The History of Photography

CAMERA OBSCURA

The ancient principle of the camera is child's play. Hard to believe? Here is a simple experiment you can try at home: Cover the windows of a room with black construction paper or aluminum foil until absolutely no light is let in. Turn out the lights. Then poke a tiny hole in the paper or foil, so that a single pinprick of light enters the room and strikes the wall opposite the windows. What do you see?

If you do it just right, when the light enters the "dark room" *(camera obscura* in Latin) and hits the wall, it will form a faint upside-down image of the view outside the window. This simple phenomenon is the basis upon which the science of photography is built.

One of the first people to make note of such an image was a Chinese scholar Mo Ti, who lived in the 5th century B.C. In the 10th century A.D., Arab physicist Alhazen discovered that the smaller he made the hole, the sharper the image came into focus. If the hole was tiny enough, the image became very clear.

THROUGH THE LOOKING GLASS

Reproducing the image created by a camera obscura was easy: you simply held a piece of paper up against the wall, so that the image landed on the paper, then traced it. The camera obscura became a useful scientific tool. Scientists built special "dark rooms" for the sole purpose of studying the sky, eclipses, changes in the seasons, and other natural events. The tracings made with the aid of the camera obscuras were so detailed and accurate that by the 1500s, people were using them to paint portraits, landscapes, and other scenes.

In 1568 a professor at the University of Padua named Daniello Barbara discovered that replacing the primitive pinhole with a glass lens brought the camera obscura image into a brighter and sharper focus.

In the 17th century, scientists and artists developed portable camera obscuras that allowed them to study objects in the field. Early versions were essentially lightproof tents with lenses sewn into the walls. Later versions were two-foot-long wooden boxes that projected an image onto a piece of frosted glass built into the lid. The user could then trace the image by placing a piece of paper over the glass.

PUTTING THINGS IN PERSPECTIVE

The images created by these early single-lens camera obscuras were circular in shape, with distortion along the edges. In the 1700s, a complex multilens system was introduced that corrected the distortion, and the camera obscura became as common a part of the painter's art as brushes and paint.

Artists were not the only ones putting the camera to use—explorers took them on expeditions all over the world so that they could record the wonders they encountered. In the process, the boxes literally changed the way people saw the world.

IMAGE PROBLEMS

For all of these improvements, there was still no way to *capture* the camera obscura's image other than by manually tracing it. There it was, tantalizingly projected onto a wall or a pane of frosted glass. You could look at it; you could reach out and touch it. But capturing the actual image was as impossible as capturing one's own shadow. It would remain so for another 75 years...until the invention of film.

SPIRITS IN THE MATERIAL WORLD

In 1674 an alchemist named Christoph Adolph Balduin performed a chemistry experiment that he hoped would help him isolate the mysterious natural force he called the "universal spirit." He dissolved some chalk (calcium carbonate) in nitric acid to create a sludgy substance that would easily absorb moisture from the atmosphere. Balduin believed that if he could distill the moisture from the sludge, he would capture the universal spirit in pure form.

Balduin did not know much about chemistry, and not many 17th-century alchemists did. When he distilled the sludge, all he got was water. However, he noticed that when he heated the dried-out crud that was left over, it glowed in the dark. He named this mysterious substance *phosphorus,* Greek for "bringer of light," (today it is called calcium nitrate).

What did this have to do with photography? Nothing... until a German anatomy professor named Johann Heinrich Schulze tried to repeat Balduin's experiment in 1727. By chance he used nitric acid that contained traces of silver. He left the chalk-acid mixture out in the sun; by the time he came back to it, it had turned a deep purple.

MESSAGE IN A BOTTLE

Schulze was not the first person to observe that substances containing silver salts turn dark when exposed to the sun. However, it had always been assumed the reaction was caused by the heat. Schulze suspected that light was to blame and came up with an experiment to test his theory: He cut a stencil of some words on a piece of paper. He put the stencil on the side of a glass bottle and covered the rest of the glass with dark material. He filled the bottle with the chalk dissolved in nitric acid and left it out in the sun, to see if the sunlight would "write" the stenciled words onto the material.

"It was not long," he wrote later, "before the sun's rays, where they hit the glass through the cut-out parts of the paper, wrote each word on the chalk precipitate so exactly and distinctly that many who were curious about the experiment took occasion to attribute the thing to some sort of trick." In a nod to Balduin, Schulze called the material *scotophorus,* or "bringer of darkness."

Schulze did not understand why the substance turned dark, but today we do: When light strikes photosensitive silver crystals, some of the atoms of silver separate out from the compound. Exactly how many atoms separate depends on how much light strikes the material. With enough light, however, the silver will become visible to the naked eye, and the material becomes dark. This is the chemical principle upon which all film photography would be based.

