Introduction

As part of the commemoration of the Centennial of Flight, the National Park Service's National Register of Historic Places and Regional Offices, in partnership with Dayton Aviation Heritage National Historical Park, United States Air Force, U.S. Centennial of Flight Commission and the National Conference of State Historic Preservation Officers (NCSHPO), proudly invite you to explore **Aviation: From Sand Dunes to Sonic Booms**. Much of America's 20th-century history is inextricably linked to aviation. America's rise to preeminence in aviation was accomplished through the astonishing achievements of men and women in both the public and private sectors. The pioneers of America's aviation industry built the technological and industrial infrastructure that enabled aviation to succeed, while the exploits of daring flying heroes captured the public imagination and encouraged the support of aviation. The Federal government supported the development of military aviation, conducted important aeronautical research, and established, regulated, and encouraged the development of interstate passenger, postal, and freight commerce. In celebration of a century of flight, this travel itinerary highlights more than 100 listings in the National Register of Historic Places--historic aircraft, airfields, research and testing facilities, aeronautical and engineering research laboratories, military installations, battle sites, launch and control facilities--that tell the stories of the significant people and events that made the United States the world's leader in aviation.

The American public had a fascination with aviation throughout the 20th century. Aerial combat in the First World War established heroes such as Lt. Edward Rickenbacker, "Ace of Aces" and winner of the Congressional Medal of Honor. The Golden Age of Aviation between the world wars brought enthusiasm for flying to all parts of the country via air shows, air races, barnstormers, and wing walkers. The exploits of daring pilots, including Charles Lindbergh, Amelia Earhart and Howard Hughes were closely followed as they set speed, distance, and endurance records. Hollywood captured America's love of the romance of flight in the movies; the first Academy Award for best motion picture was presented to the 1927 film *Wings*, the story of American Army Signal Corps pilots battling the Germans in the skies over France. America's entry into World War II was precipitated by a Japanese aerial attack on Pearl Harbor in Hawaii on December 7, 1941. The United States responded with the massive mobilization of men and war materiel that eventually destroyed German Nazism and Italian fascism in Europe and the expansionist Japanese empire. The bombers, fighters and transport aircraft produced by American industry contributed substantially to that victory. After the Second World War, developments in aviation were spurred by the tensions of the Cold War and the expanded civilian growth of air travel for pleasure and business. The military focused on high-speed aircraft to maintain air superiority. The Soviet Union's launching of Sputnik on October 4, 1957, was a pivotal event in the development of the American space program. The United States responded to this challenge with exceptional achievements: manned space flight, lunar landings, exploration of the solar system, and development of the space shuttle program.

Aviation: From Sand Dunes to Sonic Booms offers several ways to discover the places that reflect the history of American aviation. Each highlighted site features a brief description of the place's historic significance, color photographs and public accessibility information. At the bottom of each page the visitor will find a navigation bar containing links to six essays that explain more about the Idea of Flight, the Wright Brothers, Aviation Pioneers, Modern Aviation,

Air Power and Space. These essays provide historic background, or "contexts," for the places included in the itinerary. In the Learn More section, you will find links to regional and local web sites that provide visitors with further information regarding cultural events, special activities, and lodging and dining possibilities. The itinerary can be viewed online, or printed out if you plan to visit any of these places in person. Visitors may be interested in Historic Hotels of America, a program of the National Trust for Historic Preservation, located near the places featured in this itinerary.

Created through a partnership between the National Park Service's National Register of Historic Places and Regional Offices, Dayton Aviation Heritage National Historical Park, United States Air Force, U.S. Centennial of Flight Commission and NCSHPO, **Aviation: From Sand Dunes to Sonic Booms** is the latest example of a new and exciting cooperative project. As part of the Department of the Interior's strategy to promote public awareness of history and encourage tourists to visit historic places throughout the nation, the National Register of Historic Places is cooperating with communities, regions, and Heritage Areas throughout the United States to create online travel itineraries. Using places nominated by State, Federal and Tribal Historic Preservation Offices and listed in the National Register of Historic Places, the itineraries help potential visitors plan their next trip by highlighting the amazing diversity of this country's historic places and supplying accessibility information for each featured site. **Aviation: From Sand Dunes to Sonic Booms** is the 29th National Register travel itinerary successfully created through such partnerships. Additional itineraries will debut online in the future. The National Register of Historic Places hopes you enjoy this virtual travel itinerary of aviation history. If you have any comments or questions, please just click on the provided e-mail address, "comments or questions" located at the bottom of each page.

Idea of Flight

From the earliest days, humans have dreamed of flying and have attempted to achieve it. Greek and Roman mythology have examples of gods who were gifted with flight. Daedalus and Icarus flew through the air, and Icarus died when he flew too close to the sun. Religions relate stories of chariots that fly through the air and winged angels that join humans in the heavens. Flying creatures that were half human and half beast appear in legends. Birds and fantastic winged creatures pulled boats and other vehicles through the air. The ancient Chinese invented spinning toys that were the earliest helicopters and their designs may have influenced Leonardo da Vinci, one of the world's greatest inventors, artists, and visionaries.

Chinese records describe human attempts to sail through the air by attaching themselves to kites-one of the most significant inventions leading to flight which, with its inclined wing, evolved into the airfoil. Da Vinci discovered and analyzed several of the basic principles of aerodynamics and physics and designed machines (but, in most cases, did not fly them) that applied these principles. He wrote prolifically, and it was only because his written works were lost for centuries that his influence on other inventors was not greater than it was. His writings included hundred of sketches that illustrated his observations of flight in nature and the inventions he designed. He wrote and drew on key problems of aeronautics, including action and reaction; the structure of wings, carrying surfaces, and landing gear; and even devices for directional control.

Others in the next centuries took tentative steps toward flight. Various individuals tried to imitate the motion of birds and built apparatus with flapping wings called ornithopters. Sometimes they attached wings to their arms and sometimes also their legs. Some mounted winged devices that they manipulated in various ways and occasionally added foot-pedal power. Although a few were able to travel short distances, others died when they jumped off roofs or towers and they and their devices crashed to the ground. Other experimenters tried gliding rather than flapping. In general, these were more successful than the flapping efforts, although the distances were still very short. In any case, many claimed to have flown but, not surprisingly, few had witnesses or could offer proof.

The first experimenter who a ctually analyzed the various forces that contributed to flight was the Englishman George Cayley at the end of the eighteenth century. Cayley identified and defined the forces of flight and sketched out an airplane that had the primary elements of a modern aircraft. Cayley defined the principles of mechanical flight and stated that, to fly, it was necessary for surfaces to be able to support a weight by applying "power to the resistance of air." In other words, the force that moved an object in a forward direction had to be greater than the opposite force (resistance or drag) that the air exerted on an object. His "On Aerial Navigation" was one of the important early works on aviation. He also introduced the scientific method to the study of aviation-stressing careful analysis of problems and thorough testing. In the mid-nineteenth century, he demonstrated these principles with glider models that actually were able to carry the weight of a passenger a short distance. Cayley also experimented with variously shaped wings and demonstrated the importance that wing shape had on the ability of an aircraft to generate the lift that kept it afloat.

Cayley's work influenced inventors for at least the next fifty years. Both unpowered gliders and airplanes that were powered by engines were attempted. Gliders were built that progressively could fly farther and farther and over which the pilots gradually gained control. Some of these gliders were outlandish-looking devices with various types of wing designs that had one, two, three, or even more flying surfaces. Some had short stubby wings while others had wings that were extremely long and narrow. In France, the founding of the first aeronautical society, the Sociéte Aérostatique et Météorologique de France, in 1852, marked the recognition of aviation as a legitimate discipline. Louis Charles Letur built and tested a parachute-glider, which was the first pilot-controlled machine to be tested in flight. Michel Loup, Jean-Marie LeBris, and others built flying machines that were modeled after birds.

Inventors added engines to their gliders or balloons to provide forward motion as they became available or built new designs that were meant to use the power provided by an engine. The first engines were steam-driven and generally were too heavy to provide enough power for effective lift in relation to the weight of the apparatus they were meant to power. In England, William Henson designed and patented the Aerial Steam Carriage, a powered device that was based on Cayley's doctrines. It was never built, but the steam engine that was designed to power it was judged the best that had been built up to that time.

However, inventors had more success when an engine was used with a balloon. The year 1852 marked the first time a powered device had been applied to an airframe-in this case, it was Henri Giffard's airship that was driven by a three-horsepower steam engine. Two decades later, Félix

Du Temple built a steam-powered monoplane that managed to rise a few feet off the ground-the first powered fixed-wing aircraft that carried a passenger, albeit down a slope. Thomas Moy built an Aerial Steam Carriage that was a monoplane powered by a steam engine that lifted a few inches off the ground. These aircraft displayed various types of propeller assemblies that were all sizes. Other inventors, such as Alphonse Pénaud, used twisted rubber strips, basically a rubber band, to propel their flying machines. He developed theories about wing contours that he successfully applied to model airplanes, helicopters, and ornithopters. He also designed an amphibian monoplane that anticipated features that were implemented later. But he committed suicide before the design took real shape. Others used compressed air to generate thrust, and one inventor used gunpowder to power a propeller. Others reshaped wing to make them more aerodynamically effective and generate more lift.

