From: PBS' "The Wizards of Photography", American Experience, written by David Lindsay
Wikipedia, the free encyclopedia.
"Photography: A Cultural History", Mary Warner Marien

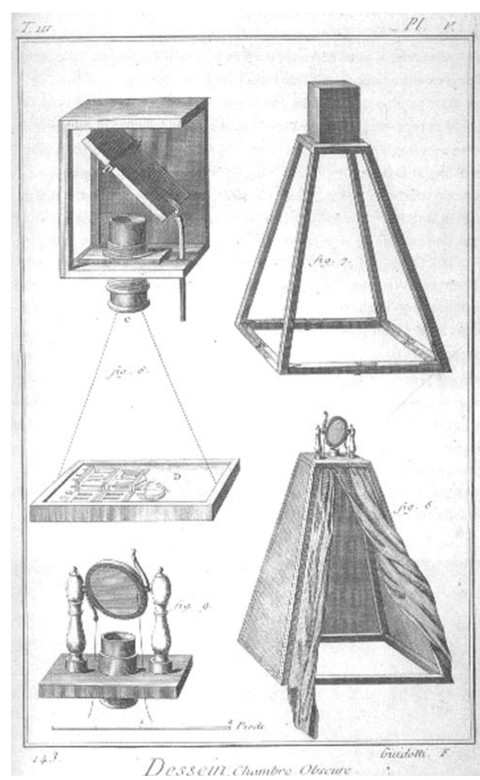
The dream of photography may be as old as the human eye, which, in processing colors and shapes for the brain, essentially does what a camera does. The first evidence of any kind of mechanical visual reproduction, however, comes from Saudi Arabia, where unknown caravan riders noticed, at a time now lost, that a hole in their tent projected the inverted image of a passing camel onto the opposite wall. In 989 A.D. the Arabian scholar Hassan ibn Hassan described this accidental invention and gave it a name: the camera obscura. The principle of the camera obscura had arrived in Europe by 1267, when the English philosopher-scientist Roger Bacon published his "Perspectiva" and "De Multiplicatione Specierum."

The Italian architect Giambattista della Porta is credited by some with inventing the first camera, although this is largely a matter of defining the word. As far is known, he built the first working camera obscura, which he used beginning in 1569 to project the images of unsuspecting guests into a special room for the delight of a few select spectators -- the first spy camera. Della Porta was also the first to suggest that artists could use a camera obscura to trace images onto a surface, and to use a concave mirror placed at a 45-degree angle, which rendered his subjects in their proper perspective.

Others followed fast on the heels of della Porta, including Robert Hooke of England, who designed a portable camera obscura that ended up in the hands of mathematician Johannes Kepler in 1600. By the 18th century, many painters were using the camera obscura, or variations on it, to capture the subtle nuances of the human form.

Camera obscura

The camera obscura (Lat. "dark chamber") was a novelty optical invention, and one of the ancestral threads leading to the invention of photography; photographic devices today are still known as "cameras".



Simply do it yourself by building a box and punching a hole in one of the walls - voilà! With a small enough aperture, light from only one part of a scene can strike any particular part of the back wall; the smaller the hole, the sharper the image on the back side. With this simple do-it-yourself apparatus, the image is always upside-down, although by using mirrors it is also possible to project a right-side-up image. Some camera obscuras have been built as tourist attractions, though few now survive. Examples can be found in Grahamstown in South Africa, Bristol in England, Aberystwyth and Portmeirion in Wales, Kirriemuir, Dumfries and Edinburgh, Scotland, and Santa Monica and San Francisco, California.

The principle of the camera obscura has been known since antiquity. Their potential as a drawing aid may have been familiar to artists by as early as the 15th century. Leonardo da Vinci described the camera obscura and it has been widely speculated that Johannes Vermeer made use of one, but the extent of their use by artists at this period remains a matter of considerable controversy.