Schulze could not figure out how to control the reaction—the silver salts darkened every time they were exposed to light, obliterating whatever writing or image had been created. As far as he could tell, the material had no use, but it was still interesting, and as word of his discovery spread, scientists all over Europe repeated the experiment.

PAPERWORK

One man who learned of Schulze's experiment was Thomas Wedgwood, son of the legendary English potter Josiah Wedgwood. Wedgwood thought he could use the process to make duplicates of artwork for his pottery.

He started out by soaking pieces of paper in a solution of silver nitrate to make them photosensitive (sensitive to light). He then laid his sketches on top of these materials and put them out in the sun. The sunlight would shine through the sketch where the paper was blank, but would be blocked where there was ink, creating a reverse, or "negative," image of the original sketch. The experiment worked. Wedgwood became the first person in history to transfer an image onto photosensitive paper.

Wedgwood might have become the father of photography, but his health was so poor that he had to abandon his research before could reach his next goal: recording the image created by a camera obscura. And like Schulze, he died without figuring out how to arrest the photosensitive reaction so that his images would be made permanent. Even when viewed by candlelight, it was just a matter of time before they disappeared into darkness forever.

FIXING THE PROBLEM

The next major contributor to the chemistry of photography was a 19th-century French physicist named Joseph-Nicephore Niepce.

Niepce was looking for a way to copy artwork automatically, to avoid having to pay artists to do it. He repeated the experiments of Schulze and Wedgwood and searched for chemicals that would give, him positive images, but finally, after years of failed experiments, gave up on chemicals that change color and started looking for chemicals that harden when exposed to light. That is when his luck began to change.

Having worked as a printer, Niepce was familiar with "bitumen of Judea," an asphalt compound dating back to the Egyptians and commonly used by lithographers. He knew that when bitumen of Judea was exposed to sunlight, it hardened to the point that solvents would no longer dissolve it. Therefore, he smeared a metal printing plate with the stuff, placed an ink drawing on top of the plate, and left them both out in the sun. Just as he expected, the sunlight passed through the blank paper, striking the bitumen of Judea underneath and causing it to harden.

But where the sunlight was blocked by the ink, the bitumen of Judea remained soft and could be washed away with solvents. The result was a perfect copy of the original drawing. Niepce named the process *heliography,* after *helios,* the Greek word for "sun," and *graphos*, "writing."

THE NEXT LEVEL

Taking his discovery to the next step, one sunny morning in 1827, Niepce smeared some bitumen of Judea onto a printing plate and put it inside a camera obscura. Then he pointed the camera obscura out of an upstairs window of his country home and left it there for most of the day. In the process, he took what historians consider the world's first true photograph.

YOU HAVE TO START SOMEWHERE

The world's first photograph, the one that Joseph Niepce took in 1827, survives to this day. There is a picture of it in just about every book on the history of photography, but it is almost impossible to make out anything that's in it. If there was not a caption next to it identifying the objects in the scene (a courtyard, a pigeon loft, and the roofs of some buildings), you would never be able to guess what they are.

Clearly, Niepce's heliographic process was flawed. For one thing, the light-sensitive medium he used, bitumen of Judea, was very slow to react, which meant that long exposure times were required to take pictures. Very long exposure times: That first picture required an exposure of more than eight hours, during which time the sun moved most of the way across the sky. So did the shadows, obscuring much of the picture's detail.

Additionally, the sloppy way Niepce smeared bitumen of Judea on his metal plates made the resulting image even blotchier and harder to make out than it would have been otherwise.

ENTER DAGUERRE

Niepce could not solve these problems himself, so he joined forces with a Parisian theater owner named Louis Daguerre, who was also experimenting with photography. Daguerre's motivation: he thought that photography, if it were perfected, could be used to create better scenery for the theater.

In 1829 the two men signed an agreement to work together for 10 years, but unfortunately Niepce died from a stroke 4 years into the partnership. Daguerre tried to continue the work with Niepce's son Isidore, but Isidore was convinced that if he contributed anything, Daguerre would take credit for it, so he refused to do any research on his own.

SERENDIPITY

Daguerre soldiered on by himself, and in 1835 made an amazing — and accidental — discovery. One sunny morning, the story goes, Daguerre polished a silvered copper plate and placed it in a box containing iodine. The iodine combined with the silver in the plate to form photosensitive silver iodide, which was a significant improvement over Niepce's bitumen of Judea. Then he loaded the plate into a camera.

That morning he set everything up and started his exposure, which he expected to take several hours... but a half hour later the sun disappeared behind some clouds, ruining everything. Daguerre took the plate out of the camera and tossed it into his chemical cabinet so it would be out of the way.

