SOUTH AUSTRALIAN AVIATION MUSEUM

SIGNIFICANT AVIATOR & AVIATION EVENTS PROFILES

AERIAL PHOTOGRAPHY
PART 1 – EARLY HISTORY PRE-FIRST WORLD WAR

Earliest recorded military history has identified scouting and reconnaissance as key tools employed by military commanders to obtain a picture of the tactical situation on which informed decisions can be made. Methods of scouting and reconnaissance have evolved and adapted over the centuries, and aided by the development of tactics, technology and weapons, remain vital for the foreseeable future.

From Spartan or Roman scouts sneaking across the plains many years B.C., fast forward to the French Revolutionary Wars and 1793, when the world's first military observation balloon *L'Entreprenant,* was constructed under the guidance of French scientist Charles Coutelle, assisted by N. J. Cont.

Approximately 19 years earlier, in 1774, the science of lighter-than-air gases was reportedly discovered by Joseph Priestley. He noted the lightness and explosive qualities of oxygen when heated. Ten years before the construction of *L'Entreprenant*, the chemistry of lighter-than-air gases was put to the test by the French Montgolfier brothers, Joseph-Michel and Jacques-Étienne, who were paper manufacturers. Following experiments with heated air caught in paper bags, they launched the first large unmanned paper balloon on 4 June 1783. The balloon was 30 feet tall and inflated with hot air. It appeared to have been used as an advertising gimmick for the Montgolfier's paper manufacturing business.

On 1 December 1783, Professor Jacques Alexandre César Charles flew another type of balloon that was inflated with hydrogen. Launched from the Champs de Mars in Paris, in front of a crowd of up to 400,000 people, the balloon travelled for 45 minutes and a distance of 15 miles, before arriving at the village of Genoesse, where it was attacked by frightened peasants on landing.

The fabric envelope of *L'Entreprenant* was coated with a special varnish to prevent the loss of hydrogen and inflated with hydrogen, produced by the Lavoisier-Meusnier method of heating iron tubes filled with metal filings and then separating the hydrogen from the steam created. It took approximately 15 hours to inflate the balloon.

L'Entreprenant was designed to remain tethered at about 1,700 feet and had to be especially strong to withstand buffeting by the wind. The balloon was tethered with two cables, increasing the degree of control and reducing the likelihood of the enemy freeing the balloon by severing a cable.

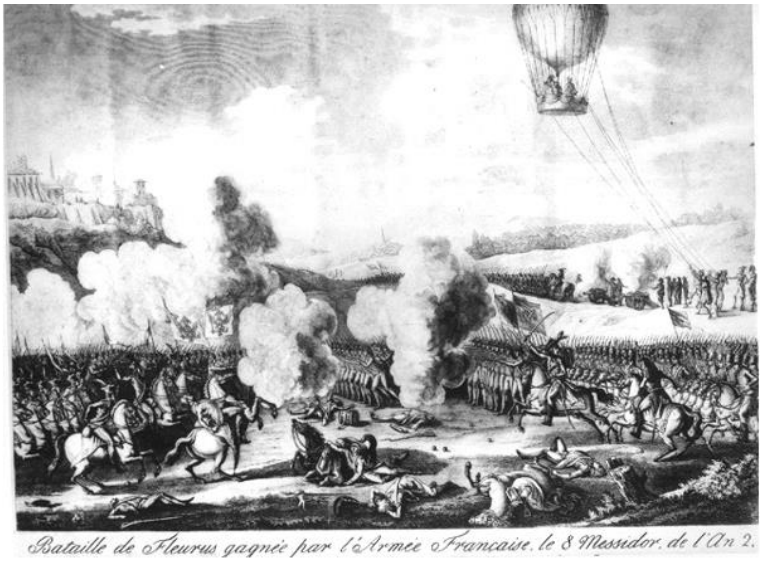

Figure 1: *L'Entreprenant at the Battle of Fleurs, 26 June 1794. Credits – 2001 National Air and Space Museum, Smithsonian Institution (SI Neg.No. 76-1196)*

The balloon's basket carried two occupants. One occupant handled the balloon and signalled the groundcrew who controlled it. The second was referred to as the "Observer." The observer communicated with the ground by flag signals or by placing written messages into sandbags that were fitted with rings enabling them to be slid down the cables. Sand ballast was carried that was equal to the

weight of the occupants in the basket, and as the balloon rose, the ballast would be discharged to compensate for the increase in weight of the two cables that tied the balloon to the ground.