The final advances before the achievements of the Wright brothers took place in Europe in the last decade of the nineteenth century. The first was that of the French inventor Clément Ader who flew one machine more than 150 feet (50 meters) but only inches off the ground and a second about ten feet (three meters) off the ground. He claimed he was the first to fly, but others categorized his achievements as mere "hops." The second, and more significant development, was that of the German engineer Otto Lilienthal, who was the first to launch himself into the air and fly. He built monoplane, biplane, and triplane gliders--eighteen variations in all--and conducted experiment after experiment that tested their flying abilities. He earned the title the "father of aerial testing" with his more than two thousand glider flights, some which covered distances of over a thousand feet (300 meters) before he died as a result of a crash landing in 1896. The American Octave Chanute also was a major figure at the end of the nineteenth and beginning of the twentieth centuries. Chanute, a respected and successful engineer and bridge builder, documented the efforts of others who had experimented with aviation, whether they had been successful or were abject failures. He was the first aviation historian and lent his considerable reputation and analytical skills to publicizing and adding respectability to the burgeoning discipline. He also constructed and flew gliders with his colleague Augustus Herring along the shores of Lake Michigan near Chicago, Illinois. Chanute served as a friend and mentor to the Wright brothers and encouraged them in their efforts.

The final unsuccessful attempt at powered flight occurred in the United States. Samuel Pierpont Langley, astronomer and secretary of the Smithsonian Institution in Washington, tested several small models that were powered by gasoline engines. These were successful and he was encouraged to try a full-size airplane called an Aerodrome. He attempted two launches in 1903, just days before the Wright brothers made their first powered flight, from a houseboat anchored in the Potomac River near Washington, D.C. Both attempts were unsuccessful.

Aside from the airplane, the aerial explorers of balloons and lighter-than-air (LTA) airships also deserve mention in the prehistory and history of aviation. The balloon predated the airplane by more than a century, and like the airplane, was used for both scientific study and military observation. The later LTA airships were a continuation of the idea of using buoyancy in transporting people, materials, and even weapons, through the air.

Balloons Airplanes are heavier than air and fly because of the aerodynamic force generated by the flow of air over the lifting surfaces. Balloons and airships are lighter-than-air (LTA), and fly

because they are buoyant, which is to say that the total weight of the aircraft is less than the weight of the air it displaces. The Greek philosopher Archimedes (287 BC - 212 B.C.) first established the basic principle of buoyancy. While the principles of aerodynamics do have some application to balloons and airships, LTA craft operate principally as a result of aerostatic principles relating to the pressure, temperature and volume of gases. A balloon is an unpowered aerostat, or LTA craft. An airship is a powered LTA craft able to maneuver against the wind.

There are only two practical methods of producing a buoyant aircraft. If the air inside a suitably large and lightweight envelope is heated to a high temperature, the gas expands and a sufficient amount of fluid (air is a fluid) may be forced out of the interior so that its weight decreases and the total weight of the craft becomes less than the amount of fluid (or air) displaced. Hot air balloons were flown by the brothers Joseph and Etienne Montgolfier as early as the spring of 1783. While the materials and technology are very different, the principles used by the earliest eighteenth-century experimenters continue to carry modern sport balloons aloft. Since 1960, hot air sport airships have also been constructed.

The other means of achieving buoyant flight is to fill the envelope with a gas that is sufficiently lighter than air. The first hydrogen-filled balloon was designed and constructed by Jacques A.C. Charles and launched from the Champs de Mars in Paris on August 27, 1783. Jean Pierre Blanchard, a French aeronaut, made the first free flight with a gas balloon in the United States from Philadelphia in January 1793. First-generation aeronauts quickly realized that hydrogen balloons would remain in the air longer, and fly higher and farther, than hot-air balloons. The basic elements of gas balloon technology fell quickly into place. A valve at the top of the balloon, controlled by a valve line dropping through the appendix of the balloon into the basket, is used to release gas, making the balloon heavier and causing it to descend. Jettisoning a small amount of ballast, usually water, shot, or sand, would lighten the balloon and cause it to rise. A combination hot air and gas balloon is called a Rozier balloon, in honor of it inventor, Pilatre de Rozier, who with Francois Laurent, the Marquis d´Arlandes, was the first human being to make a free flight.

While there were no revolutionary changes in free balloon technology until the development of the hot-air sport balloon following World War II, there were significant refinements during the nineteenth century. In Europe and America, city illuminating gas was commonly used where possible rather than hydrogen. In cases where inflation was undertaken in rural areas of towns where illuminating gas was not available, portable hydrogen generators were often used. The best known of these was produced by the American Thaddeus S.C. Lowe, who pioneered observation ballooning with the Union Army during the Civil War. The use of the drag rope was commonly adopted to assist in maintaining a fairly constant altitude close to the ground. A long line was allowed to drag on the ground behind a balloon in flight. When the balloon rose, it lifted additional rope, and weight, off the ground, slowing its rise. If the balloon began to drop, it would trail additional line on the ground, reducing the weight of the craft and slowing the descent.

Balloons served a variety of purposes in the eighteenth and nineteenth centuries. They provided a spectacular means of public entertainment throughout this period. Show people who dazzled ground-hugging spectators with their death-defying feats of aerial daring-do were popular in both

Europe and America. Attempts to put tethered balloons to work as battlefield observation platforms began with the wars of the French Revolution and continued through World War I. There can be little doubt, however, that the balloon was most successfully used gathering scientific information on the upper atmosphere. From the beginning of the nineteenth century to the dawn of the space age, the balloon carried instruments and human beings to the roof of the atmosphere. The most important change in ballooning in the twentieth century was the introduction of inert helium as the primary lifting gas for American balloons and airships. As the United States controlled the entire world's supply of helium, other nations continued to fly with inflammable hydrogen.

Science and sport remain the most common applications of ballooning today. Balloons remain meteorological workhorses and continue to carry instrument packages aloft for short and long-term voyages into the atmosphere. Hot air balloons are an important part of modern sport aviation. Finally, the highly visible attempts to accomplish one record after another, from nonstop crossings of the oceans, to altitude records, to flights around the globe, capture the imagination of the press and public. Aerostation, the oldest form of flight, is alive and well and as capable of exciting public interest and enthusiasm as it was two centuries ago.

Airships

The dream of a navigable, or dirigible, balloon can be traced to the late eighteenth century. Not until the middle years of the nineteenth century were the first serious attempts made to realize that dream, however. A French experimenter, Henri Giffard, is usually credited with flying the first primitive airship in 1852. Airships are traditionally divided into three classes: rigid, semi-rigid and non-rigid. Non-rigid airships, or pressure airships, depend on the internal pressure of the gas in the envelope to maintain their shape. The blimps so familiar to viewers of major sporting events are pressure airships. Semi-rigid airships are pressure airships with a rigid keel structure.

Beginning in the last quarter of the nineteenth century, French constructors were active and successful in the design and operation of very large semi-rigid military airships. During the period 1900-1906, small, usually single-person, blimps of the sort popularized by the Brazilian Alberto Santos-Dumont were used to entertain mass audiences in Europe and America. It was the emergence of the German Zeppelin during the years 1900-1913 that marked the genuine coming of age of the rigid airship, however.

Vehicles of commerce and weapons of war, Zeppelin airships offered the first practical means of transporting very heavy loads over very long distances through the air. As such, they served as transitional vehicles, performing a variety of duties from bombing enemy cities to providing transoceanic passenger service in an era when those tasks were beyond the capability of heavier-than-air craft. The era of the great rigid airship came to an end before World War II, when airplanes were able to carry substantial payloads over transoceanic distances at far higher speeds. Ultimately, basic technological limitations led to the demise of the rigid airship. The catastrophic destruction of the airship Hindenburg by fire in May 1937 marked the effective end of the rigid airship, although the dream of reviving the era of the "ships in the sky" continues to capture the imagination of enthusiasts.

Blimps continued in service with the U.S. Navy through World War II and into the era of the Cold War before being dropped from the inventory. Pressure airships continue to thrill spectators and to serve the needs of the media and advertisers. Proponents of the rigid airship continue to search for an economic niche that would justify a return of the large rigid airship.

This essay, titled in its original form *The Prehistory of Powered Flight--an Overview* by Judy Rumerman can be found in its original form on the U.S. Centennial of Flight Commission's website. Added to this essay is another one, slightly edited here, which can also be found in its original form on the U.S. Centennial of Flight Commission's website, titled *Lighter-Than-Air-an Overview*, by Tom D. Crouch, Senior Curator, Aeronautics, National Air and Space Museum, Smithsonian Institution.

Wright Brothers

Orville and Wilbur Wright were the sons of Milton and Susan Wright. Milton rose from circuit preacher to bishop of the Church of the United Brethren of Christ. Susan Wright attended Hartesville College in Indiana where she studied literature and science and was the top mathematician in her class. As an adult, she frequently built household appliances for herself and toys for her children. Wilbur was born in 1867 near Millville, Indiana, and Orville was born in Dayton, Ohio, in 1871. Their home had two libraries-the first consisted of books on theology, the second was a large, varied collection. Looking back on his childhood, Orville once commented that he and his brother had "special advantages...we were lucky enough to grow up in a home environment where there was always much encouragement to children to pursue intellectual interests; to investigate whatever aroused their curiosity."