Early models were large; comprising either a whole darkened room or a tent (as employed by Johannes Kepler). By the 18th century, following developments by Robert Boyle and Robert Hooke, more easily portable models became available. These were extensively used by amateur artists while on their travels, but they were also employed by professionals, including Paul Sandby, Canaletto and Joshua Reynolds, whose camera (disguised as a book) is now in the Science Museum (London). Such cameras were later adapted by Louis Daguerre and William Fox Talbot for creating the first photographs.

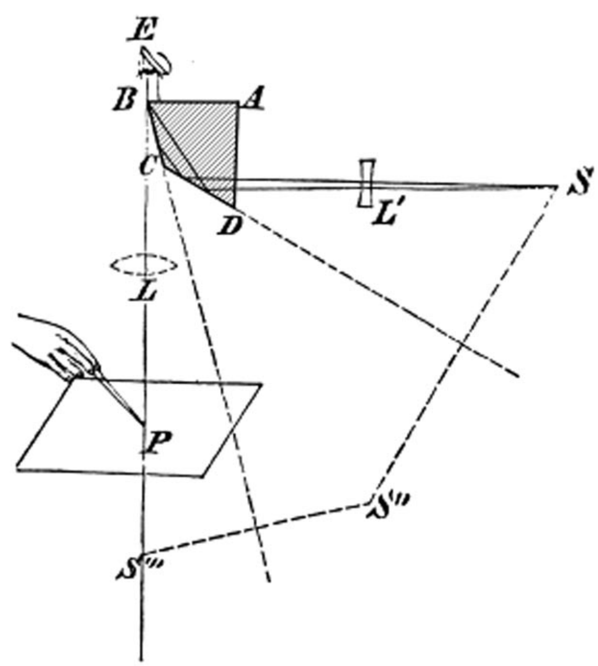
Camera lucida

A camera lucida is an optical device used as a drawing aid by artists. It was invented in 1807 by Dr. W. H. Wollaston. The camera lucida performs an optical superimposition of the subject being viewed and the surface on which the artist is drawing. The artist sees both scene and drawing surface simultaneously, as in a photographic double exposure. This allows the artist to transfer key points from the scene to the drawing surface, thus aiding in the accurate rendering of perspective. The artist can even trace the outlines of objects in the scene.

If white paper is used, the superimposition of the paper with the scene tends to wash out the scene, making it difficult to view. When working with a camera lucida it is beneficial to use black paper and to draw with a white pencil.

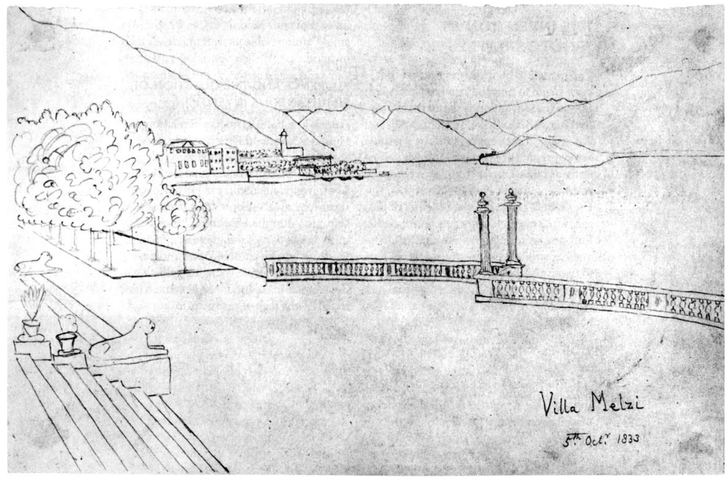
The camera lucida is still available today through art-supply channels, but is not well-known or widely used. As recently as a few decades ago it was, however, still a standard tool of microscopists. Until very recently, photomicrographs were expensive to reproduce. Furthermore, in many cases, a clear illustration of the structure that the microscopist wished to document was much easier to produce by drawing than by micrography. Thus, most routine histological and microanatomical illustrations in textbooks and research papers were camera lucida drawings rather than photomicrographs.