Coutelle demonstrated the balloon in 1794 and found that at the full extent of the cables, he could clearly make out details 29 km away through his telescope. The Committee of Public Safety, formed after the French Revolution, were so impressed with the demonstration, they recommended formation of the world's first Air Force called *'The Compagnie d'Aéronautiers.'* It was established on 29 March 1794.

L'Entreprenant was transported to Mauberge by the newly formed balloon corps (Aérostiers), where Coutelle inflated it and the French air corps went into action against the Austrians in June 1794. During the battle, Coutelle and Cont successfully spied on Dutch and Austrian troops from high above Mauberge. They were able to provide detailed reports of the location and composition of the enemy troops and they directed ground fire against them. The Austrians protested that the use of the balloon was against the rules of war and attempted to shoot it down. Accordingly, Coutelle had his groundcrew let out more cable and *L'Entreprenant* easily rose out of range.

After Mauberge, *L'Entreprenant* was moved to Charleroi, a distance of approximately 45 km. Movement of the inflated balloon required a crew of 24 men to hold ropes attached to *L'Entreprenant* and drag it across the countryside to its new location.

The French army triumphed at the ensuing Battle of Fleurus, which took place on 26 June 1794. The ground operations were entirely directed from the air. Coutelle and General Morelot remained aloft during the entire 10-hour engagement. During that time, they received written questions from the ground by means of a cable and the General sent his orders and observation reports down the cable in a bag. In addition to providing a tactical advantage, the balloon also demoralised the enemy troops, with the Austrians fearing the balloon and looking upon it as an agent of the devil allied to the French Republic.

Aerial reconnaissance by the Aérostiers and further victories by the French troops led to the building of three further balloons named the *Celeste*, the *Hercule* and the *Intrepid*, each with its own corps and equipment. Each balloon was used at a different front during 1796. Subsequent balloon observations contributed to French victories and Coutelle persuaded Napoleon to allow the Aérostiers to accompany French troops to Egypt in 1797. However, the skills of the Aérostiers were not efficiently used and at the Battle of Aboukir in 1798, the British destroyed the equipment that had been left unused on a ship. After returning to France in 1799, Napoleon disbanded the Aérostiers and their balloon school.

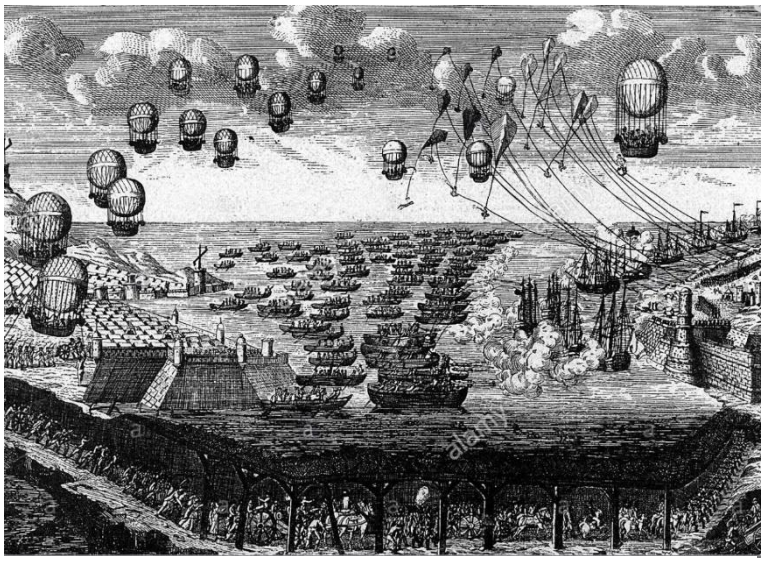

Figure 2: *Napoleon Bonaparte - Attack plan. Drawing made in 1805 by an engineer for Napoleon to invade England with 140,000 soldiers by balloons, boats and a tunnel. The plan was cancelled after Admiral Nelson defeated the French fleet at Trafalgar.*

In 1808, Major Nicholas Lhomond, who had earlier served under Coutelle, attempted to convince Napoleon that it would be possible to construct a fleet of huge hot air balloons that could transport an army across the Channel for an invasion of England. Napoleon never seriously considered the proposal, which also included a tunnel.

