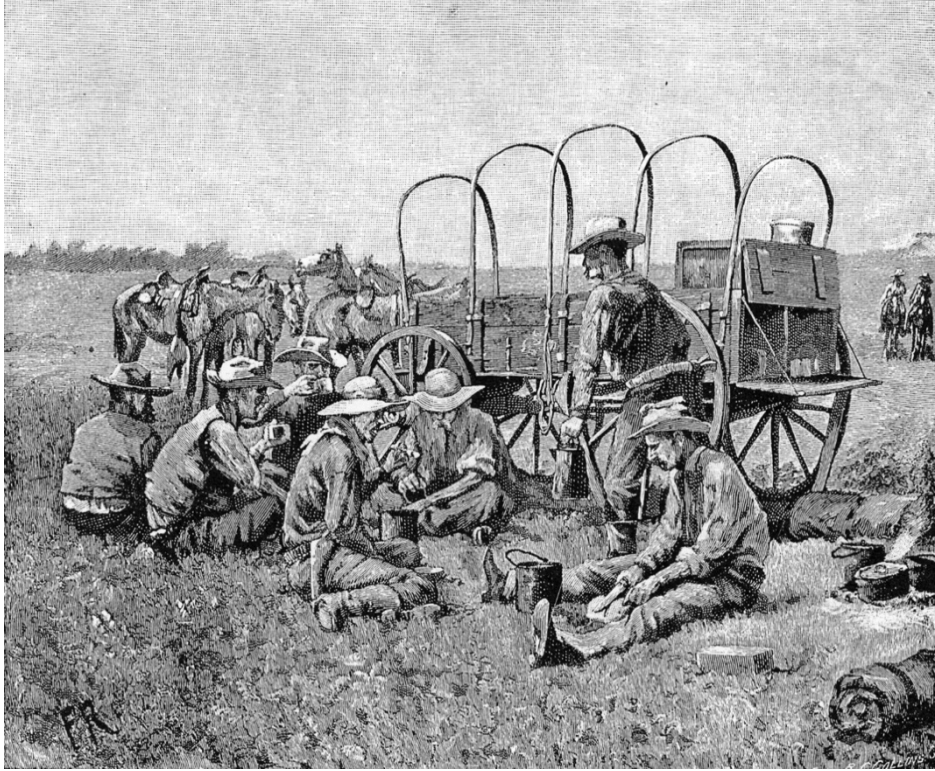
So how did Remington achieve his results?

Photography certainly came to the rescue in the form of Eadweard Muybridge's photographic motion studies. Both artists and scientists were pondering the question of the correct position of horses' legs at full gallop. Governor Leland Stanford of California commissioned Muybridge to provide the answer. He eventually developed a camera shutter with a $1/50$ second speed and used the wet-plate process for the exposures. He set up a long row of cameras, each with their own shutter. The shutters tripped as the running horse broke strings, much as runners did at the finish line of track meets before electronic finish lines were developed. The sequence of the still photographs captured positions of the horse's legs at various points in the gate heretofore unseen by human eyes.

Remington was an art student at Yale when Muybridge's motion study was published as a cover of *Scientific American*, October 19, 1878. (Jussim 1974)



23 Woodcut illustrations from Eadweard Muybridge's photographs of horses in motion published as a cover of *Scientific American* in 1878.



By all accounts Remington had a total devotion to football, less so with studying. Even so, according to Estelle Jussim, Remington would almost certainly have been exposed to Muybridge's work.

24 Woodcut from artwork by Frederick Remington based on a photograph by Theodore Roosevelt.

“It seems extremely unlikely that an art student at Yale University, no matter how devoted he was to rugged outdoor sports, especially an art student who was fascinated by his father's career in cavalry and in horse races, could have missed hearing about and seeing some news items about Muybridge's experiments, at least the front-page story in *Scientific American*, 1878. Yet there is no direct evidence that young Remington paid any attention to the ensuing furor, or was yet even aware of Muybridge's achievements.” (Jussim 1974)

We do know that Remington was known to draw and paint from photographs such as this piece based on a photograph by Theodore Roosevelt and converted to a woodcut for publication. (Jussim 1974)

In 1888, the year following publication of Muybridge's studies, Theodore Roosevelt wrote a series of articles illustrated by Remington. His horse's legs began to appear exactly as Muybridge photographed them. (Jussim 1974)

The indirect evidence suggests that Muybridge did indeed solve the artist's dilemma of how to draw horses in motion and that Remington was the first to do so.