The name "camera lucida" (Latin for "lit room") is obviously intended to recall the much older drawing aid, the camera obscura (Latin for "dark room"). There is no optical similarity between the devices. The camera lucida is a light, portable device that does not require special lighting conditions. No image is projected by the camera lucida.



In the simplest form of camera lucida, the artist looks down at the drawing surface through a half-silvered mirror tilted at 45 degrees. This superimposes a direct view of the drawing surface beneath, and a reflected view of a scene horizontally in front of the artist. The instrument often includes a weak negative lens, creating a virtual image of the scene at about the same distance as the drawing surface, so that both can be viewed in good focus simultaneously.

The original Wollaston camera lucida, as shown in the diagram at right, uses an erecting prism. The direct and reflected scenes are superimposed by arranging the apparatus so that only half of the pupil of the eye E views through the prism, viewing the drawing surface P directly. The other half views an erect image of the subject reflected from two sides of prism ABCD. Lenses L and/or L' equalize the optical distances of the viewing surface and subject.



Fox Talbot, Camera Lucida Drawing of the Terrace at the Villa Medici, 5 Oct. 1833

While on honeymoon in Italy in 1833, the photographic pioneer William Fox Talbot used a camera lucida as a sketching aid. He later recorded that it was disappointment with his resulting efforts which encoraged him to seek a means to "cause these natural images to imprint themselves durably".

In 2001, artist David Hockney created a storm of controversy with his book “Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters”. In it, he suggests that great artists of the past, such as Ingres, Van Eyck, and Caravaggio did not work freehand, but were guided by optical devices, specifically an arrangment using a concave mirror to project real images. His evidence is based entirely on the characteristics of the paintings themselves. His work may arouse fresh interest in the use of optical devices as aids to draughtsmanship.

Fixing the latent image

The ability to fix an image onto a surface only began in earnest with the efforts of Josiah Wedgwood, a British manufacturer of porcelain and fine china.

In 1773 Wedgwood was commissioned by Catherine the Great to produce a line of china decorated with famous scenes from England. Using a camera obscura purchased in London through a friend, Wedgwood attempted -- and failed -- to burn these images into the plates. Josiah's son Thomas took up the cause from there. Thomas Wedgwood had studied the relation between heat and light at the University of Edinburgh but in 1797, finding this knowledge to be insufficient, turned to his friend Humphry Davy for help.

A native of Cornwall, Humphry Davy was a poet, chemist, and electrical pioneer who eventually rose to fame as a charismatic lecturer at London's Royal Institution. In 1799, when his greatest acclaim lay ahead of him, Davy attended the Pneumatic Institute, an organization in Clifton, England, founded by Dr. Thomas Beddoes and dedicated to exploring the effects of various gasses. While primarily a scientific undertaking, the Pneumatic Institute was also a favorite haunt of Romantic poets Robert Southey and Samuel Taylor Coleridge, who dropped in at times to take in the "airs."

Davy seems to have taken the Romantic impulse in stride. While at the Pneumatic Institute, he isolated nitrous oxide and looked upon it as something close to divine inspiration. He was known to alternate between large doses of nitrous oxide and wine, and at one point conspired with the steam-engine inventor James Watt to build a nitrous-oxide chamber, in which he could fully absorb this marvelous new vapor. Once, on emerging from his chamber, Davy exclaimed: "Nothing exists but thoughts. The universe is composed of impressions, ideas, pleasure and pain." Another time, he saw fit to compose an ode to nitrous oxide in the lofty style of the era:

> Yet are my eyes with sparkling lustre fill'd
> Yet is my mouth replete with murmuring sound
> Yet are my limbs with inward transports fill'd
> And clad with new-born mightiness around.