In the decades between the end of the Napoleonic Wars and the outbreak of the American Civil War, balloons were primarily used for pleasurable excursions or scientific experiments. However, there were occasions when their military use was considered. In 1840, during the Second Seminole War, the US faced a difficult task to locate the Seminoles in the dense swamps of Florida. Colonel John H. Sherburne recommended the use of balloons at night to identify the campfires of the hostile Seminoles.

Although tentative endorsement was given to the plan, the war ended in 1842 before the proposal could be acted upon. During the Mexican War, Pennsylvania aeronaut John Wise publicised a plan for the use of balloons for an aerial bombardment of Veracruz. Although the plan was never acted on, Wise's promotion of balloons during the 1850s played an important role in leading the Union Army to establish a Balloon Corps during the Civil War.

In Europe, British commanders rejected recommendations from lower-level officers that balloons be used during the Crimean War. Although the French revived their use during the Italian War of 1859, they had little impact upon that war.

After the outbreak of the American Civil War in 1861, Northern balloonists Professor Thaddeus Lowe, John LaMountain and John Wise, tried to convince Federal officials that aerial observation could give the Union Army a decisive advantage against the South. Although the Commanding General of the Union Army was reluctant to consider such innovations, President Abraham Lincoln personally endorsed the offer to form a Balloon Corps within the Union Army, following a June 1861 demonstration by Thaddeus Lowe, who ascended 1000 feet above the White House and successfully sent a telegraph message to the President.

With Lincoln's blessing, the balloonists entered the service of the Union army and accompanied Union forces to provide observation of Confederate forces. The balloons initially operated off naval ships in the Potomac and York Rivers.

LaMountain carried out the first successful reconnaissance mission of the war in an assent above Fort Munroe, which revealed two Confederate camps. Lowe helped avoid panic after the First Battle of Manassas by ascending to a height of 3 miles and reporting that no Confederate forces were advancing on Washington. Using a telegraph to signal messages from his balloon to the ground, Lowe directed artillery fire at Falls Church on 24 September 1861.

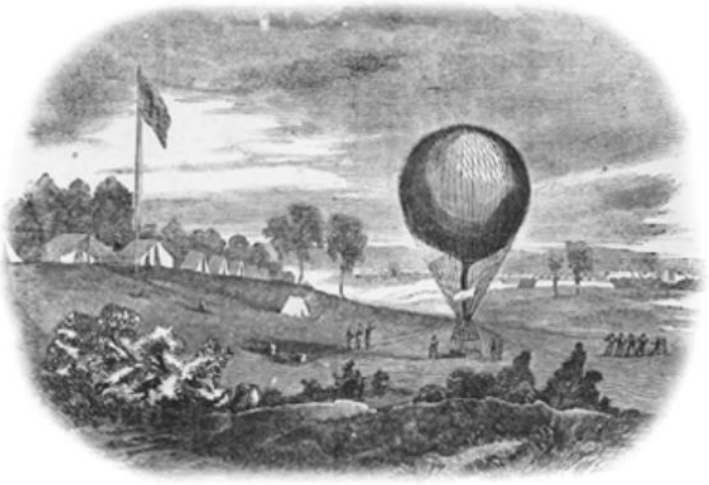

Figure 3: *Lowe's Enterprise being prepared for a reconnaissance mission at General Dowell's headquarters. From Harper's Weekly, A Journal of Civilization.*

Although the Confederates used signal balloons along the Potomac throughout 1861, their first use of manned balloons did not occur prior to 1862. Major E. P. Alexander, a young artillery officer, who had trained as a signal officer at West Point before resigning at the outbreak of war, convinced Confederate General Joseph E. Johnston to bring a balloon to the York Peninsula to observe Union movements. Using a coated cotton hot air balloon, Captain John Randolph Bryan, made three ascents before his balloon was lost after its moorings were severed.

Major Alexander next used a hydrogen balloon constructed by Captain Langdon Cheves in Savannah. This was made from silk dresses donated by local women. Alexander used the balloon during the Seven Days' Battles to report Union troop movements at Gaines's Mill. This balloon was captured on 4 July 1862, after the tugboat on which it was being transported ran aground in the James River. Because of its meagre resources, the Confederacy abandoned further use of balloons.