25 Woodcut from Frederick Remington's art depicting horses' legs correctly after publication of Muybridge's horse motion photographs.

How Were Drawings, Photographs and Engravings Reproduced?

Drawings and paintings could not be reproduced for publication without some intervening step. Before Frederic Eugene Ives invented the halftone screen method in 1881, a new class of worker emerged whose job it was to convert an art product such as a painting to another form that could be reproduced in print. Common methods used woodcuts and metal engravings. (Sack 2020)



One novel use of photography was to both speed up the process of making woodcut translations of art but also to increase the visual resolution of the art on the printed page. Before the use of photography, woodcuts were relatively crude as shown by the illustration of Lady Geraldine⁴. (Jussim 1974)

26 Woodcut of Lady Geraldine showing relatively coarse resolution of common woodcuts.

⁴ Black-line wood engraving by W.K. Linton, Illustration by Hennessy.

A light sensitive emulsion coated on the end-grain boxwood commonly used for woodcuts revolutionized the process. A photograph could be printed and developed on the wood itself. The photograph was now a guide for the engraving of the wood. Now metal engravers tools, which are much finer than woodcut tools, could be used to cut through the image to wood resulting in much finer detail shown in *Modjeska as Juliet*.⁵ (Jussim 1974)

Think of the photograph as a graphic layer on the wood and you have the predecessor of Adobe Photoshop layers. A photograph may be brought into modern drawing programs as a guide for hand drawing on other layers.



27 Modjeska as Juliet. White-line wood engraving. Notice the near photographic resolution.

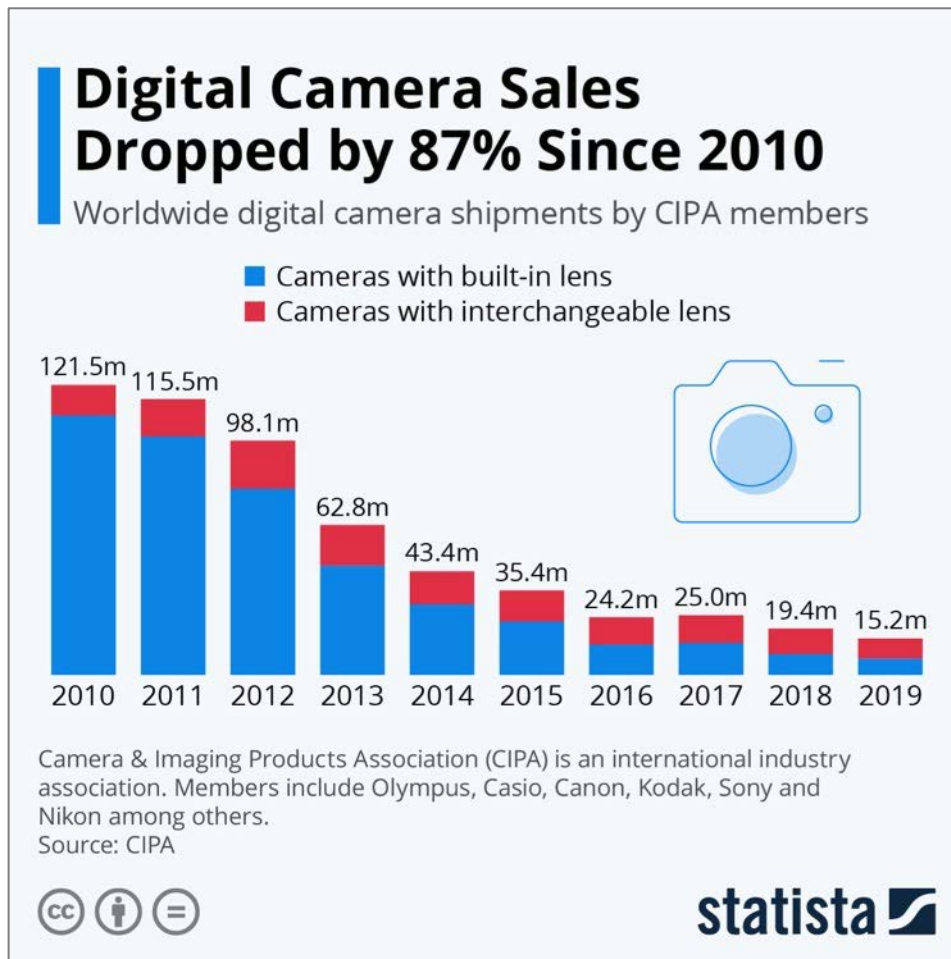
Photography enhanced artists' techniques and eventually became accepted as its own art form.

