George W. Goddard

The Pioneer of Aerial Photography

George W. Goddard: The Pioneer of Aerial Reconnaissance

In October 1962 during the Cuban Missile Crisis, aerial photography reached an unprecedented level of achievement. CIA Director John A. McCone summed up the accomplishment when he said, "War over Cuba was avoided because every weapons system was correctly identified in time to give the President and his policy advisers time to think, to make a rational estimate of the situation and to devise means of dealing with it with a maximum chance of success and a minimum risk of global war."[1] That intelligence triumph was made possible by aerial photography missions flown by the U.S. Air Force and the U.S. Navy and by photo interpreters like the CIA's Arthur C. Lundahl. Part of the success was owing to the crucial adjustment in the camera equipment. At the request of the Air Force Chief of Staff, General Curtis LeMay, a consultant was called in to help resolve the problems they were having with the clarity of the photographs. He was an Air Force brigadier general, retired now for ten years, named George W. Goddard. Around a table at the Pentagon upon which aerial photographs were spread were General LeMay, Under Secretary of the Air Force Joseph V. Charyk, Department of Defense scientists, and a number of other officers. Goddard told the assemblage: "It's all in the camera you're using. You can't use a shutter camera for this kind of low-level mission, you'll get distortion and blur every time. You've got to use the stereo continuous strip camera. It stops motion no matter how fast you fly, and you'll be able to view the results three dimensionally."[2] It was entirely fitting that George Goddard should be in on this milestone event. His life was defined by aerial intelligence and he was its creator.

Born in Tunbridge Wells, England, 30 miles south of London, in 1889, he was the son of a Prudential Life Insurance agent and had been living in the United States since he was 14 years old. A 26-year-old commercial artist in Chicago in 1917 when war with Germany was clearly on the horizon, he decided to apply for a commission in the Army's Corps of Engineers. It was on the train to New York to join that he met Captain John Gordon, a recruiter for the Signal Corps' Aviation Section. Goddard was already under the spell of the new art of flying, so Gordon had little trouble convincing him to apply for the Signal Corps' School of Military Aeronautics at Cornell University in Ithaca, New York, for pilot training. But as is so often the case in the Army, career plans had to give way to military requirements. By virtue of listing photography as a hobby on one of his forms, he was made a photographer. He was told by the adjutant of cadets that the Army was establishing a officer's training school for aerial photographers and needed "the right kind of people in it. …Right now we need aerial photographers more than we need pilots."[3]

His first job at the new school was to build it. The forty people in the first class were put to work with hammers and saws constructing the photo labs and dark rooms in Schoellkopf Hall. Using French and British instructors who were familiar with the terrain in the European theater, the course was designed to turn out officers who would command aerial photographic sections so critically needed in France. Every two weeks large shipments of actual photos taken along the front arrived at Ithaca. Goddard gave a picture of one of the teaching methods at the school.

An up to date map of the entire battlefront from the English Channel to the Swiss border was located on a long, high wall in the classroom. The map showed in great detail the first, second, and third German trench systems, no-man's land and the first, second

and third English, American and French trench systems. Each day the students would interpret the various pictures with the assistance of the French and British instructors who were familiar with the particular areas along the battle lines. The students would then revise the map and bring it up to date.[4]

Additionally, they learned about the technological progress being made by the French, British and Germans. He learned that the Germans with the Zeiss single-lens cameras were taking some 4,000 aerial photographs per day. The British were taking about 1,000 photos daily.[5] The student officers then had a chance for some practical experience, taking off in the rear seat of a Curtiss Jenny from Baker Field near Rochester with their camera in hand.

…A Folmer-Schwing was hand held by a pistol grip and weighed from eight to ten pounds. It took four-by-five-inch photos and there were twelve shots in the magazine. The photographer stood in the rear cockpit belted in by a leather strap hooked to the inside cowl. In taking his pictures, he looked through a view finder with cross hairs and fired away at the prescribed area. Optimum altitude ranged from 12,000 to 15,000 feet, and, of course, there was no such thing as an oxygen mask should it be necessary to go higher. When the picture had been taken and the aircraft was back on the ground, the men in the laboratory field units raced against time to get the photos developed. Ten minutes was considered fast work.[6]

While waiting for his second lieutenant's commission and an overseas assignment, Goddard acted as an instructor in photo interpretation. His commission was granted on 8 August 1918 and he was ordered to Langley Field, Virginia, where he took a month-long course in aerial cameras and field laboratories. Then it was on to Taliaferro Field near Fort Worth, Texas, where he was to organize and equip three photographic sections for movement to France. Here, he learned to fly from his two assigned pilots.