Although balloons had proved their usefulness as a platform for observing enemy forces from above and over the terrain, the Union Army dissolved the Balloon Corps after the Battle of Chancellorsville in 1863. Most of the Union commanders, including General in Chief of the Army, Major General Henry Halleck, discounted the overall effectiveness of balloons. Even though they worked well for defensive or siege operations, they were ineffective for offensive operations when an army was on the move. As an example, while on route to Manassas on 21 June 1861, the balloon of John Wise became lodged in trees, which eventually tore the fabric. Depending on

visibility, whereas telescopes allowed balloon observers to see approximately 15 to 25 miles, observers needed to be within 5 miles to count tents and make accurate troop estimates. Confederate commanders had learned to use campfires and wooden cannons to mislead enemy observers, resulting in faulty intelligence. Balloonists also faced problems with high winds, resulting in operations needing to be conducted at lower altitude, not to mention observers being jostled around. Finally, although balloons could identify enemy positions, their presence gave away the position of observers and attracted enemy artillery fire on nearby troops.

Because cameras and photographic processes were not yet invented, unfortunately for Coutelle and the French Aérostiers, their observations could only be recorded in writing or by sketching. Although still in its relative infancy, photography was available at the time of the American Civil War, but written observations and sketching was still being used, now aided by the use of a telegraph to signal their observations. What was clearly needed for the future was an accurate means of capturing and recording detail in a timely and efficient manner, for subsequent analysis and strategy development, i.e. Aerial Photography.

The Origins of Photography

According to Wikipedia, "The history of photography began in remote antiquity with the discovery of two critical principles: camera obscura image projection and the observation that some substances are visibly altered by exposure to light."

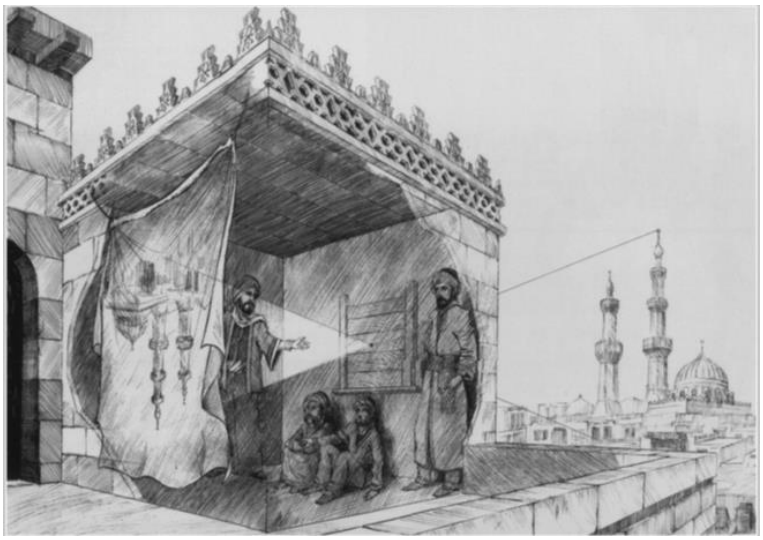

Figure 4: *The concept of the camera obscura as perceived thousands of years ago by Alhazen (Ibn al-Haytham), who coined the term.*

"Camera obscura" comes from the Latin for "dark chamber." Also referred to as a "pinhole image", it is a natural optical phenomenon that occurs when an image of the scene at the other side of the screen is projected through a small hole in that screen, as a reversed and inverted image (left to right and upside down), on the surface opposite to the opening. The surroundings of the projected image have to be relatively dark for the image to be clear, so many historical camera obscura experiments were performed in dark rooms.

Camera obscuras, with a lens in the opening, had been used since the second half of the 16th century and became popular as an aid for drawing and painting. The camera obscura box was developed further into the photographic camera in the first half of the 19th century the boxes were used to expose light-sensitive materials to the projected image.

Around 1800 Thomas Wedgwood made the first, although unsuccessful, attempts at capturing camera images in permanent form. His experiments produced detailed photograms, but Wedgwood and his associate, Humphry Davy, found no way to "fix" these images, i.e. stop the process of the light sensitive material darkening further and fogging the image.