The following morning, when he took the plate out of the cabinet to polish it for reuse, he saw that it contained a very sharp, detailed image of the picture he had tried to take the day before.

WORTH A THOUSAND WORDS

How did the picture get there? Thirty minutes of exposure was nowhere near enough time to create an image. Daguerre guessed that the short exposure had been enough to create a hidden or "latent" image on the plate, and that one of the chemicals in the cabinet must have "developed" it to the point that it was visible to the naked eye. He tested his theory by taking another 30-minute exposure and leaving it in the chemical cabinet overnight, as well.

Sure enough, the following morning there was an image on the plate. By process of elimination, Daguerre discovered that vapors from mercury, stored in the cabinet, had developed his exposures.

Daguerre made another important discovery: Like Wedgwood and Schulze, he wanted to arrest the photosensitive reaction to stop photographic images from being obliterated from further exposure to light. He solved the problem by soaking his developed *daguerreotypes,* as he called them, in a saltwater bath to create the first permanent photographic images. (Well, almost permanent: the saltwater did not arrest the photosensitive reaction completely, but it did slow it down enough that daguerreotypes could be viewed in daylight and could even be preserved for many years.)

CREDIT WHERE CREDIT IS DUE

The discovery of "mercurializing," as it came to be called, was Daguerre's and Daguerre's alone—and understandably, he wanted full credit for it. In 1837 he drew up a new contract with Isidore Niepce in which he took credit for the new process, but gave Joseph Niepce credit for the old process. Isidore Niepce objected to the terms, but had little choice in the matter—he had not participated in Daguerre's research, did not know how the new process worked, and could not claim credit for it. So he signed.

They made plans to sell both steps of the photographic process to private investors, but when the French Academy of Sciences caught wind of the idea, it persuaded the French government to purchase the rights and give them away free to the entire world... except their traditional rival, England. Daguerre's process was now free of charge for anyone in the world—except the Brits, who had to pay him a royalty.

NOTHING LIKE IT IN THE WORLD

On January 7, 1839, Daguerre went before the Academy of Sciences to show his daguerreotypes and give a description of his process. The assembled scientists were amazed. Images that detailed did not exist anywhere on Earth and were virtually inconceivable to the 19th-century mind. They were so finely detailed that people called them "mirrors with a memory."

The American inventor Samuel Morse was in Paris when the Academy of Sciences published the news of Daguerre's process; Daguerre invited him to view the pictures. Morse described what he saw in a letter home to his brother:

> The exquisite minuteness of the delineation cannot be conceived. No painting or engraving ever approached it. For example: in a view up the street, a distant sign would be perceived, and the eye could just discern that there were lines of letters upon it, but so minute as not to be read with the naked eye. By the assistance of a powerful lens, which magnified fifty times...every letter was clearly and distinctly legible, and so also were the minutist breaks and lines of the walls of the buildings; and the pavements of the streets.

The effect of the lens upon the picture was in a great degree like that of the telescope in nature.... [It is] one of the most beautiful discoveries of the age.

DAGUERREOTYPE-MANIA

On July 7, 1839, six of Daguerre's daguerreotypes were put on public display in Paris; then on August 19, the full details of the photographic process were released to the world. The world's first photography fad started within days, as Parisians descended on the city's lens makers by the thousands to order the equipment that would allow them to make their own daguerreotype images. Eyewitness Marc Antoine Gaudin described the scene:

> Opticians' shops were crowded with amateurs panting for daguerreotype apparatus, and [soon] everywhere cameras were trained on buildings. Everyone wanted to record the view from his window, and he was lucky who at first trial got a silhouette of rooftops against the sky. He went into ecstasies over chimneys, counted over and over roof tiles and chimney bricks, was astonished to see the very mortar between the bricks—in a word, the technique was so new that even the poorest plate gave him indescribable joy.

A PERMANENT RECORD

Perhaps the most impressive but underappreciated early contributor to photography was Sir John F. W. Herschel, an Englishman. When Herschel learned of Daguerre's discovery, he set out to see if he could duplicate the results without knowing anything about the process, which was still a closely guarded secret.

In several weeks Herschel accomplished what had taken Daguerre several years to do; he even improved on the process by remembering an 1819 experiment in which he had observed that hyposulfate of soda dissolved silver salts. He tried the experiment again, hoping he could use the chemical to "fix" his images permanently, something Daguerre had been unable to do. It worked— and hyposulfate of soda, now known as sodium thiosulfate, is used to fix photographic images to this day.

NO-MAN'S-LAND

In 1837 Louis Daguerre discovered how to create a lasting detailed photographic image. Within months of the groundbreaking publication of his photographic process in 1839, people started taking cameras to Greece, to the Middle East, to Africa, to Central and South America, and to every other corner of the world to photograph the wonders they saw there.