After the armistice, Goddard was transferred to Carlstrom Field in Arcadia, Florida, with orders to fly around the state photographing possible landing sites and making mosaics of larger cities. In Florida he began designing better equipment, a practice that would last over his lifetime. In 1919 he made a special mount to be used with the K-1 Folmer-Schwing camera installed in the Thomas Morse scout plane. Using four tennis balls, he eliminated vibration and made the camera more resistant to shock. Another innovation was a viewfinder in the cockpit that allowed the pilot to take a photograph by pressing a button on the control stick.

It was in Florida that Goddard met Lt. Col. Edward Steichen, a veteran of France, a champion of aerial photography, and one of the great photographers of the 20th century. Steichen was the aerial photography expert on the staff of Col. Billy Mitchell, the assistant chief of the Air Service. It was Steichen and Mitchell who recognized Goddard's devotion to the art of aerial photography and had him reassigned in 1919 as Director of Aerial Photographic Research and Development at McCook Field in Dayton, Ohio.

At McCook, he began working on improving the state of the art, studying ways to upgrade existing cameras, developing a new view finder that made overlap and stereo pictures possible, and night photography. Just a few of his accomplishments were experiments with infrared photography, and long-focal length camera lenses. On 20 November 1925 he took the first night aerial photograph, using a flash-powder bomb with timing fuses to light the city of Rochester, New York, from above, while a camera shutter was opened in his airplane. He foresaw the need of getting the photographs to the users in a timely manner, and in 1927 he took an aerial picture of the federal penitentiary at Fort Leavenworth, Kansas, developed the shot in the plane, and transmitted the picture telegraphically to New York within twenty-three minutes.

In October 1920 he moved to Washington, D.C., a new first lieutenant with a new job, that of Photographic Officer, Training and Operations, Air Service Headquarters, Washington, D.C. Replacing him at McCook was Captain Albert W. Stevens, another champion of aerial photography between wars, who devoted his time to long-distance photography as a solution to the vulnerability of recon planes to both fighters and ground fire.[7] It was a time Goddard referred to as the "lean years." There were low expectations for aerial intelligence within the U.S. Army, even after its good service during World War I. He explained: "…No one in the Air Service gave a tin nickel for the advancement of aerial photography. The young eagles who had come back from France were veteran fighter and bomber pilots and could only think in terms of better fighters and better bombers. Furthermore, neither the infantry nor the cavalry understood the value of photography. The cavalry thought reconnaissance was its job and the science of photoreconnaissance was something too highfalutin and alien for the man on horseback to accept. In fact, it's safe to say that while the U.S. Army cared about reconnaissance, it cared very little about reconnaissance from the air, particularly since the war was over. In any age few men are gifted with the ability to project the new and relatively untried over techniques and methods that have been found usable for centuries."[8] In four years, Goddard would be back at his old job at McCook.

On one occasion when Brig. Gen. Billy Mitchell visited the airfield, Goddard took the opportunity to demonstrate the work he was doing on "quick work photography." When Mitchell's train left Dayton, Goddard was airborne, buzzing the train. His low passes at the plane had the desired effect of luring Mitchell out on to the observation platform. Then Goddard's photographer snapped some aerial photographs, developing them in the plane while Goddard looked for a place to land ahead of the train. At the train's next stop, they came on board and gave Mitchell finished prints of himself standing on the observation platform.

