Top Secret WWII Bat and Bird Bomber Program

At the outset of World War II, innovative plans were laid to send some talented fliers to the front lines.

By C.V. Glines

The United States was engaged in a number of secret aviation projects during World War II. Two of them, not revealed to the public for many years, involved American fliers that were being trained to attack enemy forces and die in the process, kamikaze style. However, these fliers were not humans but common bats and pigeons, drafted to make surprise bombing raids on enemy forces.

A dental surgeon from Irwin, Pa., is credited with the idea of using bats as bombers. And a behavioral psychologist, also a Pennsylvanian, showed how pigeons could guide bombs directly to surface targets. The two projects were not related, and the two men never met.

Dr. Lytle S. Adams was vacationing in the Southwest on December 7, 1941, when he heard the shocking news of the Japanese attack on Pearl Harbor. Adams immediately headed home. He had just visited Carlsbad Caverns, N.M. -- believed to house the world's largest bat colony -- where he had been fascinated by the bats that emerged nightly to feed on insects. Thinking about that impressive colony, the dentist asked himself: "Couldn't those millions of bats be fitted with incendiary bombs and dropped from planes? What could be more devastating than such a firebomb attack?" he recalled in a 1948 interview.

He stopped by Carlsbad on his way home and captured some Mexican free-tail bats, the most common species in North America. The free-tails, also known as guano bats, are small brown mammals capable of catching more than 1,000 mosquitoes or gnats in a night. Weighing about 9 grams, the free-tails can carry an external load more than twice their own weight.

Back home, Adams looked up everything he could find about the tiny mammals and discovered that although bats are frequently vilified by the public, they are not usually dangerous to humans. They aren't blind, don't get tangled up in one's hair and don't attack people. Although generally considered evil in Europe, they symbolize prosperity and happiness in China. The Navajo Indians believe them to be intermediaries between men and the gods. They range in size from the bumblebee bat of Thailand, which weighs less than a penny, to the mastiff bat, North America's largest flying mammal with a 22-inch wingspread, and the giant flying fox bat with a 6-foot wingspan, found primarily in Indonesia.

Adams became convinced that bats could be used as bombers. On January 12, 1942, he sent a letter to the White House proposing that the government investigate this possibility. His suggestion was considered, along with hundreds of others from well-meaning citizens with war-winning ideas, but his was one of the few that reached the desk of the commander in chief.

President Franklin D. Roosevelt forwarded a memo to Colonel William J. Donovan, then coordinator of information, with a cryptic notation: "This man is not a nut. It sounds like a perfectly wild idea but is worth looking into." In fact, Adams had already made a name for himself as an inventor. In the 1920s and '30s he launched a 15-year campaign to perfect an airmail pickup system (see "People and Planes" in the March 2005 issue).

Donovan sent the proposal to the National Defense Research Committee (NDRC) of the National Inventors Council. After reviewing Adams' idea, a memorandum titled "Use of Bats as Vectors of Incendiary Bombs" was sent to the committee on April 16, 1942, by Donald R. Griffin, a special-research assistant. He described the proposal as

using "very large numbers of bats, each carrying a small incendiary time bomb. The bats would be released at night from airplanes, preferably at high altitudes and the incendiaries would be timed to ignite after the bats had descended to low altitudes and taken shelter for the day. Since bats often roost in buildings, they could be released over settled areas with a good expectation that a large percentage would be roosting in buildings or other inflammable installations...when the incendiary material was ignited."

Griffin summarized his memo by saying that, although "this proposal seems bizarre and visionary at first glance...extensive experience with experimental biology convinces the writer that if executed competently it would have every chance of success." He recommended an investigation "with all possible speed, accuracy and efficiency" by the U.S. Army Air Forces. Bomb development was passed on to the Army Chemical Warfare Service.

Adams and a team of naturalists were immediately authorized to find bats for experimentation. The team visited a number of likely sites in Texas and New Mexico where the bats could be found in large quantities -- mostly in caves, but also under bridges, in barns and in large piles of rubbish. "We visited a thousand caves and three thousand mines," Adams said. "Speed was so imperative that we generally drove all day and night, when we weren't exploring caves. We slept in the cars, taking turns at driving. One car in our search team covered 350,000 miles."