However, if you look at these early photographs, you will notice that no matter what the scene, there is always one thing missing from the picture: *people.* These first photographs appear barren and empty, completely devoid of human or even animal life. It is as if each had been taken in a ghost town.

STILL SHOTS

It turns out that there were plenty of people in these scenes when the pictures were taken; they just cannot be seen because they were moving. The early photosensitive chemicals took so long to form an image—30 minutes on a sunny day, an hour or more when it was cloudy—that pedestrians and street traffic passed in and out of the picture without registering.

The American inventor Samuel Morse noted this when he was invited to look at some of Daguerre's first photographs in 1839. One daguerreotype was a view of a busy Paris street, taken in the middle of the day when there must have been hundreds of people out. Only one person—quite possibly the first ever to be captured on film—was visible in the picture, and this only because he had been standing relatively still. Morse wrote to his brother:

Moving objects leave no impression. The boulevard, though constantly crossed by a flood of pedestrians and carriages, appeared completely deserted, apart from a person who was having his boots polished. His feet, must of course, have remained immobile for a certain time, one of them being placed on the boot-black's box, the other on the ground.

FACE TIME

The irony was that people living in the late 1830s and early 1840s wanted pictures of themselves and their loved ones more than any other photographic subject. Mortality rates were much higher then, and the pain of a death in the family was made worse by the fact that families frequently had no images of the deceased to remember them by. Only the wealthy were able to commission portraits of themselves. Now photography, with its promise of "automatic" portraits, seemed to offer the possibility of making portraiture available to everyone.

Understanding this need, photographers started looking for ways to take photographic portraits. They located their studios in rooftop glass houses to maximize available sunlight; they crammed those studios with mirrors to bring in even more light. They even filtered the sunlight through blue glass or bottles of blue liquid to take advantage of the fact that early photographic plates were especially sensitive to blue light (the lightbulb was not invented until 1879).

SAY "CHEEEEEESE"

Even with all of these measures, exposure times remained quite long—20 minutes or more—leaving the aspiring portraitist little choice but to resort to desperate measures. Since there was no easy way to stare at a fixed point in space for such a long time, many photographers instructed their subjects to pose with their eyes closed...and that was just the beginning: "Paint the face of the patient dead white," one daguerreotypist advised in 1839. "Powder his hair, and fix the back of his head between two planks attached to the back of an armchair and wound up with screws."

Posing for a portrait in such a studio was almost unbearable, something akin to having your picture taken inside a hot car with the windows rolled up and your head in a vise. The heat trapped by all that glass sent the temperature soaring, and the light from the mirrors was blinding. Looking "natural" under these conditions—sweating profusely, eyes squinting or closed, hair powdered, face painted white, head held immobile by boards while sitting perfectly still for 20 minutes or more—was just about impossible. Even when the pictures did come out, they were usually disappointing.

NEW AND IMPROVED

Fortunately, the first major improvements in daguerreotype photography came quickly. In 1840 Hungarian mathematician Jozsef Max Petzval invented a lens that let 22 times more light into the camera, reducing exposure times from 40 minutes to 2 ½ minutes. That same year, English scientist John Frederick Goddard discovered that exposing daguerreotype plates to bromine vapors increased their photosensitivity, further shortening exposures to under a minute. So what does Daguerre's process have to do with the modern photograph? Almost nothing. Daguerre became world famous, but his process was flawed—it only resulted in a single unique image. Daguerreotypes could not be reproduced, and ultimately the process fell into disuse.

The true father of modern photography was English physicist William Henry Fox Talbot. In a sense, what Talbot did was invent the negative—a reverse image on photosensitive paper that could be used to make any number of positive prints, or "calotypes" as they came to be called. Talbot invented his process in 1835, but never published his findings or patented his original process. Therefore, when Daguerre came along two years later, he got all the credit for inventing photography. It turns out that Daguerre was not just smart, he was also very lucky.

OPEN FOR BUSINESS

In 1840, a photographer named Alexander Wolcot opened America's first portrait studio in New York City; the following year a coal merchant named Richard Beard opened one in London. The "nobility and beauty of England" were soon flocking to his studio to have their pictures taken; by 1842 he was making as much as £35,000 a year (in modern U.S. currency that is $2,653,415).

Other studios soon sprang up in the major cities of Europe and the United States. By the late 1840s, nearly every city in the U.S. had a "daguerrean artist," and smaller towns were served by itinerant photographers traveling by wagon. Photography was starting to realize its promise.

GETTING IT BACKWARD

For all of the improvements that had been made to them, daguerreotypes and calotypes still had a lot of problems. Daguerreotype images not only could not be duplicated, they were also reverse images: any writing that appeared in the picture, be it on a street sign, in a shop window, or on the stern of a ship, appeared backward, something that was terribly distracting to the viewer.