⁵ White-line wood engraving by Timothy Cole, from the photograph by Scholl.

Dramatic Changes in Technology

Is your film camera worthless?

Not exactly, art schools have continued to teach photography with film and wet chemistry. Freestyle Photo has been a continuous online supply of film and chemistry for the past 75 years. (Staff 2022) There is no question that the bulk of images made today are recorded digitally. However, film has always had a presence and there are indicators of increased use.



Digital Camera Sales have dropped 87 percent since 2010. Cameras with built-in lenses are small, point-and-shoot cameras that might be carried in a shirt pocket or purse and have declined dramatically. The decline is due to the growing sophistication of smart-phone cameras, which satisfy most consumers needs for cameras. It is often said that the best camera is the one you have with you and the smart phone is always present. About 90

percent of consumers have only taken pictures with their smart phones. (Lebendig 2022)

Kodak, after declaring bankruptcy in 2012, is hiring again. In filing bankruptcy, Kodak announced it intended to survive as “a lean, world-class, digital imaging and materials science company.” (Zhang 2012)

Now a decade later, Nagraj Bokinkere, Vice President of Film Manufacturing, is soliciting job applicants for analog processes.

“So, really our strategy of being the last company standing in color films, the last company making color films in both consumer and motion picture is paying dividends. We literally cannot keep up with demand, we need more employees. We’re hiring,” says Bokinere. “Our film finishing area for example we have grown from a five days a week, single shift operation a few years back. To last year, we were three shifts, five days a week and now we are a 24/7 operation. In the last 18 months, we’ve hired over 300 people across the film and chemicals floor, and we’re looking to hire more.” (Growcoot 2022)

Pentax is starting a new film camera project with what they see as a resurgence in demand for film. Consumers may be drawn to a new Pentax camera with the attendant repair service instead of relying on older used film cameras without available parts for potential repair. (Growcoot 2022)

Conclusion

There is no doubt that Samuel F. B. Morse transformed verbal communication through his telegraph and was a major factor in the diffusion of the daguerreotype into the United States. Photographic industries quickly formed satisfying the need for cameras and materials culminating in the once dominant Eastman Kodak company that made photography accessible to everyone. As important as he was to the evolution of both verbal and visual communication, he had a darker side to his being.

Morse believed that slavery was ordained by God through the Bible. (Morse 1863) As Kenneth Silverman wrote in his biography, Morse believed,

“God arranged society as a ‘*system of restraints*’ on man’s proud will. He instituted four relationships: civil government, marriage, parenthood, and servility. Each relation consists of a superior and an inferior party: ruler and ruled, husband and wife, parent and child, master and slave.”(Silverman 2003)

Morse was very much against the abolitionists and wrote papers arguing against immigration as well.

Beyond his racist faults, we must give credit to Morse for the diffusion of photography to the United States. With equal importance, his telegraph accelerated verbal communication to speeds unknown at the time. As such he became known as the “lightning man.” Communication between cities and continents became instantaneous.

Niépce and Daguerre invented photography, the evolution of which is so important to our lives today. But it was Morse who accelerated the diffusion of photography here.