The team first investigated the mastiff bat, which they determined could carry a 1-pound stick of dynamite. But there was not a sufficient number of that variety available. The more common bat was the mule-eared or pallid species, which could carry 3 ounces. However, the naturalists concluded that the species was not sufficiently hardy for the work that needed to be done.

They finally settled on the Mexican free-tail bat for the project. Although it weighed only one-third of an ounce, experiments showed that it could fly fairly well with a payload of 15 to 18 grams. The Army's Edgewood Arsenal in Maryland, near Washington, D.C., was to design an incendiary bomb weighing no more than 18 grams.

The largest colony of free-tails found during the search was an estimated 20 to 30 million that lived in the limestone Ney and Bracken caves near Bandera, in southwest Texas. At Ney Cave, U.S. Army Captain Wiley W. Carr reported that "five hours' time is required for these animals to leave the cave while flying out in a dense stream fifteen feet in diameter and so closely packed they can barely fly."

Capturing the bats was not difficult. Team members passed nets on long poles back and forth over the cave entrance as the bats emerged from their lairs. As many as 100 were captured in two or three passes, after which they were placed in a refrigerated truck. Adams took some to the Chemical Warfare Service headquarters at Aberdeen, Md., and released them to show Army officials how they could each carry a dummy bomb.

There was much opposition to the project from CWS officials, but in March 1943 the Army Air Forces issued authority for the project to proceed by a memo -- Subject: "Test of Method to Scatter Incendiaries." Purpose: "Determine the feasibility of using bats to carry small incendiary bombs into enemy targets."

Project members studied the habits of the bats intently. Louis F. Fieser, assigned as chief chemist for the Adams project, began to design bombs light enough to be carried by the free-tails. His research showed that the British had designed miniature bombs during World War I called "baby incendiaries" made of thermite that weighed 6.4 ounces. Fieser made two sizes of incendiaries that were oblong celluloid cases filled with thickened kerosene. A small time-delay igniter fuse was attached along one side. One size weighed 17 grams and would burn for four minutes with a 10-inch flame. The other weighed 22 grams and would burn for six minutes with a 12-inch flame.

The time-delay igniter consisted of a firing pin held in tension against a spring by a thin steel wire. When the bombs were prepared for use, a copper chloride solution was injected into the cavity through which the steel wire passed. The copper chloride would corrode the wire in time; when it was completely corroded through, the firing pin snapped forward, striking the igniter head and lighting the kerosene.

To attach the bomb to a bat, technicians clipped the case to the loose skin on the bat's chest with a surgical clip and a piece of string. The bats were dropped from a plane in a cardboard container that would open in midair at about 1,000 feet. According to one CWS report, the bats were then expected "to fly into hiding in dwellings or other structures, gnaw through the string, and leave the bombs behind."

In early May 1943, about 3,500 bats were collected at Carlsbad Caverns and flown in a North American B-25 that had been assigned to the project to Muroc Dry Lake, Calif., for tests. The bats were placed in refrigerators and forced to hibernate. On May 21, 1943, five boxes of bats were dropped from 5,000 feet, but the test was unsuccessful because the bats, not fully recovered from hibernation, could not fly.

The project was transferred to an auxiliary field under construction at Carlsbad, and secret tests continued. This time bats were placed in ice cube trays and cooled off to place them in hibernation. They were then positioned in cardboard cartons for the drop tests. Captain Carr explained the procedure: "Bats were taken from the refrigeration truck in a hibernated state in lots of approximately fifty. They were taken individually by a biologist, and about a one-half inch of loose chest skin was pinched away from the flesh. While this operation was being done, another group was preparing the incendiaries. One operator injected the solution in the delay [mechanism], another sealed the hole with wax, and another placed the surgical clip that was fastened to the incendiary by a short string....The incendiary was then handed to a trained helper who fastened it to the chest of the bat."