Calotype images did not have those problems—they were printed from negatives, so 1) the images were not reversed, and 2) you could make as many prints as you wanted. However, calotype negatives were made of opaque paper. The resulting image was blurrier than a daguerreotype, and the grainy surface of the photographic paper used to make prints only made things worse.

People wanted the best of both worlds: pictures as sharp and clear as a daguerreotype that could be easily duplicated like a calotype. The obvious solution was to replace the calotype's paper negatives with negatives made of smooth-surfaced glass. Figuring out how to do this was a challenge, however, because the nonporous surface of the glass was so slippery that photographic chemicals wouldn't stick to it. Scientists tried everything to get them to stick (including smearing glass with snail slime), but nothing seemed to work.

EGGING THEM ON

Then in 1847, Claude-Felix-Abel Niepce de Saint-Victor, nephew of photographic pioneer Joseph Niepce, finally found something that did the trick: egg whites, also known as albumen. It got the chemicals to stick, and the images that resulted were as crystal clear as daguerreotypes and as easy to duplicate as calotypes. But the exposure times for albumen plates were so long that the plates couldn't be used for portraits.

In 1851 English sculptor and photography buff Frederick Scott Archer used a substance called collodion to glue together some broken glass photographic plates. Made from guncotton (an explosive) dissolved in ether and alcohol, collodion formed a tough, waterproof skin when it dried; doctors us'ed it to seal burns and wounds while new skin grew in underneath.

As Archer pieced together the broken glass, it occurred to him that collodion might be as good as egg whites for getting photosensitive chemicals to stick. He used it to apply a photosensitive emulsion to some photographic plates...and it worked. Not only that, but the plates had exposure times that were 20 times shorter than daguerreotypes (two minutes) or calotypes (one and a half minutes). With good lighting, an exposure of just a few seconds would result in a good picture.

THE WET LOOK

The only drawback to the collodion process was that the photographic plates only worked while the collodion was still wet, because once it dried into its tough waterproof skin it was impervious to the developing chemicals. Photographers had to prepare their plates before they took photographs, and develop them immediately afterward. There was no time to waste. That meant that a photographer had to bring all necessary equipment—chemicals, darkroom, and everything else—along for every picture. This, of course, was a huge hassle, but the "wet-plate process," as it came to be known, produced such beautiful photographs that it quickly passed the daguerreotype and the albumen calotype to become the most popular form of photography. It remained so for more than 30 years.

Now there was only one thing left that kept people from having their pictures taken: the price.

ACCENTUATE THE NEGATIVE

As he worked on his wet collodion process, Archer noticed that when he held one of his negatives against a black piece of paper, it didn't look like a negative—it looked like an ordinary photograph, very similar to a daguerreotype.
Archer made note of his observation, but didn't do much with it. But other photographers did—they grabbed the idea as a way to make portraits cheaper. Why go to the trouble and expense of making a positive print, when a negative backed with black paper or some other dark material—soon to become known as an "ambrotype"— worked just as well?

In 1854 Boston photographer James Cutting patented an improved method of making ambrotypes and began selling them. Other photographers followed suit, and in the price war that followed, pressure from ambrotype photographers drove the price of a single daguerreotype from $5 down to 50 cents. Ambrotypes sold for as little as a dime, and though they were lower in quality they were much easier and quicker to produce: a person could pose for an ambrotype and receive the finished portrait in less than 10 minutes. Higher-quality daguerreotypes quickly began to lose ground to the speed and affordability of the ambrotype.

THE TINTYPE

If viewing a glass negative against a black background gave it the appearance of a photograph, why not just make the negative out of something black to begin with, like a thin sheet of tinned iron painted with black varnish? You would get the same effect for less money because you would be leaving out the glass, which was expensive.

That is what Hamilton Smith was thinking when he invented what became known as the "tintype process" in 1856. Tintypes were cheap—they sold for a fraction of the cost of an ambrotype — and because they were made of iron they could take a lot of abuse. You could carry them in your pocket, send them through the mail, and collect them in photo albums. The images were still reversed, but with simple portraits no one seemed to mind.

As it turned out, you could even carry tintypes into war: In four years' time, Union and Confederate soldiers would bring tintypes of their loved ones with them into battle; between skirmishes they would line up outside the photographer's tent to pose for pictures of themselves to send back home.

MULTIPLE PERSONALITIES

As popular as they were, tintypes never came close to matching the craze of another type of photograph, the cartes-de-visite. Invented by French photographer Andre Disderi in 1854, the cartes-de-visite was, like the ambrotype and the tintype, an extension of the collodion process. Disderi's idea was to use a special camera with four lenses to divide a single large photograph into many smaller photographs. Some cartes-de-visite cameras only let the subject pose for one photograph, which was then duplicated eight or more times; others allowed several poses. Either way the effect was the same: for the price of a single photograph, the customer got as many as 24.