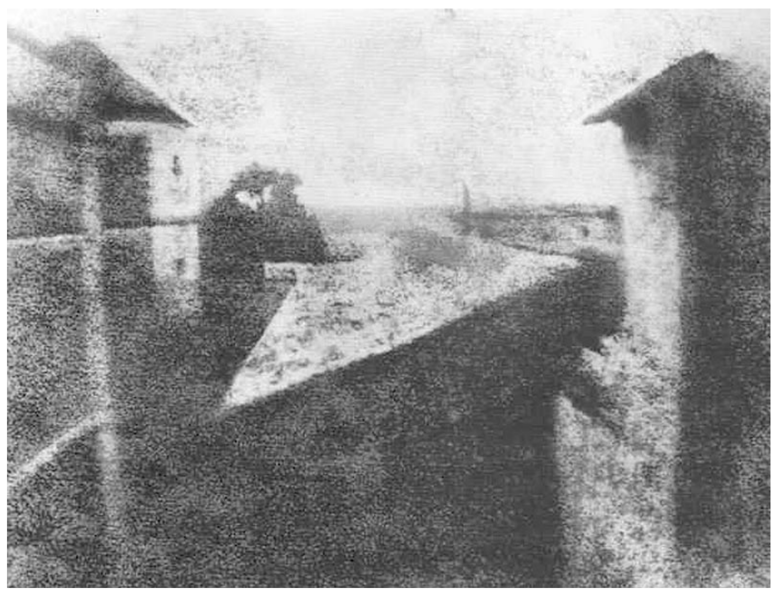
It was with this expansive soul that Wedgwood set about trying to make good on his father's promise. Together, Wedgwood and Davy coated insect wings and leaves with silver nitrate, laid them on various surfaces (paper, white leather and glass being favorites) that had been treated with chemical compounds, and then exposed the entire assemblage to the sun. These experiments did indeed bring about results, but the fixed images faded quickly -- much, one imagines, like the intoxicating mood around the Pneumatic Institute.

Niépce & Daguerre

Niépce

While credit for the invention of photography is highly contested -- and is bound to be for the foreseeable future -- there is no denying that Joseph Nicéphore Niépce and Louis J. M. Daguerre both played central roles.

The son of a Counselor to King Louis XVI of France, Niépce survived the French Revolution with his family fortune intact, which allowed him to pursue his interest in inventions. In 1816 he obtained a camera obscura and began taking images of landscapes on paper soaked in photosensitive silver chloride. At first, these images were blurry and faded to nothing after a day. When he began producing positive prints from the original plates, he was able to obtain longer-lasting images, but the results were still crude. A chance discussion in a shop where camera obscuras were sold then brought Niépce to the attention of Louis Daguerre.



Niépce's "View from the Window at Gras", 1826, Heliograph (8-hour)

Originally a specialist in trompe l'oeil effects (optical illusions), Daguerre was already famous in Paris for the sunlit stage he had painted in February 1822 for the Paris Opera's production of "Aladdin," and more so for his Diorama, a 350-seat theater at 4 rue Sanson that presented backlit images on a stage for the enjoyment of large audiences. Daguerre's profession naturally led him to be curious about Niépce's work, and by 1829 they were collaborating. Niépce and Daguerre generated images exposed by the sun on bitumen (AKA asphaltum, or, Bitumen of Judea), but Niépce never lived to see these joint efforts bear fruit. As it was, Daguerre, who continued after Niepce's death in 1833, met with success only by accident. In 1835 he placed his plates in a cabinet, not knowing that a container of mercury had a leak in it and was emitting vapor into the enclosed space, thus creating the first daguerreotype.

Daguerre

With his first successful picture in hand in 1837, Daguerre paraded his invention by cart through the streets of Paris, hoping to solicit licenses for its use. This approach achieved limited success, but in 1839 the eminent scientist Francois Arago promoted the process and the daguerreotype became a veritable sensation. Before the year was out, Daguerre's instruction booklet ran to 30 editions and was translated into eight languages. By 1845 Parisians were buying 2,000 cameras and three million plates a year.