Both Wilbur and Orville did well in school, although Orville was known for getting into mischief. Orville and Wilbur were the only members of the immediate Wright family who did not receive a high school diploma, attend college, or marry. Because of Milton's position in the church, the Wrights moved frequently-twelve times before finally settling in Dayton, Ohio, in 1870. He traveled widely on church business, but always sent back many letters and often brought presents home. In 1878, he brought Wilbur and Orville a rubber band powered toy helicopter. Wilbur and Orville made several copies of this toy-it was the first powered aircraft they built together. Orville later recalled that the helicopter was based on a design by French inventor Alphonse Pénaud. They later studied his work in aeronautics as grown men.

During the winter of 1885-86, Wilbur was injured in an ice skating game. Complications-both mental and physical-followed. His illness derailed his plans to enter Yale College and become a teacher. It took him three years to recover his health. During his convalescence, he read avidly and nursed his mother, who had been suffering from tuberculosis since 1883. By 1886, she required constant care. In 1888, Milton Wright broke with the liberal leadership of the church and started his own conservative sect, Church of the United Brethren, Old Constitution. Susan Wright died in 1889.

The year 1889 was a turning point for the family. After many years of convalescing and caring for his mother, Wilbur recovered from his illness and joined Orville in the printing business. As soon as they had mastered the printing process, they moved on to building their own printing presses and briefly published two local newspapers. In 1892, the brothers went into the bicycle

business -first selling and repairing bicycles, and then, in 1896, building them. The brothers added a few original improvements to the customary components, including an oil-retaining wheel hub and coaster brakes, which are still used today.

Ever since Milton brought home the helicopter toy, Wilbur and Orville had an interest in aviation. They followed the accounts of the German gliding pioneer, Otto Lilienthal, with great interest. Lilienthal's death in 1896 inspired the brothers to seriously investigate flight.

The Wright Brothers' 1900 Kite and Glider Experiments

By 1899, the Wright brothers had become seriously interested in the problem of human flight. After they exhausted the references locally available to them, they wrote to the Smithsonian Institution in Washington, D.C., for further information. When they read the works of others, particularly Lilienthal, Octave Chanute, and Samuel Pierpont Langley, they realized the one factor that had prevented others from achieving successful flight was the pilot's lack of ability to balance and control the craft once it was airborne. They believed the other difficulties of propulsion and determining the most efficient wing shape were minor in comparison, or had already been solved.

In May 1900, when Wilbur was 33 and Orville 29, Wilbur wrote to Octave Chanute and introduced Orville and himself. At 68, Chanute was a well-known engineer and leading authority on aviation. He had conducted his own flight experiments and documented the efforts of the many people who had attempted to build flying machines. Chanute would become a good friend and encouraged Wilbur and Orville's efforts for many years.

At the time, most inventors were designing flying machines that were inherently stable. These craft would maintain a straight and level course with little maneuvering by the pilot. In contrast, Wilbur believed that the pilot had to have a means of controlling and balancing the motion of an aircraft in every axis. To solve the lateral control issue, he developed the concept of "wing-warping." This control system worked by twisting the wings in opposite directions, which increased the air pressure on one wing while decreasing it on the other. The resulting effect lifted one wing and lowered the other. In July 1899, Wilbur built a kite to test a wing-warping control system. When he tested the kite, he was able to make it climb, dive, and roll by manipulating the kite strings. The Wrights were ready to move on to the next step.

In 1900, they methodically began designing their first full-size, man-carrying aircraft, which they originally intended to use as a kite and control from the ground. This craft had two sets of wings, one above the other, a framework that allowed wing-warping, and an elevator in front of the wings to control the pitch (or angle) of the aircraft. When their design was nearly complete, they wrote to the U.S. Weather Bureau for help in finding the best place to build and test their invention. Based on the information they received, they decided Kitty Hawk, a wind-blown village on the Outer Banks of North Carolina, offered them the most suitable wind conditions and plentiful sand dunes to cushion their landings.

Wilbur departed Dayton and arrived at Kitty Hawk on September 12, 1900. He began assembling their kite, a biplane, with a 17-foot (5.2-meter) wingspan. Orville joined him two weeks later, bringing a tent and more supplies. The brothers began their test flights during the first week in

October. Their kite had a wing area of 165 square feet (15 square meters) and a forward elevator for pitch control and some protection in the event of a crash. The first flights of the tethered kite were made without a pilot on board. The aircraft did not develop as much lift as they had expected and the flights were disappointing. On October 10, the wind caught the aircraft while parked, hurling it 20 feet before it struck the ground, which damaged it in several places. It was repaired and design adjustments were made, and the test continued. On October 18, Wilbur climbed on board and flew-gliding without the constraints of a tether-as much as 300 to 400 feet (91 to 121 meters) for up to 15 seconds. During the next week, the wind was too light for manned glides, and the brothers broke camp for the winter on October 23. They returned to Dayton with plans to come again the next year with a larger glider.

Further Gliding and Wind Tunnel Experiments - 1901

The brothers returned to Kitty Hawk the next summer and set up at Kill Devil Hills, in what is today the Wright Brothers National Memorial. From July 17 to August 16 they conducted tests with a new glider featuring 290 square feet of wing area. It also incorporated a foot actuated wing-warping control system that the pilot used to turn the aircraft. The brothers also made sure the wing camber matched Otto Lilienthal's calculations. The glider would nose-dive into the ground, and, once, only the front-located elevator saved Wilbur's life. The brothers realized how Lilienthal had been killed when his glider crashed on his final flight. They began questioning the validity of Lilienthal's aerodynamic calculations they were using and suspected Lilienthal's data for camber contributed to the problem.

Although the brothers succeeded in making one flight of 389 feet (120 meters), outdistancing Chanute's gliders of 1896, they decided to return to Dayton and perform their own calculations for airfoil lift and drag. Back in Dayton, they received an invitation from Chanute, inviting them to speak at the distinguished Western Society of Engineers meeting. Wilbur's speech, titled 'Some Aeronautical Experiments,' was made to an appreciative crowd of society members and their wives, where he showed slides of his machines in the air. He suggested that Lilienthal's lift and drag tables were wrong. Once Wilbur had publicly stated they believed that Lilienthal's data was wrong, they had to find a way to determine the correct data.

Setting out to collect accurate information with a wind tunnel constructed in the back room of their bicycle shop, they designed and operated wind tunnel balances; the instruments placed inside the tunnel to accurately measure the forces operating on small model airfoils. Tom D. Crouch, in his entry on the Wrights in the *American National Biography*, wrote "Constructed of bicycle spoke wire and hacksaw blades, the balances enabled Wilbur and Orville to gather those precise bits of information required to design the wings of a flying machine."

During late October and early November, Orville and Wilbur conducted tests on some 200 different wing shapes in the tunnel. By mid-December 1901, they had discovered, much to their surprise, that Lilienthal's tables were largely correct. It was Smeaton's coefficient that was wrong. The brothers also found the camber, or curvature, of Lilienthal's wings was inefficient. To remedy this, they designed wings with more of a parabolic curve that placed the high point of the wing about one-fourth of the way back down the chord from the leading edge rather than at its center, as Lilienthal had. There was one other area where they had erroneously relied on Lilienthal's tables. They did not correct for the differences in the aspect ratio between Lilienthal's

wing and the wings of their gliders. In other words, the proportion between the wingspan and the wing's chord length was different. This also affected the amount of lift generated.

Success! Orville's and Wilbur's 1902 Glider Flights

The brothers returned to Kill Devil Hills on August 27, 1902, and spent their first week there repairing the aircraft hangar and setting up camp. They then began to assemble their new machine. Based on their wind tunnel data, their 1902 glider had a new wing with a shallow camber and high aspect ratio. It was a major departure from their earlier machines. It had roughly the same wing surface area as the 1901 machine, but the similarities ended there. The wingspan was ten feet (three meters) longer and the chord two feet (0.6 meter) shorter than the old machine, making the glider look larger and more graceful. It had an overall length of 16 feet (5 meters) and weighed 112 pounds (51 kilograms). The wing camber followed a shallow parabolic curve, and the elevator was extended farther out in front of the pilot. This gave it more leverage, which allowed better control. The 1902 glider also had a new rudder that consisted of two fixed vertical surfaces located behind the aircraft. Wilbur and Orville calculated that these would help prevent the skidding that had occurred when they warped the wings.

After adjusting the wing trussing to provide more stability in a crosswind, they began their tests on September 19. From the first test flight as a kite, it was evident their new glider was vastly superior to their two previous machines. One problem persisted. The glider still slipped in turns. The tail did little to stop it; in fact, Orville suspected it made the problem worse. When the wings were warped and the airplane began to turn, the set of wings inside the turn was moving slower (and therefore generating less lift) than the wings on the outside. At the same time, the fixed tail-no longer parallel to the air stream-presented a broad surface that dragged in the air, increased the skid, and further slowed the inside wings. The wings dropped as they lost more and more lift, and the glider went into an uncontrolled spiral and struck the ground. The brothers called this "well-digging." Orville determined that they could avoid "well digging" if the fixed tail was changed into a movable rudder with its own separate control. This would allow the pilot to adjust its angle during a turn to overcome the drag from the high wing, keep the inside wing from losing too much lift and prevent the aircraft from skidding. Wilbur accepted the idea but suggested the pilot already had enough to do without the addition of another control. Instead, the brothers coupled the wires that turned the rudder with the wing warping mechanism. On October 6, 1902, they replaced the double rudder with a single movable rudder.