The next stage in the development of a closer-to-real time aerial photographic capability, occurred when Goddard, working closely with American Telephone and Telegraph Company which had patented new technology that allowed the transmission of pictures over telephone lines, set up a demonstration at Fort Leavenworth. A newspaper account in the Chicago *Tribune* gave the details:

> The purpose of the test made by the American Telephone & Telegraph Co., and the army air service was to show the practicability of the device developed by Lieut. George W. Goddard. The picture of the Fort Leavenworth barracks, the theoretical base of the enemy, was snapped at 10:48 a.m.; developed in the air in seven minutes, and two minutes later was dropped by parachute to the Fort Leavenworth station, and in eight and one-half minutes it was going over the wires. At 11:17 the completed picture was ready for inspection and study.
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> The development of this photographic device is only another instance of the valuable work army officers are doing. Lieut. Goddard was told that to enable the commanding officer to make proper and effective disposition of his forces he required a photograph of the enemy's position within half an hour. The lieutenant went aloft, located the position of the enemy, made the exposure, and had the developed negative in the hands of operators ready for transmission by telephone in nine minutes.[9]

A critical stage in Goddard's research into night photography was his adaptation in 1926 of a photoelectric cell to trip the shutter of his camera when light from the exploding flash powder reached the cell. This perfectly synchronized the flash with the shutter. "No more," he wrote, "would I have to drop bombs attached to parachutes or tow a glider full of powder," practices which had produced close calls in

the past. He patented the system which would be used as standard American and allied equipment for the next thirty years.

Even though he was scheduled for an unwelcome tour in the Philippines, Goddard passed up offers of large salaries to come to work for some of the leading camera and lens makers in order to continue his work in the Army. Returning to the U.S. in 1929, after being commended for his work in the Philippines by the commanding general there, he reported to Chanute Field, Rantoul, Illinois, to be Director of the School of Photography, Air Corps Technical Command. He described the curriculum.

The course for enlisted students covered a varied curriculum of subjects ranging from mathematics to mosaic making. (The basic photographic course included mathematics involved in photography, the principles of photography, negative making processes, lantern slide making, photographic optics, cameras, practical ground photography, newspaper and commercial photography, copying, filters, the work of the field photographic section and mosaic making.) There was also a nine-month course for a class of officers. Their curriculum was basically the same as that of the enlisted men, but in addition, they studied practical aerial photography, the military use of photographs, photographic interpretation, and aerial intelligence. Included were approximately 150 hours of air time divided equally between piloting and acting as the photographic observer.

In the training of officers to become photographic pilots and observers, the utmost care was taken in selecting men who had an aptitude for navigation, engineering and endurance flying—rather than the spectacular fighter or attack types. Bomber and transport pilots generally made good photographic aviators, particularly for mapping operations. With our limited number of navigation instruments, it required months of practice and study to become a good photographic pilot.

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Since some of the officer trainees would go on to command photo sections and, both officers and enlisted men alike were required to be proficient in the demanding work involved in every aspect of aerial photography, I stressed innovation in all training. Resourcefulness became the watchword of the school.

For example, in the dead of winter a group of students would be dumped out beside a frozen river. They would have portable laboratory equipment with them. At some point in the next twenty-four hours a plane would fly over and drop rolls of exposed film. Processing the film required cutting a hole in the ice to get fresh water. When the film was developed it was sent back to base by motorcycle. During the exercise the men not only worked under difficult climatic conditions, they also lived under them.[10]

It was while running the school that Goddard ran across many promising enlisted men who he encouraged to attend college. One of them, Private "Red" Nelson, could not afford the cost of higher education so Goddard loaned him Air Corps cameras and lab equipment so that he could work his way through school. He graduated as an honor student and became successful in military and civilian aviation.

He was still working on getting the aerial intelligence product to the commander in the quickest time possible. At the Century of Progress Exposition in Chicago his crew photographed a 25-square-mile area, developed the film, mounted the prints to form a mosaic map of the exposition grounds and surrounding area, and handed the finished display to Maj. Gen. Frank Parker, Sixth Army Corps Area Commander, in a total time of two hours and twenty minutes.