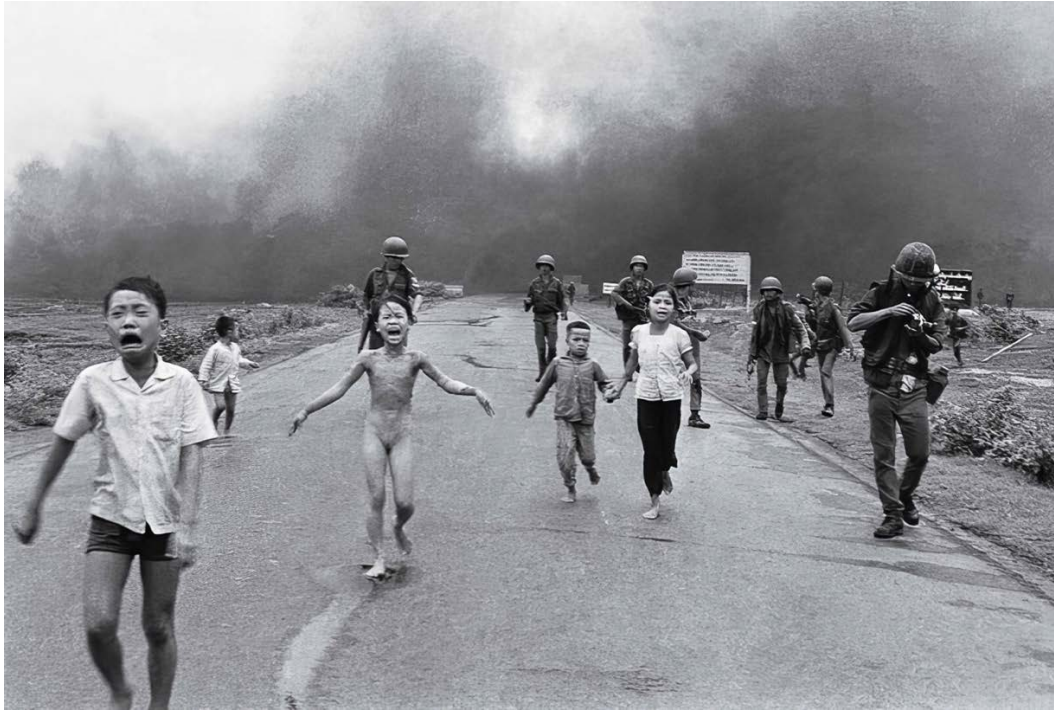
Photography, as a means of expression and communication, has led to career paths such as photojournalism, which may convey emotion well beyond the capability of words alone.



28 Picture from 9/11 of a man diving to his death to avoid being burned alive.

We recall with horror images from 9/11, 2001 such as this man who dove to his quick death rather than being burned alive.

Images from Viet Nam brought the war home to our borders through photographs such as these from Nick Ut and Eddie Adams.