Drops of the bats were made with dummy bombs from a B-25 and a Piper L-4 Cub, but troubles once again developed. Many of the bats didn't awaken from hibernation in time to be able to fly, the cardboard cartons didn't always open properly, and the surgical clips proved difficult to attach to the chests of the bats. Team members worked to resolve these problems, and more bats were secured. This time, however, they woke up too quickly when they were released, then escaped.

Captain Carr stated in an interim report: "The bats used at Carlsbad weighed an average of nine grams. They could carry eleven grams without any trouble and eighteen grams satisfactorily, but twenty-two grams appeared to be excessive. These didn't fly very far, and three returned in a few minutes to the building where we were working. One flew underneath, one landed on the roof, and one attached itself to the wall. The ones with eleven-gram dummies flew out of sight. The next day an examination of the grounds around a ranch house about two miles away from the point of release disclosed two dummies inside the porch, one beside the house, and one inside the barn."

Tests continued, and more than 6,000 bats were used in the experiments. In a report dated June 8, 1943, Carr stated that if further tests were to be carried out, a better time-delay parachute-type container, new clips and a simplified time-delay igniter should be designed. He added that "testing was concluded...when a fire destroyed a large portion of the test material." What he didn't point out was that a barracks, a control tower and other buildings at the Carlsbad auxiliary field had been set afire by the bats on the not-yet-occupied base.

The Army had had enough of the experiment by August 1943, and the project was passed to the Navy and assigned to the Marine Corps as Project X-Ray. Marines were assigned to guard four bat caves in Texas, and their first tests began on December 13, 1943. Experiments were carried out with improved "egg crate" trays and bomb shells. In the course of those tests, 30 fires were started -- 22 of which went out on

their own. New and more powerful incendiaries were ordered, and full-scale tests were planned for August 1944. However, when the Navy learned that it would take until mid-1945 to complete the tests, the 27-month, $2 million project was canceled -- "not based on any shortcomings of the incendiary and time units developed," according to the notice, "but rather upon the shortcomings of the fundamental idea and the opportunity of getting sufficient reliable data in order to plan a timely operation."

Adams was very disappointed. He maintained that fires set by bat bombers could have been more destructive to Japanese cities than the two atomic bombs. He noted that bats had scattered up to 20 miles during the tests, adding, "Think of thousands of fires breaking out simultaneously over a circle of forty miles in diameter for every bomb dropped. Japan could have been devastated, yet with small loss of life."

Meanwhile, tests had been ongoing for some time to train birds as kamikaze pilots. Burrhus Frederic Skinner, a behavioral psychologist at the University of Minnesota who believed that pigeons could be trained to guide missiles, originated the idea of using birds as bombers. A scientist noted for his view that learning occurred as a result of an organism responding to, or operating on, its environment, he did extensive research with animals, notably rats and pigeons, and concluded that a rat or pigeon could learn to press a lever in order to obtain food. Skinner wondered, after the Germans bombed Warsaw in 1939, whether a shell or missile could be designed that could be guided to a ground target from an aircraft. He was riding on a train at the time and saw a flock of birds lifting and wheeling in formation as they flew alongside the train. "Suddenly I saw them as ‘devices' with excellent vision and extraordinary maneuverability," he recalled. "Could they not guide a missile? Was the answer to the problem waiting for me in my own back yard?"

Skinner, who already had much experience with birds, chose to work with them in many experiments because they have better vision than humans, are faster in their movements, can distinguish colors, don't get airsick and are more easily handled than many other animals. He decided to focus on pigeons because he discovered that they are more predictable than other birds.

Skinner bought some pigeons at a poultry store and started teaching the birds to earn kernels of grain by pecking at a specific target image. During this training the birds were held in position in front of a screen by means of a special harness. "Feet and wings would be hard to harness," he reasoned, "but the head and neck might be used. The pigeon's eyes could pick out a target, movement of its neck could produce signals to steer the missile, and its head and neck together could pick up grain as a reinforcer.

"I found that I could conveniently package a pigeon in a man's sock with its head and neck protruding through a hole in the toe and its wings and legs drawn together at the back and lightly tied with a shoestring. The jacketed bird could be strapped to a block of wood and put into an apparatus."