Promoted to Captain in 1934, Goddard became director of photographic research and development in 1936. He summarized his work up until that time in a letter to the Chief of the Air Corps. "The most important accomplishment during that period was my patented elec-

tronic flash and shutter night photo system. Also outlined was the development of quick-work photography in flight, the transmission of aerial pictures over telegraph lines, the K-7 camera which took 9x18-inch photographs, and the development of the first long-range photography."[11]

In his new job he was faced with the dual burdens of general ignorance about the potential of aerial intelligence and the lack of dollars. To illustrate the first difficulty, he said a typical question on an Air Corps Tactical School exam would be "how many bales of hay and how many bushels of oats would it take to move a company of cavalry from point A to point B." In his first year, his budget to develop new cameras, optics and buy lab equipment was $50,000, only $20,000 more than it had been a decade before. Over the last ten years, the staff had been reduced from fourteen to seven, and many key scientists were lost.[12]

But despite the problems, Goddard made some of his major contributions to aerial intelligence during this period, including color film, a new electric flash system, the long-range lens, and the strip camera.

He got the idea for the strip camera while watching the horse races at the Agua Caliente racetrack in California. A camera was positioned at the finish line to determine the winner in close finishes. It was a new kind of camera, shutterless, taking a continuous panoramic picture with the film moving across the a 1/4000-inch slit in the center of the focal frame. The film was synchronized to move at the same speed as the passing horses.

He immediately applied the idea to a military purpose, calling upon civilian contractors to build a prototype camera that had an automatic electronic image synchronizing device that set the film speed to the speed of the plane over the ground. The result was a camera that automatically stopped motion no matter what the aircraft speed or altitude. But the strip camera was not to see immediate acceptance. In Goddard's words, "Some failed to see its potential, others refused to see its value. There is no doubt that of all the many battles I had to fight in the cause of research and development, the battle of the strip camera was the most bitter and difficult and at a later date played a part in an attempt to discredit me and ruin my military career."[13]

The war with Germany was imminent. By 1939, Goddard's budget had climbed to $250,000. General Werner von Fritsche of the German General Staff was predicting that the side with the best aerial reconnaissance capabilities would win the war.

The Army Air Corps had the mission of aerial reconnaissance during the second World War, using unarmed P-38s with their distinctive long-range fuel tanks under the wings. These planes were also known as F-5As. Armed F-6s were also used so that pilots could attack targets of opportunity. By 1944 the Air Corps had an armada of photo recce planes in tactical reconnaissance squadrons. So much had the aerial surveillance mission burgeoned that over 200 missions were flown in one month in 1943 and over half a million prints were delivered.[14]

"There is no substitute for focal length." This became known as Goddard's Law. According to its author it simply meant "the longer you made the lens, the higher your aircraft could fly and the photograph still retained its close-up sharp detail. Great altitude to a reconnaissance pilot in world War II was money in the bank; it meant he had a much better chance of coming home safely."[15]

In October 1941 he arrived in London on a four-month mission to evaluate the state of aerial reconnaissance in the country of his birth. Later, from December 1943 to January 1944 he was back in the states detailed to the Navy Department's Bureau of Aeronautics doing work unrelated to aerial photography, an exile, Goddard be-

lieved, brought about by a rival on General Hap Arnold's staff. In February 1944 he reported to Colonel Elliot Roosevelt's staff in England where he would resume his work in aerial reconnaissance along with the British.

At war's end, Goddard was Photographic Disarmament Officer with the Air Force Technical Intelligence Group, a job that involved collecting aerial photography information and equipment, and rounding up German military and civilian scientists connected to aerial intelligence research. He returned from Europe in August 1945 to his old job as director of aerial research and development at Wright Field. He was wearing the Legion of Merit with Oak Leaf Cluster and the Distinguished Service Medal.

During the Korean War he was hard at work on Project Red Light, a mission to improve night photography that was necessitated by the mountainous terrain of the Korean peninsula. His stereo strip camera was used on RF-80s that made photo runs of the beaches at Inchon in preparation for MacArthur's decisive landing there in September 1950.

Goddard's resourcefulness and inventiveness was not only a boon to the military intelligence profession. It signalled a new way of thinking for military innovators—the adaptation of new technology to military purposes. Henceforth, soldiers would be on the alert for potential advantages that could be provided by technology, culminating in the creation of the research and development arm of the services. He retired from the U.S. Air Force in 1953 and worked as a consultant to the Itek Corporation specializing in aerial photography. He is a distinguished member of the MI Corps.