Disderi intended that the tiny pictures, which were printed on paper and backed by stiff cardboard, would serve as photo versions of traditional calling cards to be given as a memento of a visit with friends.

THE ROYAL TOUCH

Then in 1860, Queen Victoria, her husband Prince Albert, and their children posed for some cartes-de-visite. These images were the first photographs of the royal family ever commissioned for the public. They were sold individually, in sets, and in a book called the *Royal Album.* And they were hugely popular.

Photo studios took note. They started printing photographs of other famous people—Sarah Bernhardt, Abraham Lincoln, and Gen. Ulysses S. Grant among them—to see if they would sell. They did, prompting what came to be known as "cardomania." *Cartes-de-visite* covered a huge variety of subjects, including animals, politicians, military leaders, famous works of art, scenes of faraway places... even Bamum's circus freaks. Collectors bought them all. During the Civil War, people bought pictures of Maj. Robert Anderson, the hero of the battle of Fort Sumter, at a rate of 1,000 prints a day.

HOUSE OF CARDS

Cardomania was so powerful that it may be the reason the White House still stands in Washington B.C. The Founding Fathers never intended the White House to be a permanent presidential residence; it was just supposed to serve until something bigger and better would be built.

Few Americans had ever seen the White House, until Lincoln's assassination in 1865, when photos of the fallen president—as well as of the house where he had lived—circulated in great numbers.

STILL WET AFTER ALL THESE YEARS

In the fifteen years since the invention of the daguerreotype in 1837, photography had made amazing progress. The collodion process and its descendants—ambrotypes, tintypes, and cartes-de-visite—were huge improvements, but they were still "wet-plate" processes.

Photographers had to apply fresh collodion to their glass photographic plates right before they took a picture, and then develop the plates immediately afterward, before the chemicals dried. That meant lugging all their chemicals and equipment, including a portable darkroom, wherever they went to take a picture. Every photo shoot was an expensive camping trip... which made photography off-limits to everyone except professionals and a handful of dedicated amateurs. Someone either had to find a substitute for collodion or find a way to stop it from drying out so quickly, perhaps by mixing in substances that were slower to dry. They tried everything they could think of—honey, glycerine, raspberry syrup, beer—but nothing worked.

THE SMELL OF SUCCESS

Ironically, the person who finally stumbled onto the answer, English physician Richard Leach Maddox, was not even trying to solve the problem. Maddox didn't mind the inconvenience of the wet-plate process—he just hated the way it smelled. His photography studio was set up in a glasshouse, and when it heated up, the smell of the ether in the collodion was overpowering. He became determined to find a process that did not require ether.

In 1871 Maddox found one that showed a lot of promise: a silver-gelatin emulsion. He believed this was the key to a non-smelling "dry-plate process," but the demands of his medical practice prevented him from spending the time needed to refine it. Therefore, in a letter to the *British Journal of Photography,* Maddox invited others to pick up where he had left off.

Seven years later another Englishman, Charles Harper Bennett, refined the process and proved Maddox right. He discovered that he could "ripen" the gelatin emulsion by heating it to 90°F and holding it at that temperature for several days. Then, after washing the plate to remove excess chemical salts, Bennett discovered that he could create a "dry plate" that was 60 *times* more sensitive to light than one made with the collodion or any other photographic process.

IN THE BLINK OF AN EYE

For decades, photographers had yearned to capture all that the human eye could see. Now, in a single stroke, Bennett had invented plates that worked /aster than the human eye, allowing people to see things that it had never been possible to see before: horses in mid-gallop, birds flapping their wings in flight, children jumping rope, water droplets falling in mid-air. Before gelatin plates, all of these images had appeared as blurs—now they were crystal clear. The invention of gelatin plates prompted new camera designs: bulky wooden tripod-mounted cameras were replaced by smaller units that photographers could easily hold in their hands. The new cameras were also more sophisticated: In the past people took pictures by removing the lens cap and replacing it a few seconds later, but gelatin plates were too sensitive for that. Precise exposure speeds, accurate to within a fraction of a second, were necessary. So camera makers added shutter systems that allowed for short and accurate exposure times. By 1900 it was possible to take exposures as short as 1/5000 of a second.

SCIENTIFIC METHOD

Just as important as the speed of the new gelatin plates was the fact that they remained photosensitive for months on end, which meant that they could be prepared well in advance of being used. Photographers no longer had to prepare plates themselves; they could buy them from the hundreds of small companies that sprang up to sell ready-made plates. They still had to develop the plates themselves, but at least now they could do it at their leisure.