Skinner built a system in which the pigeon steered by moving pairs of lightweight rods around its neck. By lifting or lowering its head, the bird closed electrical contacts operating a hoist. By moving its head from side to side, it drove a hoist back and forth on an overhead track.

A bull's-eye was placed on a far wall of the room, a few grains of food were placed in a small cup in the center, and the apparatus was pushed toward it. By moving up or down and from side to side, the pigeon could reach the wall in position to take the grain.

"My pigeons became quite adept at this," Skinner recalled in his autobiography. "I pushed them faster and faster across the room until they were operating the moving hoist as fast as the motors permitted.

He next worked out a system whereby the pigeon pecks were picked up as an electronic signal and transferred to a control system. As the image moved off center,

the pigeon would peck frantically to bring the device back on track; the resulting signals would operate the simulated missile control system to center the device on the target. With practice, his birds hit the target with near perfect accuracy and could easily distinguish one target from another.

Skinner, convinced that his idea had merit, contacted members of the National Inventors Council, who were startled by the proposal and rejected the idea with the comment that it was unrelated to national defense. Undeterred, Skinner made his proposal to the NDRC on June 9, 1941, but again he received a polite "No."

News of the Pearl Harbor attack sparked Skinner to resume his work. He filmed his pigeons in action and again contacted the NDRC, and this time government scientists showed mild interest but felt it was a long shot. When A.D. Hyde, then head of the mechanical division of General Mills Inc., heard about the revolutionary idea, he was at first skeptical that pigeons could be trained as flying suicide bombs. However, he thought Skinner's reasoning was sound and persuaded the company's top management to back the project with technical help until it could be turned over to a government agency.

With this support, Skinner's system was refined. The previous harness was discarded in favor of a more practical lens and screen grid with a special servo-control mechanism. The force of the pigeon's pecking motion was increased by running a bomb's gyro and controls in a vacuum and by placing valves behind the top, bottom and sides of the flexible screen. When the pigeon tapped one of these valves, it opened, permitting air pressure to build up in the system and operate the fins on the bomb. When the target image was at dead center and the pigeon pecked at dead center, all the valves opened an equal amount and the setting was unchanged.

At this stage, the project showed enough promise that the newly formed Office of Scientific Research and Development (OSRD) awarded Skinner a contract in June 1943 under the name of Project Pigeon for "a homing device." The inventor "recruited" a squadron of 64 pigeons (40 homers and 24 ordinary pigeons) from local sources and began their training. The birds were left without food for 36 hours, then placed in a cage with some grain about 30 minutes a day.

The target for the actual bombing experiments, to be located in Florida, was a white pyramid on a green field, so Skinner used a screen of white triangles cut into green paper. Once a bird learned that pecking the white pyramids would produce a few kernels of grain, it was conditioned to expect to be fed when he saw them. As soon as the bird had learned to break through light paper, heavier sheets were substituted. Eventually the pigeon was pecking with the force of a miniature air hammer.

Once a bird had completed this "primary" training, it was graduated to an advanced trainer. This was a lightproof box mounted over a projection screen. A moving picture of a ground target appeared on this screen, and whenever the pigeon pecked it on the screen it caused an electrical contact to close and a small drawer to pop out containing kernels of grain.

This training worked well for a time, but the pigeons quickly learned they could get the grain no matter where they pecked the screen and began to disregard the target itself. Skinner outsmarted them by crossing two beams of light at right angles in front of the image. From then on, a pigeon had to peck the target image at dead center in order to break both beams of light and actuate a photoelectric relay to release the food.

Skinner then added a new tactic. He found he could feed the birds at regular time intervals or after a certain number of pecks. After a while, the pigeons learned to rap out as many as four pecks a second for more than two minutes without a break, and would work feverishly to prevent the target image from moving off dead center.

In one final test, Skinner put each bird into a hand-operated trainer. A person sat behind each pigeon and moved a color photo projected on the screen, at the same

time operating the food magazine. The pigeon had to peck correctly or he got no food at all. According to the report on these experiments: "There wasn't a single washout in the entire class of 64. Every bird earned his wings with an A grade."