In the mid-1820s, French inventor Nicéphore Niépce first managed to fix an image that was captured with a camera, but at least eight hours or even several days of exposure in the camera were required and the earliest results were very crude. The oldest surviving camera photograph, titled *"View from the Window at Le Gras"* was created by Niépce in 1827, showing parts of the buildings and surrounding countryside of his estate:

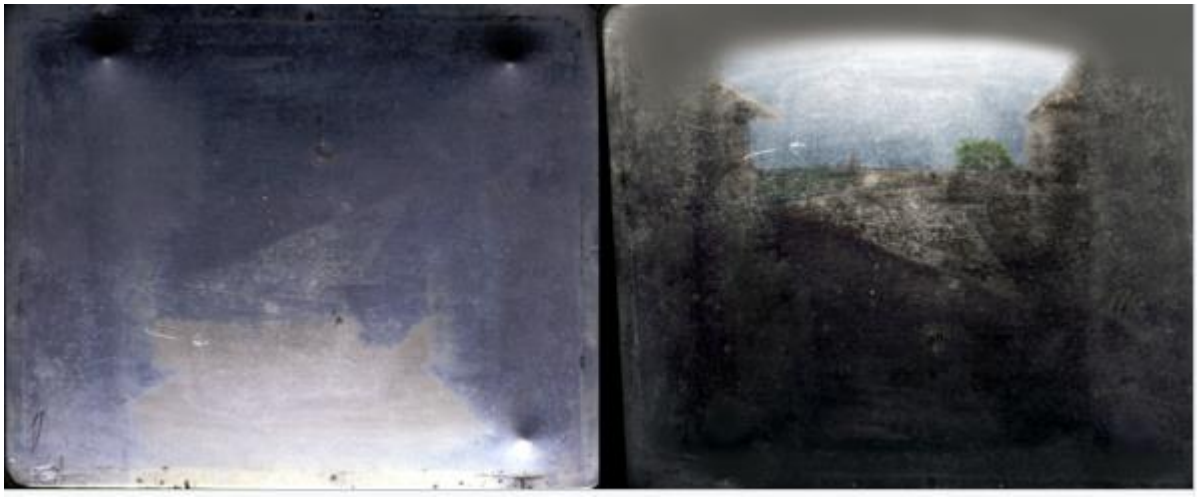

Figure 5: *The original plate is shown on the left. The right image has been colourised and re-orientated.*

The scene was captured with a camera obscura, focused on a 16 cm x 20 cm pewter plate that was thinly coated with Bitumen of Judea, a naturally occurring asphalt. The bitumen hardened in the brightly lit areas, but in the dimly lit areas it remained soluble and could be washed away with a mixture of oil of lavender and white petroleum. In the image, sunlight striking the buildings on opposite sides suggested an exposure lasting about eight hours. While this became the traditional estimate, a researcher who studied Niépce's notes and recreated the process, found that the exposure must have continued for several days.

Niépce's associate, Louis Daguerre, went on to develop the Daguerreotype process, known as the first commercially viable photographic process, introduced in 1839 and widely used during the 1840s and 1850s. The daguerreotype required only minutes of exposure in the camera and produced clear, finely detailed results. The metal-based Daguerreotype process soon had some competition from the paper-based Calotype negative and salt print processes invented by William Henry Fox Talbot and demonstrated in 1839.

From the 1850s the Collodion process, using glass based photographic plates (light-sensitive emulsion of silver salts coated on a glass plate), combined the high quality known from the Daguerreotype metal-based process with the multiple print options known from the calotype process (paper coated with silver iodide). Unfortunately, the Collodion process required the photographic material to be coated, sensitised, exposed and developed within the span of about 15 minutes, necessitating a portable dark room.

The first flexible roll film was made by George Eastman in 1885. This film was paper-based. The first roll film on transparent plastic (nitrocellulose) was invented in 1889. Because nitrocellulose was highly flammable a "Safety Film", made of cellulose acetate, was introduced by Kodak in 1908.

Subsequent innovations made photography easier and more versatile. New materials reduced the required camera exposure time from minutes to seconds, and eventually to a small fraction of a second.

Figure 6: *(Left Image): Nadar "elevating photography to the condition of art", caricature by Honoré Daunier. Published in Le Boulevard 25 May 1862. (Right Image): Nadar's earliest surviving aerial image, taken above Paris in 1866.*

Earliest Aerial Photography

The first known aerial photograph was taken in 1858 by French photographer and balloonist, Gaspar Felix Tournachon, known as "Nadar." In 1855, Nadar patented the idea of using aerial photographs for mapmaking and surveying. However, it took him three

years of experimentation before he successfully produced the very first aerial photograph. This was a view of the French village of Petit-Becetre, taken from a tethered hot air balloon, approximately 262 feet above the ground.