Upon seeing his first daguerreotype, the painter Paul Delaroche declared, "From today painting is dead," and Samuel F. B. Morse, an accomplished painter as well as the inventor of the telegraph, apparently agreed. Morse happened to be in Paris just as the daguerreotype craze was blooming, and he arranged to meet Daguerre on March 2 and 9 of 1839. Looking through a microscope at Daguerre's plates, he was amazed to be able to read every letter of a street sign. It was, he said, "Rembrandt perfected." (In one of fate's cruel twists, Daguerre's Diorama was burning to the ground even as this meeting was going on.)

Back in New York, Morse set himself up as a daguerreotype instructor to pupils that came to include Matthew Brady, whose Civil War photographs achieved lasting fame, and Edward Anthony, who would go on to become one of George Eastman's first dry-plate clients. The daguerreotype thus began its American career on a respectable note. The aura of high art did not last long, however.

While Britain required licenses for the taking of daguerreotypes, America placed no such restrictions on the profession. In rural areas, a daguerrotypist could go so far as to pose as a magician before the unsuspecting villagers, "especially," writes photography historian Robert Taft, "if he had a smattering of phrenology." A long debunked science, phrenology espoused the doctrine that a person's character, as concealed in the brain, was revealed by the shape of the skull. By 1846 the twin crazes of phrenology and the daguerrotype had become so inextricably entwined that the journalist E. Littell could write:

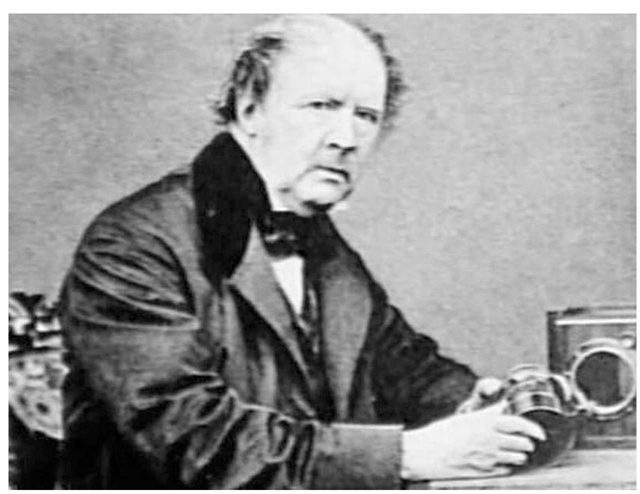
> Daguerreotypes properly regarded are the indices of human character. Lavater judged of men by their physiognomies; and in a voluminous treatise has developed the principles by which he was guided. The photograph, we consider to be the grand climacteric of the science.… It has been said that the inhalation of exhilarating gas is a powerful artificial agent for disclosing weaknesses of human nature. In reality, however, the sitting for a daguerreotype, far surpasses all other expedients.

In this sense, the daguerreotype invoked something vaguely evil. The "New York Sunday Courier," picked up this theme with "The Magnetic Daguerreotype," the story of a scientist who captures a woman's image by "electro-galvanic" means. From then on, the woman is haunted by the scientist's ability to see her innermost thoughts, even as he becomes plagued by her seemingly living portrait. The power to steal souls had been born.

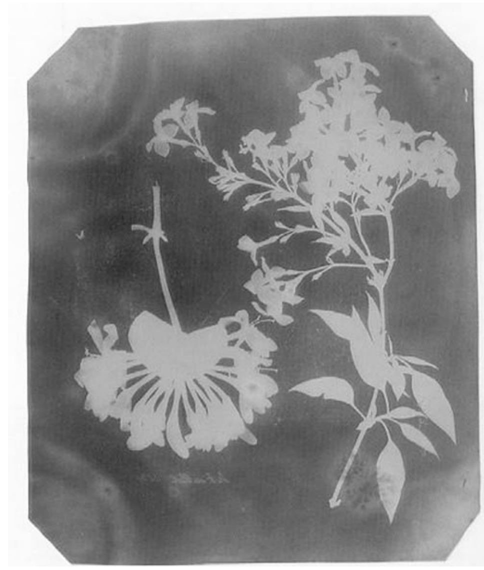
By 1841 New York City boasted 100 studios, each set up after the fashion of elegant parlors. By 1853 there were 37 parlors on Broadway alone, and on the banks of the Hudson, a town one mile south of Newburgh had been named Daguerreville.