Notes

1. Alsop, Stewart, *The Center*, Harper and Row, New York, p. 216.
2. Goddard, George W., with Copp, DeWitt S., *Overview: A Life-Long Adventure in Aerial Photography*, Doubleday and Company, Inc., Garden City, New York, 1969, p. xi.
3. *Ibid.*, p. 8.
4. *Ibid.*, p. 8.
5. The advances in weaponry by World War I created a stalemate in the trenches of France. A part of the new technology was full blown aerial surveillance to determine enemy strong points and direct artillery fire. Sausage-shaped balloons with tail fins for stability were tethered in the thousands along the trenches and used by both sides for observation. Observation balloons could reach an altitude of between 1,200 and 1,800 meters, depending on whether it carried one observer or two. A fighter pilot named Frank Luke, Jr., from Phoenix, Arizona, earned the reputation as the "Arizona Balloon Buster."

Aerial reconnaissance also included airplanes. Cameras were aimed from the cockpit by photographers/observers. Most of the pictures were taken at oblique angles rather than pointed straight down. Fighter planes were developed with the express purpose of shooting down the reconnaissance planes. The first American tactical surveillance flight of World War I was made on 15 April 1918 by Major Royce of the 1st Aerosquadron.

Great importance was placed on aerial photography by both the Germans and the allies. Near the war's end, during the Meuse-Argonne offensive in 1918, the U.S. Army reported that 56,000 aerial shots were printed for use by the American Army. Between 1 July and 11 November 1918, 1.3 million aerial photos were taken. And the products were approaching a "real time" usefulness as the time between a photograph being taken and the time it was developed,

printed and interpreted, was as little as twenty minutes.

6. Goddard, p. 11.

7. Along with pilot Captain St. Clair Streett, Stevens set a two-man airplane altitude record of 37,854 in 1928, and later established another record for long-distance photography when he took a picture of Mount Rainier from a distance of 227 miles. Goddard described the six-foot-three, two-hundred pound Westerner as having "a wide open face with jug-handle ears and a bushy mustache." [Goddard, pp. 52-3] He was a mining engineer when he joined the Air Service in 1917, graduated from the short-course at Cornell, and had photographed enemy lines from an observation balloon in France.

8. Goddard, p. 21.

9. *Ibid.*, p. 145-6.

10. *Ibid.*, pp. 215-17.

11. *Ibid.*, p. 231.

12. *Ibid.*, pp. 235-37.

13. *Ibid.*, p. 243.

14. The role of the aerial reconnaissance officer was immortalized by the French poet and novelist Antoine de Saint Exupery, himself an aviator, when he described in *Flight to Arras* a 1940 mission he flew with a photographer named Duterte to gather intelligence over the German lines.

…How long will this crazy challenge go on? I am flying now at two thousand three hundred feet beneath a ceiling of heavy clouds. If I were to rise a mere hundred feet Dutertre [the photographer] would be blind. Thus we are forced to remain visible to the anti-aircraft batteries and play the part of the archer's target for the Germans Two thousand feet is a forbidden altitude. Your machine serves as a mark for the whole plain. You drain the cannonade of a whole army. You are within range of every caliber. You dwell an eternity in the field of fire of each successive weapon. You are not shot at with cannon but beaten with a stick. It is as if a thousand sticks were used to bring down a single walnut.

* * *

The fighters come down on you like lightning. Having spotted you from fifteen hundred feet above, they take their time. They weave, they orient themselves, take careful aim. You know nothing of this. You are the mouse lying in the shadow of the bird of prey. The mouse fancies that it is alive. It goes on frisking in the wheat. But already it is the prisoner of the retina of the hawk, glued tighter to that retina than to any glue, for the hawk will never leave it now.

* * *

The photographs one brings back are submitted to stereoscopic analysis, as organisms are examined under a microscope; the interpreters of these photographs work exactly like bacteriologists. They seek on the vulnerable body of France traces of the virus which devour her. One can die from the effects of these enemy strongholds and depots and convoys which, under the lens, appear like tiny bacilli.

Saint Exupery never returned from a recon mission on 31 July 1944.

15. Goddard, p. 307.