Gelatin plates also helped bring standardization to the photography industry. In the past, each photographic plate was prepared from scratch moments before being put into use, so photosensitivity varied from plate to plate and from photographer to photographer. Not anymore: Now plates could be made under more controlled conditions, making their performance more predictable and reliable.

This mass production made it possible for two British scientists, Vero Charles Driffield and Ferdinand Hurter, to begin some of the first serious scientific studies of the chemistry and physics of photography. Through their research they calculated the optimum exposure time for photographic plates depending on lighting, temperature, and other factors, and they perfected the developing process to the point that people could develop exposures in absolute darkness, just by timing how long the exposures soaked in developing chemicals. As Driffield and Hurder unlocked photography's secrets, they helped to make it more accessible to ordinary people.

ONE MORE THING

The introduction of smaller, more sophisticated cameras and standardized, ready-made supplies simplified photography, but there were still a few hurdles that kept most people away.

For one thing, people still needed a darkroom or at least a *dark room,* because the gelatin plates had to be loaded into a camera in absolute darkness. The plates were so sensitive that exposing them to even a small amount of light caused them to fog over. And they were still made of glass, which was expensive, fragile, and heavy. Glass plates and plate holders added several pounds to the weight of a camera, which meant that no matter how small the cameras got, photography was still a costly and unwieldy affair.

However, the most daunting problem of all was that most people still had to develop exposures themselves. If you wanted to *take* a picture, you had to *make* the picture. And if you weren't willing to do that, you were out of luck.

Then in 1880, George Eastman, a bookkeeper at the Rochester Savings Bank in Rochester, New York, decided to go into the gelatin-plate business.

CAMERAMAN

On November 13, 1877, a 23-year-old bank clerk named George Eastman walked into a camera store in Rochester, New York, and paid $49.58 for a camera and some equipment. Eastman bought only the essentials, but in those days "the essentials" included a tripod, glass plates, a plate holder, containers of photographic chemicals, and more than a dozen other items, including a tent to serve as a darkroom.

Eastman took his camera with him on a trip to Mackinac Island in Lake Huron, where he photographed some of the local sights. But as fascinated as he was by photography, he loathed the amount of equipment that was required. "It seemed," he said, "that one ought to be able to carry less than a pack-horse load."

MADE IN ENGLAND

Eastman began to experiment to see if he could simplify the process. He bought a subscription to the *British Journal of Photography,* and by chance his first issue was the one reporting Charles Harper Bennett's perfection of the gelatin dry-plate process. The article prompted him to abandon the collodion "wet process" and start making his own gelatin plates. "The English article started me in the right direction," he wrote. "At first I wanted to make photography simpler merely for my own convenience, but soon I thought of the possibilities of commercial production."

Like most other commercial plate makers, Eastman started out making them one at a time. He heated chemicals in an old teakettle, poured them over glass plates, then smoothed out the emulsion with a rod. It was a cumbersome, time-consuming process, and that made precoated plates expensive. Eventually, Eastman invented a machine to coat gelatin plates automatically, then, in April 1880, started manufacturing them to sell to local photographers and photo supply stores.

ON A ROLL

The Eastman Dry-Plate Company grew rapidly on the strength of gelatin plate sales, but that did not stop Eastman from introducing a product in 1884 that he believed would make glass plates obsolete: it was a roll of photosensitive paper, or "film," that could be used instead of glass plates. Eastman sold this film in a box that could be attached to existing cameras, in place of the box that held the glass plates.

Using glass plates, photographers could take at most a few shots before having to reload the camera, which usually required a darkroom; with Eastman's roll film there was enough paper for 50. Added bonus: Roll film was not heavy. "It weighs two and three-quarters pounds," Eastman explained. "A corresponding amount of glass plates and holders would weigh fifty pounds."

A TOUGH SELL

Eastman's new film seemed such an obvious improvement over glass plates that he believed it would take the photographic world by storm. He was wrong: Professional photographers had too much money invested in glass-plate technology. Besides, glass plates made negatives as large as 20 by 24 inches, which captured an incredible amount of detail and produced beautiful photographs. Eastman's film could not duplicate the quality.

At first Eastman tried to adjust his product line to accommodate the needs of professional photographers, but he soon realized that this was exactly the opposite of what he should be doing. And that was when he changed photography forever.

"When we started out with our scheme of film photography," he recalled in 1913, "we expected that everybody who used glass plates would take up films, but we found that in order to make a large business we would have to reach the general public."

JUST PLAIN FOLKS

Eastman was one of the first people to understand that the number of people who wanted to take pictures was potentially much larger than the number of those who were interested in developing their own film. He realized that if he was the first person to patent a complete and simple camera "system" that anyone could use, he would have that market all to himself.