Photography Becomes a Profession

When it was first introduced, the daguerreotype was a cumbersome prospect, requiring not only perfect stillness from the subject but tremendous patience from the photographer as he labored to bring the image to fruition. It didn't take long, however, for other innovators to begin making improvements on the technology.



Englishman William Henry Fox Talbot, for one, was fast on Louis Daguerre's trail. In 1833 Talbot attempted without success to sketch a scene at Lake Como using a variation on the camera obscura known as the camera lucida to project images from nature onto a tracing surface. "How charming it would be," Talbot later wrote, "if it were possible to cause these natural images to imprint themselves durably, and remain fixed on paper!" To that end, he applied himself, and by 1839 -- the year of Daguerre's success -- he was publicizing his own method. Two years later, he had improved on daguerreotype with the calotype, which could generate multiple positives from a single paper negative. For his discoveries, which are detailed in his “Pencil of Nature” (1844), he received in 1842 the Rumford medal of the Royal Society. In 1843-44, he set up his establishment in Baker Street, Reading where he remained for three years.

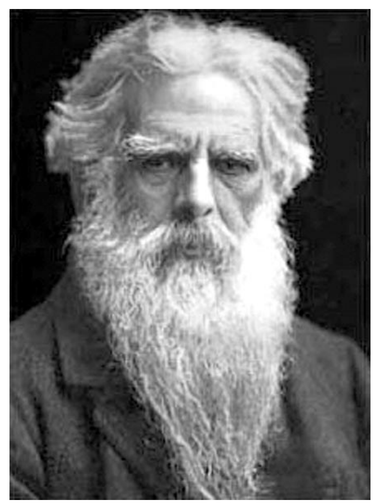


Talbot, Flower leves & stem, 1838

Another breakthrough came in 1854, with James Cutting's ambrotype: a thin collodion negative on a glass plate. The ambrotype, which yielded multiple positives while giving a clearer image than Talbot's calotype, was the first truly viable example of wet-plate photography. As the technology evolved further, it became possible to create paper positive prints from wet collodion glass plate negatives. This wet collodion process dominated photography from 1860s to the 1880s, and with it, photographers who once felt constrained by their equipment began to leave the studio in search of more exotic subjects.

In America, this meant a headlong rush toward the frontier, in a trend that came to be known as expeditionary photography. One of the most famous photographers from this era was Carlton E. Watkins of San Francisco, whose images of Yosemite won him international fame. Even more famous again, though ultimately for different reasons, was Watkins's pupil, Eadweard Muybridge.