They had finally solved three-dimensional control. The movable rudder, which had an area of 5.7 square feet (0.5 square meter), made the 1902 Wright glider the first aircraft capable of being precisely balanced in flight. This glider was the world's first aircraft with three-axis control-control around the longitudinal, lateral, and vertical axes-and was the heart of the Wrights' first pioneer "flying machine" patent. This breakthrough was so basic every aircraft and spacecraft flying today still use the same fundamental controls of roll, pitch, and yaw first developed by the Wright brothers. Altogether, the brothers flew their glider almost 1,000 times during September and October. The best flying came in late October, after all the visitors had left. Wilbur made a glide covering 622 feet (190 meters) with a duration of 26 seconds; Orville's best was 615 feet (187 meters), staying aloft just over 21 seconds.

They returned home to Dayton on October 28, ready for the next step, powered flight. The 1902

glider was, for all practical purposes, the first true airplane. It was this machine that would form the basis of there 1906 patent. All that was now needed for powered flight was a propeller and an engine.

Before the First Powered Flight

Orville and Wilbur Wright returned to Dayton at the end of October 1902. In December 1902, Wilbur wrote to ten engine manufacturers with his specifications. He needed a gasoline motor weighing no more than 180 pounds (82 kilograms). It needed to provide at least 8 horsepower (6 kilowatts).

While they waited to hear from the engine companies, they begin working on the propeller. Realizing that a propeller was simply an airplane wing that turned on a spiral course rather than moving ahead, they turned to the wind tunnel to provide the information they needed. They built a larger wind tunnel to test their propeller theory. They first used the tunnel to develop their equations; then they tested small-scale models of propellers. In February 1903, they hand-built and tested their first full-size propeller. They ended up with two 8.5-foot (2.6-meter) spruce propellers with tips covered in muslin to keep the wood from splitting.

To eliminate the effect of torque, the two propellers would turn in opposite directions by means of crossing one of the drive chains. When coupled with the motor that the Wright brothers built through the effective chain drive transmission, the propellers provided a combined thrust of 90 pounds, just enough to let their airplane rise under its own power, fly, and land. The propellers had a high efficiency of 66 percent.

This compared to propellers designed in nineteenth century Europe that had an efficiency of only 40 to 50 percent and propellers designed by Samuel Langley with an efficiency of 52 percent. (Propeller efficiency is defined as the power output of the propeller divided by the shaft power input from the engine, expressed as a percentage.) In practical terms, the propellers converted two-thirds of the energy applied to them to thrust.

In the meantime, they had heard from the engine manufacturers. All replies were negative-no one had an engine that met the Wrights' specifications and no one was willing to develop one. They decided to build their own engine with the help of their talented mechanic, Charlie Taylor. After their first effort failed, the four-cylinder engine was finally ready in May 1903. The airplane on which they planned to mount the engine and propellers was their largest so far-40 feet (12.3 meters) from wingtip to wingtip. Orville referred to it as the "whopper flying machine." It was too large to assemble in Dayton, and the brothers packed up the parts to assemble when they arrived at Kitty Hawk, North Carolina. On September 23, 1903, Wilbur, Orville, the parts of their machine, and a launch system they had constructed, left Dayton for Kitty Hawk.

The First Flight

Thursday, December 17, 1903, dawned, and was to go down in history as a day when a great engineering feat was accomplished. It was a cold day with winds of 22 to 27 miles an hour blowing from the north. The Wrights waited indoors; hoping the winds would diminish. But they continued brisk, and at 10 in the morning the brothers decided to attempt a flight, fully realizing the difficulties and dangers of flying a relatively untried machine in so high a wind.

In strong winds, hills were not needed to launch the machine, since the force of the winds would enable the machine to take off on the short starting track from level ground. Indeed, the winds were almost too gusty to launch the machine at all that day, but the brothers estimated that the added dangers while in flight would be compensated in part by the slower speed in landing caused by flying into stiff winds. As a safety precaution, they decided to fly as close to the ground as possible.

A signal was again displayed to notify the men at the Kill Devil Hills Life Saving Station that further trials were intended. They took the machine out of the hanger, and laid the 60-foot starting track in a south-to-north direction on a smooth stretch of level ground less than 100 feet west of the hanger and more than 1,000 feet north of Kill Devil Hill. They chose this location for the trials because the ground had recently been covered with water, and because it was so level that little preparation was necessary to lay the track. Both the starting track and the machine resting on the truck faced directly into the north wind. The restraining wire was attached from the truck to the south end of the track.

Before the brothers were quite ready to fly the machine, John T. Daniels, Willie S. Dough, and Adam D. Etheridge, personnel from the Kill Devil Hills Life Saving Station, arrived to see the trials; with them came William C. Brinkley of Manteo, and John T. Moore, a boy from Nags Head. The right to the first trial belonged to Orville; Wilbur had used his turn in the unsuccessful attempt on December 14.

After running the engine and propellers a few minutes, the takeoff attempt was ready. At 10:35 a.m., Orville lay prone on the lower wing with hips in the cradle that operated the control mechanisms. He released the restraining wire and the machine started down the 60-foot track, traveling slowly into the headwind at about 7 or 8 miles an hour--so slow that Wilbur was able to run alongside holding the right wing to balance the machine on the track. After a run of 40 feet on the track, the machine took off. The airplane then climbed 10 feet into the sky, while Orville struggled with the controlling mechanisms to keep it from rising too high in such an irregular, gusty wind.

Orville sought to fly a level flight course, though buffeted by the strong headwind. However, when turning the rudder up or down, the airplane turned too far either way and flew an erratic up-and-down course, first quickly rising about 10 feet, then suddenly darting close to the ground. The first successful flight ended with a sudden dart to the ground after having flown 120 feet from the takeoff point in 12 seconds time at a ground speed of 6.8 miles an hour and an airspeed of 30 miles an hour. In the words of Orville Wright:

This flight lasted only 12 seconds, but it was nevertheless the first in the history of the world in which a machine carrying a man had raised itself by its own power into the air in full flight, had sailed forward without reduction of speed, and had finally landed at a point as high as that from which it started.

Orville found that the new, almost untried, controlling mechanisms operated more powerfully than the previous controls he had used in gliders. He also learned that the front rudder was balanced too near the center. Because of its tendency to turn itself when started, the unfamiliar

powered machine's front rudder turned more than was necessary.

The airplane had been slightly damaged on landing. Quick repairs were made. With the help of the onlookers, the machine was brought back to the track and prepared for a second flight. Wilbur took his turn at 11:20 a.m., and flew about 175 feet in about 12 seconds. He also flew an up-and-down course, similar to the first flight, while operating the unfamiliar controls. The speed over the ground during the second flight was slightly faster than that of the first flight because the winds were diminishing. The airplane was carried back to the starting track and prepared for a third flight.

At 11:40 a.m., Orville made the third flight, flying a steadier course than that of the two previous flights. All was going nicely when a sudden gust of wind from the side lifted the airplane higher by 12 to 15 feet, turning it sidewise in an alarming manner. With the airplane flying sidewise, Orville warped the wingtips to recover lateral balance, and pointed the airplane down to land as quickly as possible. The new lateral control was more effective than he had expected. The airplane not only leveled off, but the wing that had been high dropped more than he had intended, and it struck the ground shortly before the airplane landed. The third flight was about 200 feet in about 15 seconds.

Wilbur started on the fourth flight at noon. He flew the first few hundred feet on an up-and-down course similar to the first two flights. But after flying 300 feet from the take-off point, the airplane was brought under control. The airplane flew a fairly even course for an additional 500 feet, with little undulation to disturb its level flight. While in flight about 800 feet from the take-off point, the airplane commenced pitching again, and, in one of its darts downward, struck the ground. The fourth flight measured 852 feet over the ground; the time in the air was 59 seconds.

The four successful flights made on December 17 were short because the Wrights, not desiring to fly a new machine at much height in strong winds, sometimes found it impossible to correct the up-and-down motion of the airplane before it struck the ground. They carried the airplane back to camp and set it up a few feet west of the hangar. While the Wrights and onlookers were discussing the flights, a sudden gust of wind struck the airplane and turned it over a number of times, damaging it badly. The airplane could not be repaired in time for any more flights that year; indeed, it was never flown again. Daniels gained the dubious honor of becoming the first airplane casualty when he was slightly scratched and bruised while caught inside the machine between the wings in an attempt to stop the airplane as it rolled over.

Orville made this matter-of-fact entry in his diary: "After dinner we went to Kitty Hawk to send off telegram to M. W. While there we called on Capt. and Mrs. Hobbs, Dr. Cogswell and the station men." Toward evening that day Bishop Milton Wright in Dayton received the telegram from his sons:

Success four flights Thursday morning all against twenty-one mile wind started from level with engine power alone average speed through air thirty-one miles longest 57 seconds inform press home Christmas. Orevelle Wright.