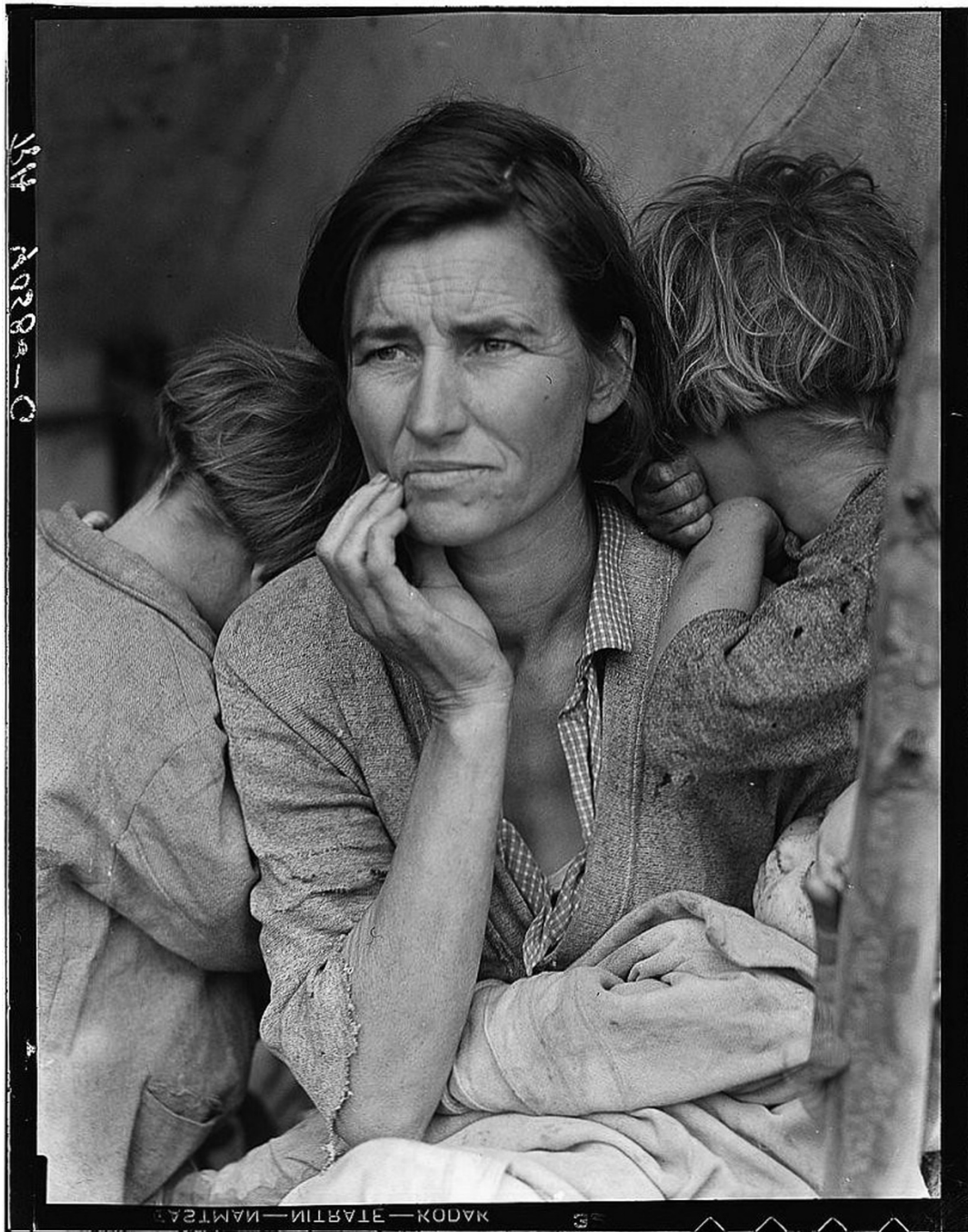


29 Photograph by Nick Ut, Viet Nam.



30 Photograph by Eddie Adams, Viet Nam.

The Farm Security Administration sponsored a documentary project on the post-depression years in the 1930s. Dorothea Lange made this iconic picture of Florence Thompson, a pea picker from California who had just sold the tires off the car to buy food for the day.



31 Photograph by Dorothea Lange from the Farm Security Administration Documentary.

Who can forget the pictures immediately before and after the Kennedy assassination?



32 Photograph of President Kennedy just before his assassination.

Photographers also bring us lasting images of the beauty of nature. Ansel Adams not only made stunning images but also invented a scientific system of using exposure and development manipulation known as the Zone System to previsualize tonality in a photographic print. *Moon Over Hernandez* is one of his most famous prints.



33 Moon Over Hernandez by Ansel Adams.

One of my favorite images was made at Boy Scout Camp Daniel Boone. The Scout Sign is up, meaning that all should be quiet. These boys are decidedly not conforming.



34 Scouts at Camp Daniel Boone.

Photojournalism has been my career.

Sending Morse code has little practical application today except in my hobby of amateur radio. When I fire up my ICOM 7300 transceiver and operate the key I used as a teenager, I often think of Morse and the history of the code I send and of the career he helped make possible.

ILLUSTRATIONS

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