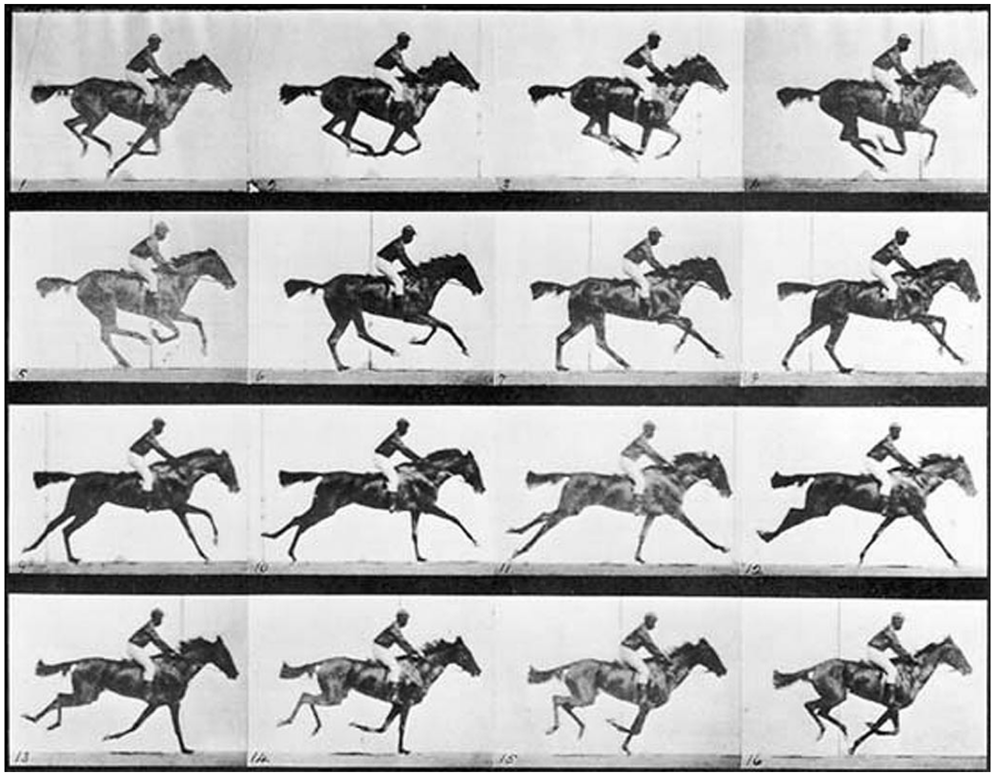
Muybridge & the germ of cinema



Born Edward Muggeridge on April 9, 1830, in Kingston-on-Thames, Muybridge sailed for America in 1852 on the scent of California gold and worked a string of obscure jobs until 1860, when he was injured in a stagecoach accident and had to return to England. By 1867 he was back in the States, studying with Watkins in San Francisco. Soon he was selling his photographs in sets of 20, for $20. Frustrated that exposures for the sky and the earth varied so greatly, he developed a method of painting clouds onto photographs -- his first invention.

Like Watkins, Muybridge was often in the wilderness. In 1867 he organized his own expedition to Yosemite Valley and captured the grandeur of El Capitan and the Bridal Veil Falls on whole plate negatives and stereoscopic slides. A year or so later he received a commission from the federal government to photograph the newly purchased Alaskan territory. In 1873 he photographed the Modoc Indian War, a gruesome conflict with the whites in which this tribe virtually perished from the face of the earth. The mid-70s saw him in Central America working under the "pseudonym" Eduardo Santiago Muybridge, documenting the cultivation of coffee, the ruins of great Mesoamerican cultures, and the local life of Mexico, Guatemala and Panama. Needless to say, all of the expeditions required tremendous physical endurance.

Muybridge was a capable expeditionary photographer, but if it hadn't been for his association with Leland Stanford, he probably would not be remembered today. In 1872 Stanford, the ex-Governor of California and an accomplished industrialist, hired Muybridge to settle a gentleman's wager: whether there was a moment when all four legs of a moving horse were in the air. In pursuit of the answer (which was yes), Muybridge developed a camera with a faster shutter speed, which not only captured a horse in motion but allowed him to use photography as a basis for the



study of living motion and, from there, to invent the zoopraxiscope: an early motion-picture device.

Meanwhile, the lure of expeditionary photography was making its mark back East as well. In 1877 the Grant administration was considering Hispaniola as a potential spot to build a new naval base. As a result, the property values spiked around Santo Domingo and land speculators took note.

One of these speculators was George Eastman, who was looking to expand his horizon beyond the Rochester Savings Bank where he worked. A fellow employee suggested that the best way to document his prospects would be with a camera. In the end, the voyage never materialized, but Eastman found his vocation. "In making ready," he later said, "I became totally absorbed with photography."

The collodion process

The collodion process is an early photographic process which gave way in the late 19th century to today's gelatin emulsion process. It was invented by Frederick Scott Archer in 1848 and developed further by others.

The original idea

In 1864 W. B. Bolton and B. J. Sayce published the germ of a process which revolutionized photographic manipulations. In the ordinary collodion process of Scott Archer, a sensitive film is procured by coating a glass plate with collodion containing the iodide and bromide of some soluble salt, and then, when set, immersing it in a solution of silver nitrate in order to form silver iodide and silver bromide in the film.