In the transmission of the telegram, 57 seconds was incorrectly given for the 59-second record

flight, and Orville's name was misspelled. The Norfolk telegraph operator leaked the news to a local paper, the *Virginian-Pilot*. The resulting story produced a series of false reports as to the length and duration of the December 17 flights. Practically none of the information contained in the telegram was used, except that the Wrights had flown.

Their father gave out a biographical note: *Wilbur is 36, Orville 32, and they are as inseparable as twins. For several years they have read up on aeronautics as a physician would read his books, and they have studied, discussed, and experimented together. Natural workmen, they have invented, constructed, and operated their gliders, and finally their 'Wright Flyer,' jointly, all at their own personal expense. About equal credit is due each.*

The world took little note of the Wrights' tremendous achievement and years passed before its full significance was realized.

After the First Flight

After 1903, the Wrights carved brilliant careers in aeronautics and helped found the aviation industry. The successful flights made at Kill Devil Hills in December 1903 encouraged them to make improvements on a new airplane called Flyer No. 2. About 100 flights were flown near Dayton in 1904. These totaled only 45 minutes in the air, although they made two 5-minute flights. Experimenting chiefly with control and maneuver, many complete circuits of the small flying field were made.

A new and improved plane, Flyer No. 3, was built in 1905. On October 5 they made a record flight of 24 1/5 miles, while the airplane was in the air 38 minutes and 3 seconds. The era of the airplane was well on the way. The lessons and successes at Kill Devil Hills in December 1903 were fast making the crowded skies of the Air Age possible.

Believing their invention was now perfected for practical use, the Wrights wanted the United States Government to have a world monopoly on their patents, and more important, on all the aerodynamic, design, and pilotage secrets they knew relating to the airplane. As early as 1905 they had received overtures from representatives of foreign governments. The United States Army turned down their first offers without making an effort to investigate whether the airplane had been brought to a stage of practical operation. But disbelief was on the wane. In February 1908 the United States War Department made a contract with the brothers for an airplane. Only 3 weeks later the Wrights closed a contract with a Frenchman to form a syndicate for the rights to manufacture, sell, or license the use of the Wright airplane in France.

During their Dayton experiments, the Wrights had continued to pilot their airplanes while lying prone with hips in the cradle on the lower wing. Now they adopted a different arrangement of the control levers to be used in a sitting position and added a seat for a passenger. The brothers brought their airplane to Kill Devil Hills in April 1908 to practice handling the new arrangement of the control levers. They wanted to be prepared for the public trials to be made for the United States Government, near Washington, and for the company in France.

They erected a new building at Kill Devil Hills to house the airplane and to live in, because storms the year before had nearly demolished their 1903 camp buildings. Between May 6 and

May 14, 1908, the Wrights made 22 flights at their old testing grounds. On May 14 the first flight with two men aboard a airplane was made near West Hill; Wilbur Wright being the pilot, and Charles Furnas, a mechanic, the passenger. Orville and Furnas then made a flight together of over two miles, passing between Kill Devil Hill and West Hill, and turning north near the sound to circle Little Hill before returning over the starting point close to their camp to land near West Hill on the second lap.

Byron R. Newton, a newspaper reporter, was concealed in the woods with other newsmen near camp to watch the Wrights fly. Newton predicted in his diary just after seeing his first flight: "Some day Congress will erect a monument here to these Wrights." Nineteen years later the Congress established the area as a National Memorial.

Wilbur journeyed to France after completing the tests at Kill Devil Hills, while Orville returned home to complete the construction of an airplane for the United States Government. As Wilbur set about methodically to assemble his airplane at Le Mans, some 125 miles from Paris, skeptics greeted the delay by accusing him of bluffing. But Wilbur refused to hurry. "Le bluff continue," cried a Paris newspaper. However, when Wilbur took off on August 8, circling the field to come in for a perfect landing, the crowd could scarcely believe its eyes. Skeptics were confounded, and enthusiasm was uproarious.

Wilbur's complete lack of conceit, together with his decency and intelligence, won a hero-worship attitude from the French people, while the press was unsparing in its praise and lamented having called him a bluffer. The Figaro commented, "It was not merely a success but a triumph; a conclusive trial and a decisive victory for aviation, the news of which will revolutionize scientific circles throughout the world." It was a statement to the press by a witness, Maj. B. F. S. Baden-Powell, president of the Aeronautical Society of Great Britain, that is most often quoted: "That Wilbur Wright is in possession of a power which controls the fate of nations is beyond dispute."

Orville's first public flight was on September 3, 1908 at Fort Myer, in Virginia. He circled the field one and one-half times on the first test. "When the airplane first rose," Theodore Roosevelt, Jr., recorded "the crowd's gasp of astonishment was not alone at the wonder of it, but because it was so unexpected." Orville's final flight at Fort Myer in 1908 ended in tragedy. The airplane crashed, killing Lt. Thomas Selfridge, a passenger flying with Orville. Orville suffered broken ribs, a fractured leg, and hip injuries.

In 1909, Orville completed the Government test flights by flying 10 miles in 14 minutes, or just under 43 miles an hour. The United States Army formally accepted its first airplane from the Wrights on August 2, 1909. During the same year both brothers made further flying triumphs in Europe where they became famous flying in France and Italy. While Orville was making sensational flights in Germany (as required for the formation of a Wright company in that country), Wilbur, in America, made spectacular flights at New York City where more than a million New Yorkers got their first glimpse of an airplane in the air.

Commercial companies were formed in France and Germany to manufacture Wright planes before the Wright Company was organized in the United States with Wilbur as president and

Orville vice president. In financial affairs the Wrights were remarkably shrewd-- a match for American and European businessmen. They grew wealthy as well as famous, but they were not happy as businessmen and looked forward to the time when they could retire to devote themselves again to scientific research. While the Wright brothers finally obtained a patent for their aircraft, they became involved in legal battles with Glenn Curtiss. The lawsuit dragged on.

Orville returned to Kill Devil Hills in October 1911 to experiment with an automatic control device and to make soaring flights with a glider. The new device was not tested because of the presence of newspapermen at the camp each day. Orville set a new world's soaring record of 9 minutes and 45 seconds on October 24. On May 30, 1912, Wilbur Wright, aged 45, died of typhoid fever. Orville survived him by 36 years, dying on January 30, 1948.

The Original Airplane Exhibited

Orville Wright was unwilling to entrust the 1903 airplane to the National Museum in Washington, D.C., because of a controversy between him and the Smithsonian in regard to the history of the invention of the airplane. In 1928, Orville lent the airplane to the Science Museum at South Kensington, near London, England, with the understanding that it would stay there permanently unless he made a written request for its return. Finally, in 1942, the dispute with the Smithsonian was settled to Orville's satisfaction, and the next year he wrote a request to the Science Museum for the return of the airplane to this country when it could be safely shipped after World War II ended.

After Orville Wright's death, on January 30, l948, his executors deposited the original 1903 airplane in the National Air Museum. It was formally placed on exhibition on December 17, 1948, in Washington, D.C., the 45th anniversary of the first flights. The priceless original 1903 Wright airplane now occupies the highest place of honor among other interesting aeronautical exhibits in the National Air and Space Museum in Washington D.C.

The National Memorial

On March 2, 1927, the Congress authorized the establishment of Kill Devil Hills Monument National Memorial to commemorate the Wrights' achievement of the first successful flight of a man-carrying, power-driven, heavier-than-air machine. The area was transferred from the War Department to the National Park Service, U.S. Department of the Interior, on August 10, 1933, and on December 1, 1953, the name was changed to Wright Brothers National Memorial. The memorial contains about 425 acres. It embraces the actual site of the first four flights and the sites of most of the glider experiments. A 60-foot granite monument dedicated in 1932 is perched atop 90-foot high Kill Devil Hill commemorating the achievement of these two visionaries from Dayton, Ohio. A visit should include touring the museum exhibits, participating in a ranger conducted program, touring the reconstructed camp buildings and first flight trail area, and a climb up Kill Devil Hill to view the memorial pylon. The visitor center houses exhibits which are available year-round. Adjacent to the camp buildings are granite markers which designate the lengths of the four successful powered flights. Learn more about The Wright Brothers National Memorial at the park's website.

The preflight section of this essay was exerpted, in abridged form, from Judy Rumerman's essays on the the Wright Brothers found on the U.S. Centennial of Flight Commission's website, with additional information taken from Tom D. Crouch's book *The Bishop Boys: a Life of Wilbur and Orville Wright* (New York: W.W.

Norton Company, 1989) and his essay on Wilbur and Orville Wright in *American National Biography* (New York: Oxford University Press, 1999). The section of the first flight onwards, slightly abridged, was taken from U.S. Department of the Interior, National Park Service pamphlet *Wright Brothers National Memorial* by Omega G. East. Washington: Government Printing Office, 1961. (National Parks Service Historic Handbook Series No. 34) (129.58:34).

Aviation Pioneers

Throughout human history, many people have challenged themselves and each other to see who could be the "best." Aviators are no exception. From the dawn of flight up to the present day, pilots have been a particularly competitive group as they vied to see who could fly the fastest, the highest, and the farthest. Many of them have also battled to see who could achieve an aviation "first." To non-pilots, some aviators' actions in pursuit of these goals may have seemed foolhardy, careless, or even crazy and needlessly reckless. But in reality, these aviators were actually pushing themselves in a courageous and determined manner to move beyond their supposed mental and physical limitations to conquer their many challenges.