Nadar's use of the Collodion process, necessitating the photographic material being coated, sensitised, exposed and developed within about 15 minutes, required a complete darkroom to be carried in the basket of the balloon. Unfortunately, Nadar's earliest photographs no longer survive and his earliest surviving aerial image was taken in 1866.

The oldest surviving aerial photograph and the first known aerial image in the US was taken by James Wallace Black in 1860. It was taken from the tethered hot air balloon Queen of the Air, 2000 feet above Boston.

Improvements in photographic technology gradually made it easier to take cameras into the skies. Besides hot air balloons, early pioneers also used kites, pigeons and even rockets to carry their cameras aloft. In 1882, English meteorologist E. D. Archibald was among the first to take successful photographs from kites. A string of kites was used, with the camera attached to the last kite in the string.

Figure 7: *Oldest surviving aerial photograph, taken 2000 feet above Boston on 13 October 1860, by James Wallace Black.*

In 1889 Frenchman Arthur Batut took aerial photographs using a kite. He suspended the camera from a single kite and set an automatically timed exposure. A slow burning fuse, responding to a rubber band driven device, triggered the shutter within a few moments of the kite being launched.

Figure 8: *(Above) Batut's 1889 image of Labruguiere taken from his kite.*

Figure 9: *(Left) Batut's kite with suspended camera.*

George Lawrence perfected a method of taking aerial panoramas by strapping large format cameras, which used curved film plates, to kites. His most famous image, taken in 1906, captured damage caused by the San Francisco

earthquake and fire. He used 17 kites to suspend the camera 2000 feet in the air. Exposures were made by an electric current carried through the insulated core of the steel cable kite line. When the shutter snapped, a small parachute was released. At this signal that the picture had been taken, the kites were then pulled down and the camera reloaded.

Figure 10: *George Lawrence's 1906 photograph of San Francisco, taken 2000 feet above San Francisco Bay, overlooking the waterfront. George Lawrence - Prints & Photographs Division/Library of Congress.*

In 1897, the first successful aerial photograph from a rocket mounted camera was taken by Swedish inventor, Alfred Nobel, best known for the Nobel Prize. In 1906, Albert Maul produced a more reliable method by using a rocket propelled by compressed air. After reaching approximately 2,600 feet in just eight seconds, his camera took an aerial image before being ejected and parachuted back to earth. He had patented the idea of using powder rockets in 1903, and by 1904 was testing gyroscopically-stabilised cameras launched by rockets and recovered by parachute. In 1912, Maul demonstrated his perfected rocket to the Austrian army, but by that time aircraft were found to be more effective.

Figure 11: *(Left) Aerial photograph of the Swedish countryside, taken by Alfred Nobel from a rocket powered camera circa 1897. (Right) Albert Maul's rocket. (Centre) One of Maul's aerial photographs of the German countryside.*

In the twilight of the 19th century, while balloons and kites could carry cameras, for military aerial reconnaissance they were very restricted in their movement and speed. The stage was set for a faster and rangier kind of aerial reconnaissance. Enter the pigeon!

In the early 1900's, Dr Julius Neubronner designed several tiny breast mounted cameras for carrier pigeons. An apothecary and pigeon fancier, since 1903, Dr Neubronner had been using carrier pigeons to exchange urgent prescriptions and medications with a sanitorium a few miles from his home near Frankfurt. A pigeon lost during one of these flights returned to the dovecote about four weeks later, safe and unharmed. This gave Neubronner an idea to create lightweight wearable cameras to record his couriers' flights.

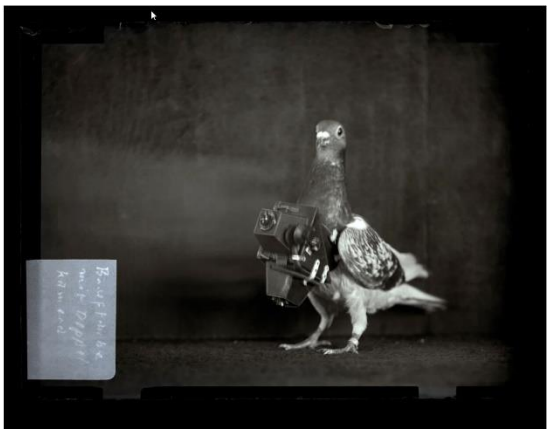

***Figure 12: Julius Neubronner's pigeon with** a camera strapped to it circa 1909. Rorhof/Stadarchiv Kronberg.*

Neubronner built several models which included a pneumatic timing mechanism to activate the shutter at set intervals, leather harness and aluminium breastplate. Neubronner would take the pigeons up to 60 miles away before releasing them, knowing they would want to take the most direct route home to unburden themselves. To increase the mobility of his fleet, he also built a horse-drawn dovecote with an attached darkroom.