The question that presented itself to Bolton and Sayce was whether it might not be possible to get the sensitive salts of silver formed in the collodion whilst liquid, and a sensitive film given to a plate by merely letting this collodion, containing the salts in suspension, flow over the glass plate. Gaudin had attempted to do this with silver chloride, and later G. W. Simpson had succeeded in perfecting a printing process with collodion containing silver chloride, citric acid and silver nitrate; but the chloride until recently has been considered a slow working salt, and nearly incapable of development.

Up to the time of W. B. Bolton and B. J. Sayce's experiments silver iodide had been considered the staple of a sensitive film on which to take negatives; and though bromide had been used by others, it had not met with so much favour as to lead to the omission of the iodide. At the date mentioned the suspension of silver iodide in collodion was not thought practicable, and the inventors of the process turned their attention to silver bromide, which they found could be secured in such a fine state of division that it remained suspended for a considerable time in collodion, and even when precipitated could be resuspended by simple agitation.

The basic method

The outline of the method was to dissolve a soluble bromide in plain collodion, and add to it drop by drop an alcoholic solution of silver nitrate, the latter being in excess or defect, according to the will of the operator. To prepare a sensitive surface the collodion containing the emulsified sensitive salt was poured over a glass plate, allowed to set, and washed till all the soluble salts resulting from the double decomposition of the soluble bromide and the silver nitrate, together with the unaltered soluble bromide or silver nitrate, were removed, when the film was exposed wet, or allowed to dry and then exposed.

The rapidity of these plates was not in any way remarkable, but the process had the great advantage of doing away with the sensitizing nitrate of silver bath, and thus avoiding a tiresome operation. The plates were developed by the alkaline method, and gave images which, if not primarily dense enough, could be intensified by the application of pyrogallic acid and silver nitrate as in the wet collodion process. Such was the crude germ of a method which was destined to effect a complete change in the aspect of photographic negative taking; but for some time it lay dormant. In fact there was at first much to discourage trial of it, since the plates often became veiled on development.

The collodion process becomes widely adopted

M. Carey Lea of Philadelphia, and W. Cooper, jr., of Reading, may be said to have given the real impetus to the method. Carey Lea, by introducing an acid into the emulsion, established a practicable collodion emulsion process, which was rapid and at the same time gave negative pictures free from veil. To secure the rapidity Carey Lea employed a fair excess of silver nitrate, and Colonel H. Stuart Wortley gained further rapidity by a still greater increase of it; the free use of acid was the only means by which this could be effected without hopelessly spoiling the emulsion.

The addition of the mineral acids such as Carey Lea employed is to prevent the formation of (or to destroy when formed) any silver sub-bromide or oxide, either of which acts as a nucleus on which development can take place. Abney first showed the theoretical effect of acids on the stib-bromide, as also the effect of oxidizing agents on both the above compounds. A more valuable modification was introduced in 1874 by W. B. Bolton, one of the originators of the process, who allowed the ether and the alcohol of the collodion to evaporate, and then washed away all the soluble salts from the gelatinous mass formed of pyroxylin and sensitive salt.

After washing for a considerable time, the pellicle was dried naturally or washed with alcohol, and then the pyroxylin redissolved in ether and alcohol, leaving an emulsion of silver bromide, silver chloride or silver iodide, or mixtures of all suspended in collodion. In this state the plate could be coated and dried at once for exposure. Sometimes, in fact generally, preservatives were used, as in the case of dry plates with the bath, in order to prevent the atmosphere from rendering the surface of the film spotty or insensitive on development. This modification had the great advantage of allowing a large quantity of sensitive salt to be prepared of precisely the same value as to rapidity of action and quality of film.

A great advance in the use of the collodion bromide process was made by Colonel Stuart Wortley, who in June 1873 made known the powerful nature of a strongly alkaline developer as opposed to the weak one which up to that time had usually been employed for a collodion emulsion plate, or indeed for any dry plate.