Whether pursuing a flight record, performing aerial tricks in front of crowds, or exploring new areas of the globe, they shared some of the same fearless qualities. In all, the aerial explorers, daredevils, and record setters of the 20th century have been a very intrepid and driven group of individuals, determined to bring out not only the best in themselves, but also in each other.

In July 1909, Louis Bleriot, a French aircraft designer and self-trained pilot, became one of the first record setters in aviation history. On July 25, Bleriot, piloting a monoplane, braved strong winds and rain to become the first person to fly across the English Channel. Bleriot's 37-minute journey between France and England was the first major flight over a large body of water. It also inspired several adventurous individuals to become aviators, as well as helping to spark the public's interest in flight. When the first organized international air meet took place in Bleriot's native land only a month after his trip, somewhere between 300,000 to 500,000 spectators flocked to the event.

The Reims Air Meet, which took place from August 22 to 29, 1909, in the Champagne region of France, was the world's first major aerial exhibition. Twenty-two aviators competed in a variety of contests and races. One of the contestants, Hubert Latham, who had unsuccessfully vied with Bleriot to become the first person to fly the English Channel, had better luck at Reims, when he won the altitude contest. The premier event of Reims was the 20-kilometer Gordon Bennett Cup Race, won by American airplane builder and pilot Glenn Curtiss, who beat Bleriot, the race favorite, and collected a $5000 purse as well as the title of "Champion Aviator of the World." As the first international air meet, Reims served as the model for all of the other organized contests that would soon follow, not only providing entertainment and the opportunity to set air records, but also offering a place to test the technological advances of aircraft.

In 1910, only a few months after Reims, three major air meets took place in the United States that drew many of the world's top aviators, among them Glenn Curtiss and Englishman Claude Grahame-White. Several aviation records were set at these meets, held in Los Angeles; Atlantic, Massachusetts near Boston; and at Belmont Park, New York. The meets also served to inspire

future aviators, notably Lincoln Beachey and Harriet Quimby. Quimby was so thrilled by her experience that she instantly decided she wanted to learn to fly. Within a year, she became the first U.S. woman to earn a pilot's license. Quimby would go on to give several aerial demonstrations and help break down stereotypes that suggested that women could not make good pilots. Her ultimate achievement was when she became the first woman to cross the English Channel, on April 16, 1912, a feat also inspired by Bleriot's flight. Although Quimby had a major impact on women's roles in aviation, she did not live long. At the Third Annual Boston Aviation Meet in July 1912, the same meet that had enticed her to learn to fly two years earlier, Quimby died while demonstrating an aircraft.

Meanwhile, Curtiss, as well as history's first aviators--Orville and Wilbur Wright--were assembling their own teams of exhibition pilots. These teams traveled the country, entertaining crowds and helping to feed the public's interest and enthusiasm in flight by competing against each other to see who could fly the fastest, farthest, and highest. Curtiss team member Lincoln Beachey became the most accomplished and popular of all of the exhibition aviators. By the end of 1911, he was the single greatest moneymaker in aviation up to that time. During his career, he became the first to fly upside-down and the first American to "loop-the-loop." Unfortunately Beachey met the same fate as so many early exhibition pilots; he too, died while performing a stunt.

Cal Rodgers, one of the Wright brothers' students, had learned to fly in June 1911 after only 90 minutes of flight lessons. Despite being deaf as the result of a childhood bout with scarlet fever, he established one of the first American aviation records. Starting from Sheepshead Bay, New York, on September 17, 1911, Rogers flew his Wright biplane flyer, the Vin Fiz, to California, landing in Pasadena, on November 5, and becoming the first person to fly across the United States, while setting the first major American aviation endurance and distance record.

Rodgers had carried the first transcontinental mail pouch on his cross-country trip, consequently joining the intrepid group of pioneering pilots that transported mail during aviation's first decades. Airmail pilots risked their lives delivering correspondence and packages across the nation and around the world while braving bad weather and difficult navigational challenges. Their efforts helped connect the United States and the world more quickly. Some well-known airmail pilots included Claude Grahame-White and even Charles Lindbergh, who would go on to have a major impact on aviation in the late 1920s.

After World War I, aerial daredevilry became more widespread thanks to the advent of "barnstorming." Stunt pilots and aerialists--or "barnstormers" as they became known, many of whom were former World War I pilots--performed almost any trick or feat with an airplane that people could imagine, often piloting their JN-4 "Jenny" biplanes, which the government sold cheaply as surplus. During the 1920s, barnstorming became one of the era's most popular forms of entertainment. For many pilots and stunt people, barnstorming provided an exciting and challenging way to make a living, as well as an outlet for their creativity and showmanship. The entire phenomenon seemed to be founded on bravado, with "one-upmanship" a major incentive. The fact, too, that there were no federal regulations governing aviation at the time allowed barnstorming to flourish during the postwar era.

Several well-known aviators were barnstormers at one time or another. Charles Lindbergh, for example, learned to fly on the barnstorming circuit. He also did some wing walking and parachute stunting. Some other famous daredevils included Roscoe Turner (a future major speed racer), Bessie Coleman (the first licensed African American female pilot), Pancho Barnes, (born Florence Leontine Lowe who earned her nickname "Poncho" while working as a deck hand aboard a ship impounded by the Mexican authorities during the 1927 Cristero rebellion and would become a well-known speed queen of the "Golden Era of Airplane Racing"), Wiley Post, (a future holder of two trans-global speed records), Clyde "Upside Down" Pangborn" (who would set a major trans-Pacific flight record) and Ormer Locklear, (the first man to wing walk and Hollywood's first stunt flier).

After his days as a barnstormer and airmail pilot, Charles Lindbergh made history on May 20, 1927, when he became the first person to fly the Atlantic Ocean solo nonstop. Lindbergh's record-setting flight from New York to Paris, in the Spirit of St. Louis, a journey of 3,610 miles in 33 hours, became a major source of inspiration and a catalyst for many pilots who would later set their own significant aviation endurance and distance records.

Soon after Lindbergh crossed the Atlantic, other pilots looked to other oceans to traverse. The Pacific Ocean became the next logical and major challenge. Just a little more than a year after Lindbergh's flight, on June 10, 1928, Australian aviators Charles Kingsford-Smith ("Smithy") and Charles T. P. Ulm landed in Brisbane, Australia, having become the first pilots to fly across the Pacific. Their record-setting feat, like Lindbergh's, would inspire many aviators.

Jean Gardner Batten, a New Zealand woman, was one of the people particularly inspired by both Lindbergh and Smithy. Determined to become a record-setting aviator, she obtained her pilot's license in England, and soon after established a solo flight record, flying from England to Australia in 14 days, 22 hours, 30 minutes. The following year, on November 11, 1935, she set another record, the best flight time from England to South America. Braving extremely hazardous weather over the South Atlantic, Batten succeeded in flying the approximately 5,000 mile in just a little over 61 hours. Notably, Batten would go on to set several more aviation records during her career.

One of the pilots inspired to take action by Lindbergh's transatlantic flight was Douglas "Wrong Way" Corrigan, an Irish-American flier who incidentally had assembled the wings for Lindbergh's Spirit of St. Louis. Corrigan decided that he, too, was going to make his own transatlantic flight, and chose Ireland as his destination. Although federal authorities never granted him permission for a transatlantic flight because they considered his airplane too unstable, Corrigan defiantly flew to Ireland in July 1938 when he was "supposed" to be flying back to California. Corrigan gained his nickname by claiming that he had honestly flown the "wrong way" due to heavy fog and a faulty compass.

One of the most remarkable aviation endurance and distance records of the era was set by former barnstormer Wiley Post, the one-eyed son of a poor farmer, and Harold Garry, a well-known Australian pilot. The pair took off on June 23, 1931, from Roosevelt Field, Long Island, in pursuit of the current around the world record of 21 days held by the German dirigible, the Graf Zeppelin. Post and Gatty made it around the world in 8 days, 15 hours, 51 minutes.

Approximately two years later, Post made the same flight solo, bettering his and Gatty's record by 21 hours.

Soon other aviators tried to surpass Post's record. Among these were former barnstormer Clyde "Upside-down" Pangborn and his navigator Hugh Herndon Jr., who had unsuccessfully raced against Post and Gatty in June 1931 in their attempt to better the Graf Zeppelin record. Pangborn and Herndon were actually doing quite well until they got lost over Mongolia and caught in a driving rainstorm. The pair settled on being the first aviators to fly nonstop from Japan to the United States, on October 4-5, 1931.

Howard Hughes, Jr., one of America's most famous billionaires and among the world's most important aviators, was determined to let nothing stop him in his pursuit of Post's global flight record. By the early 1930s, flying racing planes he had designed himself, Hughes had set several speed and altitude records. In 1936, he established several transcontinental flight records. Then, in July 1938, Hughes and a four-man crew took off from Floyd Bennett Field in Brooklyn and systematically set out to demolish Post's trans-global flight record. On July 14, he landed in front of some 25,000 cheering people in New York. Hughes and his crew had smashed Post's record, setting a record of 3 days, 9 hours, and 17 minutes, more than four days better than Post's mark.