Other experiments followed to test the birds' psychological fitness for battle. Target pistols were fired only a few inches from a bird's head. The pigeons didn't miss a peck, didn't even look up. Other extremely loud noises were introduced. Again, the pigeons stayed at their task. Skinner also put the pigeons in a pressure chamber, setting the altitude at 10,000 feet. They were also whirled around in a centrifuge, put on pure oxygen and exposed to bright flashes, simulating shell bursts. High vibrations were also introduced, and the birds were subjected to massive G forces without harmful effects.

Following the success of those experiments, pigeons were placed in three, five and seven tandem positions in a missile to see whether, if one or more birds became obstinate or lazy, the majority could override any incorrect signals and keep the missile on course. The final test was to see whether a male pigeon placed alongside a female would abandon his task or vice versa. Once more, the birds' dedication to the mission was paramount. They pecked away at the target; hunger overcame any other desires. Skinner also learned that pigeons were seemingly fearless when feeding on hemp seed. They worked faster when it was used in place of the standard grain.

When sufficient data had been collected on the pigeons, it was sent to Washington for evaluation. Time passed, and Skinner was invited to OSRD to plead his case before a group of scientists. He brought a jacketed pigeon with him in a box, facing a translucent screen on which a target could be projected from across the room. He described what happened:

The pigeon had been in its jacket for 36 hours, and we had checked the box into and out of the baggage window at Chicago and had carried it with us on two long train rides. If the image on the screen was to be clear, the box would have to be closed, and I had installed a tube through which the pigeon could be watched without admitting too much light, but it would take too long to look down a tube, one person at a time, and I was asked to open the box. That meant that the pigeon saw a very faint image. Nevertheless, it performed beautifully, pecking steadily as we moved the target about. Someone put his hand in the beam from the projector and the pigeon stopped quickly. It started again just as quickly when the hand was withdrawn.

There could scarcely have been a better demonstration of the extraordinary predictability of behavior, the keenness of a pigeon's vision, the accuracy of its responses, and its freedom from distraction.

However, on October 8, 1944, Skinner and his associates were told that "further prosecution of this project would seriously delay others which in the minds of the Division have more immediate promise of combat application." Skinner, like Adams, was disappointed after so much effort had gone into his project. He commented in one of his books that if they meant other guided missile projects had more potential, "the United States had not only no way of guiding a missile but no missile worth guiding. The Germans were far ahead. In September 1943, long before our final meeting in Washington, they had used missiles controlled by radio from mother planes to wreak havoc on the American fleet landing soldiers at Salerno."

Skinner kept his pigeons at home and used the box he had taken to Washington to see if they would retain what they had learned. He tested them at six months, a year, two, four and six years later. All of them accurately struck the target, which enabled him to conclude his work had been worthwhile. While his pigeons were never tested in combat, he was confident they could have carried out their missions.

In the years following World War II, the U.S. Navy became more interested in missiles and their use against surface ships. The reports on Project Pigeon remained classified, but they were unearthed from the Navy files in 1948 and given new life under the

designation Project Orcon (for organic control). The Naval Research Laboratory was tasked with "conducting a program of research to determine the feasibility of using pigeons as the sensing element for controlling missiles."

Tests were conducted over the next five years, using a sophisticated trainer that simulated a missile. The pigeon suspended inside faced a screen on which color photos of actual ships were projected. A metal contact was attached to its beak, and a flexible wire from it linked the bird to the missile.

A gridless screen made of electrically conducting glass tracked where the pigeon had pecked it. The servo-motors then steered the missile to a target ship, and the bird was rewarded with the usual kernels of corn. Repeated performances showed that the pigeons could guide missiles -- well enough under ideal conditions to score hits, although clouds, waves and shadows could throw them off course.

Project Orcon was canceled in 1953, when electronic guidance systems for missiles were deemed reliable. The Orcon test results, however, were kept under wraps for six more years before they were declassified. Meanwhile, there was an important spinoff from the research. The electrical conducting glass developed for the pigeon training became a key feature in the combat control centers of U.S. warships. It was employed by plotters using magnetic probes to trace the course of attacking aircraft.

Although bats and pigeons were never used to bomb enemy targets, the test results show that they could have. It is interesting to speculate what the results might have been if they had actually gone to war.