In 1888, Eastman patented what he described as a "little roll holder breast camera," so called because the user held it against their chest to take a picture. But what would he call it? He wanted the name of his camera to begin and end with the letter K—he thought it a "strong and incisive" letter—and to be easy to pronounce in any language. He made up a word: Kodak.

CLICK

Just as Eastman intended, his camera was easy to use: The photographer simply pulled a string to set the shutter, pointed the camera at the subject, pushed a button to take the picture, then turned a key to advance the film. The user did not even have to focus: the lens was designed so that anything more than six feet away was always in focus. Price: $25 — a lot of money in those days, but half what Eastman had paid for his first camera equipment 11 years earlier.

However, the most important selling point of this new system was that Eastman offered to develop and print all of the pictures taken with Kodak cameras—something no camera maker had ever offered before. He sold the Kodaks loaded with enough film for 100 pictures, and when these were used up the owner could, for $10, mail the entire camera back to Rochester. The company would remove the film, process and print the pictures, and return them to the owner along with the camera, freshly loaded with enough film for 100 more pictures.

"You press the button," the company's slogan went, "We do the rest."

PICTURE PERFECT

The Kodak camera went on sale in June 1888. It was followed by an improved model, the Kodak No. 2, in 1889. By September of that year, Eastman had sold more than 5,000 cameras in the U.S. and was developing an average of 7,000 photographs a day.

Eastman quickly came to understand that the real money in the photography business was not in selling cameras — each customer needed only one — it was in selling and processing film. This gave him an incentive to lower the cost of his cameras, so that more people could afford to buy the film. In 1895 he introduced a Pocket Kodak camera, which at $5 was Kodak's first truly affordable camera. Then in 1900 he introduced the Brownie, which sold for $1. Eastman sold more than 100,000 Brownies in the first year.

KODAK MOMENTS

Most photographers had approached photography as an art form, but Eastman worried that if his customers did the same thing, they might get bored with their new hobby and find something else to do. He believed that if he could convince the public to use their cameras to document birthdays, summer vacations, and other special moments of their lives—once a family purchased a camera they would never go without one again.

Accordingly, Kodak's advertisements featured parents photographing their children, and children photographing each other. The Kodak Girl, one of the most popular advertising icons of the early 20th century, was shown taking her camera everywhere: to the mountains and the beach, on yachts, and on bicycle rides in the country.

"Don't let another weekend slip by without a Kodak," the magazine ads cooed. "Take a Kodak with you." And millions of people did.

PATENTS PENDING

Eastman believed that the best way to stay ahead of the competition was to constantly improve his products, and to protect his improvements with patents, which would guarantee sole ownership of those markets. In 1886 he became one of the first American businessperson to hire a full-time research scientist, Henry Reichenbach.

One of Reichenbach's first triumphs was a roll film that used a solution of guncotton or *nitrocellulose*—the same substance that served as the basis for the collodion process—as a base, instead of paper. The first rolls went on sale in August 1889; when it did, film as we know it was born and the word *snapshot* entered the language.

BROUGHT TO YOU BY THE LETTER K

True to form, Eastman patented the chemistry and every step of the manufacturing process so that Kodak would have the roll film market all to itself. Then, when the profits started rolling in, he used the money for more research and more patents — so that the company would continue to dominate the industry it had played such a huge part in creating.

In 1891 Kodak marketed its first "daylight-loading" camera, which allowed the user to reload film into a camera without a darkroom. In 1896, just a year after the discovery of X-rays, Eastman began manufacturing plates and paper for X-ray photographs; that same year, Kodak began selling the first motion picture film. Film for "talkies"—motion pictures with sound—followed in 1929.

These advancements continued long after Eastman's death in 1932. In 1936 Kodak brought Kodachrome Film to market, the world's first amateur color slide film; they introduced color print film in 1942. Instamatic cameras, which used easy-to-load film cartridges instead of rolls, came out in 1963; the company sold more than 50 million Instamatics in the next seven years alone. Super-8 home movie cameras hit the market in 1965, and Kodak dominated that market too.

KING OF THE HILL

Decades of continuous innovation have turned Kodak into a household word, synonymous with photography itself. When astronaut John Glenn became the first American to orbit Earth in 1962, a Kodak camera in the space capsule recorded the event. When Neil Armstrong walked on the moon seven years later, he had a Kodak with him.

Eastman accomplished what he had set out to accomplish—he brought photography to the masses. Now, with the advent of digital technology, film photography may soon disappear, like the disposable cameras Kodak makes today. But that doesn't take away from the miracle of what the pioneers of photography achieved—capturing actual images from the air and preserving them for all time, an amazing feat that once seemed as impossible as catching lightning in a bottle.