Amelia Earhart was another pilot who attempted to set an around the world flight record. Earhart, inspired to take up flying after going to an early air show, earned her pilot's license in October 1922.

Soon after, she established the first of many altitude records. Over the next 15 years, Earhart would set several women's speed, altitude, and transcontinental records and also become the first woman to solo across the Pacific Ocean. Her ultimate goal was to be the first pilot of either gender to fly around the world at its widest point--close to the Equator. Earhart, one of the most accomplished pilots of either sex, set out on her journey on May 20, 1937. With roughly only 7,000 miles left to go, Earhart and her navigator Fred Noonan disappeared in bad weather near Howland Island in the Pacific. Search parties have never located Earhart, Noonan, or their plane.

While Earhart, Hughes, and others pushed themselves and their airplanes to their limits in pursuit of trans-global records, other intrepid aviators were testing their own limitations while exploring the harshest and most remote areas of the world, the polar regions. During the 1920s and 1930s, several aviators explored both the Arctic and Antarctic by air. Although some aerial explorers had used hot air balloons in the late 19th and early 20th centuries to venture into these areas, aviators did not conquer the Arctic until U.S. Navy Lieutenant Commander Richard Byrd and his pilot Floyd Bennett reached the North Pole via the skies on May 9, 1926. A few years later, in April 1928, Australian adventurer George Wilkins joined forces with a former Alaskan airmail pilot named Carl Ben Eielson to became the first humans to fly across the North Polar Sea. Then, on June 18, 1937, Russian pilot Valery Chkalov and two crew members improved on Wilkins and Eielson's record by setting a nonstop, long distance flight record when they flew the approximate 5,500 miles from Moscow to Vancouver, Washington, via the North Pole, in 62 hours. In the following years, several Russians would set other aerial records in the Arctic.

In December 1928, Wilkins and Eielson also became the first team of pilots to fly over

Antarctica. Less than a year later, on November 28, 1929, Byrd established another polar first when he, pilot Bernt Balchen, and two other crew members were the first to fly over the South Pole. The last major Antarctic aviation "first" came when American explorer Lincoln Ellsworth and Canadian pilot Herbert Hollick-Kenyon became the first team to fly the width of the Antarctic continent from November through December 1935.

As aviators were exploring the most extreme reaches of the Earth during the 1920s and 1930s and setting records in the process, other pilots were establishing their own series of records at the major air racing trophy contests of the period. These contests produced arguably the most-exciting competitions in aviation history and contributed significantly to the advancement of aeronautics during what some historians have labeled "The Golden Age of Air Racing." Often, sponsored by wealthy benefactors, aviators competed at four major races during the era: the Pulitzer Trophy Race, a speed contest flown around a pylon-marked course; a seaplane race called the Schneider Cup; the Thompson Trophy, a closed circuit, pylon-marked contest, similar to the Pulitzer except that it was a mass start, free-for-all contest; and the Bendix Trophy Race, a transcontinental, point-to-point race. Many aeronautical innovations resulted because of these contests as engineers developed highly maneuverable aircraft that could race at breakneck speeds.

The major trophy races of the era produced several stars and record-setting performances. Jimmy Doolittle, a daredevil pilot and army man with a Ph.D. in aeronautical engineering, was one of the standouts of the era. Doolittle won the Schneider Cup in 1925 and then went on to capture the Bendix Trophy in 1931 and the Thompson race in 1932. He also established an aircraft speed record in September 1932 flying a Gee Bee racing plane. The Gee Bee racers, which several pilots flew to record-setting performances, were among the fastest and most controversial airplanes of the era, sporting the dubious reputation among some as "killers." Roscoe Turner, another former barnstormer and a Hollywood stunt pilot, also did extremely well in the major trophy races. The flamboyant Turner, who at one time carried a lion cub with him on his flights, won the Bendix Trophy in 1933 and three Thompson Trophies, a feat never matched by any other pilot. Turner also set seven transcontinental speed records during his career.

Several women also excelled in the air races of the 1920s and 1930s. Pancho Barnes, also a former barnstormer and Hollywood stunt pilot, competed in some of the women's air races of the period, including the Women's Air Derby (also known as the "Powder Puff Derby"). Barnes set several women's air speed records during her flying days.

Louise Thaden was another woman who made significant showings in the trophy races. In 1936, Thaden and her copilot Blanche Noyes won the Bendix. Two years later, Jackie Cochran, arguably the greatest female aviator, won the same contest. Cochran, the president of the Ninety-Nines, an organization of female pilots who championed women's roles in aviation, set more speed and altitude records than any of her contemporaries, either male or female. During her career, she would receive more than 200 awards and trophies. Cochran not only became one of the world's great aviatrixes but also one of the best pilots of either gender. She would test and fly aircraft into the 1960s and become the first woman to break Mach 1, or the sound barrier.

The first person to fly faster than the speed of sound, however, was Cochran's good friend Chuck

Yeager. On October 14, 1947, Yeager exceeded Mach 1 in the X-1, an experimental aircraft. Yeager is undoubtedly the world's most famous test pilot and one of the "toughest" fliers, both mentally and physically. During his career in the U.S. Air Force, he not only established multiple flight records but also displayed extraordinary courage and determination.

Joseph Kittinger was another U.S. Air Force officer who demonstrated outstanding bravery and established several records. On June 2, 1957, Kittinger became the first person to ascend to over 96,000 feet (29,261 meters) in a balloon. Two years later, on November 16, 1959, he became the first individual to parachute back to Earth from a high altitude when he jumped from a height of 76,000 feet (23,165 meters). Within a year, he would go on to establish several more high-altitude records and free-fall marks while challenging many people's ideas about the limits of human beings and helping prepare the country for the human spaceflight program.

In December 1986, Dick Rutan and Jeana Yeager, two pilots who embody much of the same spirit, character, adventure, and heroism as Kittinger and Chuck Yeager (although Jeana is not related to the test pilot), broke one of aviation's last record barriers when they flew nonstop around the globe in their plane, the Voyager. Taking nine days, three minutes, and 44 seconds they traveled 24,986 miles and established a nonstop global record. They also endured the longest flight up to that point and almost doubled the then current flight distance record. Rutan and Yeager's flight explored the limits of human endurance and mental fatigue and represented the triumph of the human spirit.

From Louis Bleriot to Dick Rutan and Jeana Yeager, aviators have pushed themselves and their aircraft in their quest to be the "best." Many aerial explorers, daredevils, and record setters spurred each other on and motivated others to follow in their flight paths. With their competitive natures, aerial explorers, daredevils, and records setters all shared a little bit of the same traits. In many ways, each had to be part explorer, daredevil and records setter and willing to explore their own personal limits and the limits of their machines in a very brave and determined manner.

This essay is taken from *Explores, Daredevils, and Record Setters-an Overview* by David H. Onkst. The original essay can be found at the U.S. Centennial of Flight's website.

Modern Aviation

The U.S. Aircraft Industry - An Overview T. A. Heppenheimer

Inspired by the first successful flights in 1903 of Wilbur and Orville Wright, of Dayton, Ohio, men such as Glenn Curtiss of Hammondsport, New York started their own aircraft companies, competing with the Wright Brothers, who had swiftly capitalized upon their success by creating the Wright Company. A California planebuilder, Glenn L. Martin, established a firm called the Glenn L. Martin Company. These outfits all did plenty of business during World War I. Following that conflict; there was little demand for new aircraft, for there were plenty of war surplus planes and engines. Martin built some of the earliest bombers--one sank a captured German battleship in a 1921 exercise, impressing military planners.

Other airplane builders also went into business: Donald Douglas, William Boeing, and Alan

Loughead, who pronounced his name "Lockheed," and took to spelling his company's name that way. All three found good prospects. Donald Douglas got started by working with a wealthy enthusiast who wanted a airplane that could cross the country nonstop. By building it, Douglas gained experience that allowed him to develop a long-range Army plane, the World Cruiser. Two World Cruisers flew around the world in 1924 in a succession of short hops.

Airmail held promise. It earned federal subsidies for mail carriers that made it easy to turn a profit. A few brave travelers also began buying airplane tickets. Boeing gained an important success in 1926 with a single-engine airplane that was well suited for carrying mail and passengers over the Rocky Mountains. The same year Lockheed, which then employed the engineer Jack Northrop, crafted the Vega, which set speed and altitude records and became popular as an airliner. Jack Nothrop later founded his own plane-building firm.

By the 1930s airliners were mainstays of the industry. Boeing brought out the 247, a fine twin-engine job that carried ten passengers where the Vega had room for only six. It eventually lost out in competition with the swifter Douglas DC-2, which carried 14. The DC-3, an enlarged version, entered service in 1936 with 21 seats and the range to fly nonstop from New York to Chicago. It soon swept most of its rivals from the skies. Small military orders for airplanes continued. Martin built a good twin-engine bomber, the B-10. Boeing found new business by crafting a much better bomber: the B-17. It had four engines, which gave it greater speed and allowed it to carry more gasoline for longer range. Army officials, who saw it in tests in 1935, placed orders. This gave Boeing a leg up on building bombers for use in World War II.