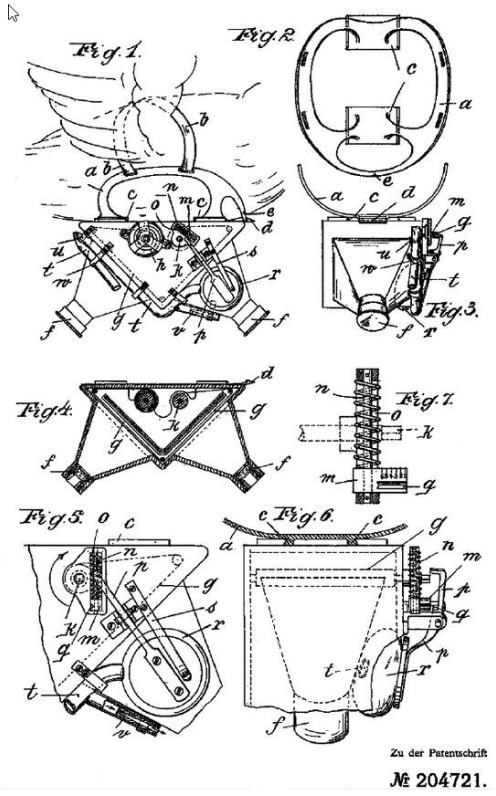

***Figure 13:** Neubronner's patent.*

Neubronner applied for a patent in 1907 but the German patent office initially objected to his application, on the grounds that domestic pigeons could not possibly carry a 75-gram load. Neubronner countered the objection with photographic evidence, and in 1908, finally gained his patent.

The invention brought Neubronner International notability after he presented at expositions in Dresden, Frankfurt and Paris between 1909 and 1911. Spectators in Dresden were able to watch the arrival of the camera-equipped pigeons, and the photos were immediately developed and turned into postcards for sale.

It was just a few years after the Wright brothers first flight at Kitty Hawk in 1903 that piloted, powered aircraft were first used for aerial imagery. Cinematographer L.P. Bonvillain took the first known image in 1908, photographing from an aircraft over Le Mans, France. The aircraft was piloted by Wilbur Wright.

World War I consumed the world shortly thereafter, and military commanders soon saw the potential advantages offered by up-to-date aerial imagery of the battlefield, troop movements etc. The German military considered the images taken by Neubronner's pigeons sufficiently impressive to warrant testing 'pigeon cam' on the battlefields of the Western Front in World War I. However, rapid improvements in powered aircraft reconnaissance consigned Neubronner's birds back to their traditional role of carrying messages.

***Figure 14:** (Right) One of the early images, taken of the Schlosshotel in Kronberg, became famous for accidentally capturing the wingtips of the photographer.*

Figure 15: *Image taken by one of Julius Neubronner's pigeons at the 1909 Dresden International Photographic Exhibition, Rorhof/Stiflung Deutsches Technikmuseum Berlin.*

Cameras were subsequently equipped on all manner of aircraft, and the wartime practice of aerial reconnaissance was born. Part 2 will cover the development of aerial photography during the two World Wars.

Sources:

US Centennial of Flight Commission – *Military use of Balloons During the Napoleonic Era.*
Wikipedia – *History of Photography, History of Military Ballooning, Balloonomania, Aerial Photography*.
Military Aircraft, Origins to 1918: An Illustrated History of Their Impact by Justin D. Murphy.
Spies in the Sky : The Leaps and Bounds from Balloons to Spook Sat's – The Register.
Bird's-Eye View: The Development of Aerial Reconnaissance – DefenseMediaNetwork.
Military Reconnaissance - Looking at Earth - Smithsonian National Air and Space Museum.
Time – *Aerial Photography's Surprising Role in History* by Olivia B. Waxman.
Professional Aerial Photographers Association International – *History of Aerial Photography*.
The Public Domain Review - *Dr Julius Neubronner's Miniature Pigeon Camera*.

Gary Petts
History Group Member

August 2020