That war brought an enormous surge of business to the aircraft industry. Several companies built the important warplanes of the era:

Boeing: B-17, B-29 bombers

Convair: B-24 bomber

Lockheed: P-38 fighter

Curtiss: P-40 fighter, C-46 transport

Douglas: C-47, C-54 transports

North American: P-51 fighter

Republic: P-47 fighter

Most importantly, the War Department bought airplanes by the tens of thousands. Here are aircraft deliveries by year:

Type	**1940**	**1941**	**1942**	**1943**	**1944**	**1945**	**Total**
Very Heavy Bombers	**0**	**0**	**4**	**91**	**1,147**	**2,657**	**3,899**

Heavy Bombers	**19**	**181**	**2,241**	**8,695**	**13,057**	**3,681**	**27,874**
Medium Bombers	**24**	**326**	**2,429**	**3,989**	**3,636**	**1,432**	**11,836**
Light Bombers	**16**	**373**	**1,153**	**2,247**	**2,276**	**1,720**	**7,785**
Fighters	**187**	**1,727**	**5,213**	**11,766**	**18,291**	**10,591**	**47,775**
Reconnaissance	**10**	**165**	**195**	**320**	**241**	**285**	**1,216**
Transports	**5**	**133**	**1,264**	**5,072**	**6,430**	**3,043**	**15,947**
Trainers	**948**	**5,585**	**11,004**	**11,246**	**4,861**	**825**	**34,469**
Communication/ Liaison	**0**	**233**	**2,945**	**2,463**	**1,608**	**2,020**	**9,269**
Total by Year	**1,209**	**8,723**	**26,448**	**45,889**	**51,547**	**26,254**	**160,070**

Fleets of B-17s and B-24s escorted by P-47, and P-51 fighters, destroyed many of Nazi Germany's factories and railroads. B-29s carried firebombs that burned Japan's cities to the ground. The C-46 carried supplies to China. The C-47, a military version of the DC-3, carried troops as well as cargo. Over ten thousand of them entered service. General Dwight Eisenhower, the top U.S. commander, counted it as one of the items that did the most to win the war. The end of the war brought a swift collapse of the aviation industry, as the nation became awash in used aircraft.

For airlines, the DC-3 remained popular for short air routes, but coast-to-coast routes along with connections that crossed the Atlantic were gaining in popularity. For these routes only new four-engine aircraft would do. Two became popular: the Lockheed Constellation and the Douglas DC-6 (along with a later and faster version, the DC-7). The rivalry between Lockheed and Douglas defined progress in commercial aviation until the coming of the jets. The first jets were military-Lockheed, Republic, and North American built the first jet fighters: the P-80, F-84, and F-86. The F-86 was the best of them, ruling the skies during the Korean War of 1950-1953.

Missiles and jet bombers also drew attention. North American made a strong and early commitment to develop a missile of intercontinental range, the Navaho. This project needed rocket engines, guidance systems, and advanced designs that called for close understanding of supersonic flight. North American brought in good scientists and developed the necessary know-how to forge ahead in this new field. Boeing showed similar leadership with jet bombers. The company used scientific data from the National Advisory Committee for Aeronautics, supplementing it with data from its own wind tunnel, a research facility that helped to determine the best shapes for aircraft flying close to the speed of sound. This allowed the company to develop the earliest important jet bomber, the B-47. It first flew in 1947. The Air Force purchased over 2000 of them from 1948 to 1956.

The Navy and Air Force had their own requirements. Convair built the B-36, which had six and later ten engines. Boeing countered with the B-52, which mounted eight jet engines. It became the main bomber of the Air Force's Strategic Air Command. Almost every company in the industry built fighter aircraft in the 1950s, including Douglas, Grumman, Lockheed, McDonnell, North American, Northrop, Republic, and Vought. Missiles and space flight brought new opportunities. In 1954, the Air Force launched a major push toward rockets of intercontinental

range, able to reach Moscow. These included the Atlas from Convair and the Titan, built by Martin. Douglas created the Thor, based in England, which had less range but was available sooner. These missiles evolved into launch vehicles for the space program.

Within that program, the civilian National Aeronautics and Space Administration (NASA) came to the forefront. During the 1960s it sponsored the Apollo program, which landed astronauts on the moon. Again there were a number of participants, including Douglas, Grumman, McDonnell, and Boeing. North American did the most, drawing on its experience with the Navaho. This company built rocket engines, a major rocket stage, as well as the spacecraft that carried Apollo's astronauts. It went on to build the Space Shuttle.

While airliner sales remained very strong, military demand fell off sharply with the end of the Cold War. Officials of the Defense Department responded by facilitating a series of mergers, to consolidate the industry within a small number of companies that would have enough business to remain strong. Boeing, holding great power due to its success in selling airliners, bought out McDonnell Douglas and Rockwell International. Lockheed merged with Convair and with Martin Marietta, forming the firm of Lockheed Martin. A similar merger created the firm of Northrop Grumman. Today, these three U.S. companies dominate the American market for commercial airliners, military aircraft, and launch vehicles for space flight.

Air Transport - Commercial Aviation - An Overview T. A. Heppenheimer

On January 1, 1914, a wealthy manufacturer named Thomas Benoist launched air service between Tampa, Florida, and nearby St. Petersburg. Those towns were separated by Tampa Bay; the only connections were by once-a-day boat or by railroad. His airline drew business all through the winter, but his prospects faded when the tourist season ended in spring. His airline shut down permanently. No one else tried to carry passengers by air for several years, and there was a reason: railroads. The United States had a quarter-million miles of track, with rail carriers offering fast, convenient service from downtown terminals.

Early airline builders therefore tried a different approach, by carrying airmail. The U.S. Post Office became involved during the Presidency of Woodrow Wilson. The planes of the day were little faster than mail trains, and aviators saw that their best hope lay in cross-country service. Flying at night, three pilots carried mail from San Francisco to New York on a trial flight in February 1921. In 1923, the assistant postmaster general, Paul Henderson, began installing powerful beacon lights to mark air routes for routine night flying in clear weather. Scheduled transcontinental air service began in mid-1924. This did not suit the railroads, which depended on income from carrying the mail. In Washington, railroad lobbyists won passage in Congress of the Kelly Act of 1925, which turned the new airlines into privately owned businesses. A follow-up law, in 1926, gave the government responsibility for aircraft safety. Collectively, these acts served to create an air transport industry that was regulated by the U.S. government and received direct subsidy through a complex set of contracts awarded to airlines to carry the mail.

In 1927, Charles Lindbergh touched off an enormous surge of interest in aviation by flying nonstop from New York to Paris. Only 5,800 passengers had flown in 1926; this leaped to 417,000 four years later. In 1930, Postmaster General Walter Folger Brown set out to encourage

this trend. Brown disliked the Kelly Act. He thought it provided overly generous subsidies for airmail. Brown won passage of a new law, the McNary-Watres Act, which encouraged the airlines to carry more passengers. Airmail still remained their main business, and Brown took action in that area. By law, he had the power to award airmail contracts to competing airlines. The nation's existing air-route map was a hodgepodge of local lines, whereas Brown wanted a few strong carriers that could serve the entire nation. Drawing on his legal powers, he awarded airmail routes to airlines that he favored, forced others to merge to qualify for his awards, and left still others to die for lack of business. When he had finished, he had a major north-south carrier, Eastern Airlines, along with three coast-to-coast airlines: TWA, American, and United.

Brown's reforms worked. The airlines he selected continued to dominate the nation's air routes for the next fifty years. However, Brown was a Republican. When the Democrats returned to Washington with President Franklin Roosevelt, in 1933, they lost little time in declaring that Brown's actions amounted to a scandal. He had used his powers in high-handed ways, and Democrats declared that he and the airlines together had committed fraud. Roosevelt responded by turning the airmail over to the pilots of the U. S. Army. It didn't work-they were unprepared, and a number of them crashed. Roosevelt had to rely on the airlines, whose pilots knew their business. But the Air Mail Act of 1934 cut their mail pay particularly sharply, forcing them to rely even more on passenger traffic for their income.

This meant that they needed aircraft that could make money just by carrying people. The firm of Douglas Aircraft responded to this need with the DC-3 in 1936. It quickly drove competing airliners from the airways, and went on to dominate American aviation. As late as 1958, as jet airliners were about to enter service, the nation's airlines counted more DC-3s than any other type of airplane.

Brown left a further legacy, in the area of overseas travel. An ambitious young airline operator, Juan Trippe, convinced Brown to give him a monopoly on the right to carry airmail to foreign countries. Trippe's airline, Pan American World Airways, started with its 90-mile (145-kilometer) route in 1927 from Florida to Cuba and completed its conquest of Latin America in 1930, with 20,308 miles (32,683 kilometers) of airway in 20 Latin American countries. Profits from these Latin American routes subsidized Trippe's losses as he expanded his operations. In 1935, he introduced his four-engine Clipper flying boats on a route that crossed the Pacific, reaching from San Francisco to the Philippines. In 1939 he introduced commercial service across the Atlantic.

The air transport revolution swung into full power with the building of advanced new airplanes in the latter 1930s. Carriers expressed much interest in four-engine airliners that could carry more passengers at higher speeds, while carrying extra gasoline for longer range. Two aviation leaders competed for advantage in this field: Donald Douglas, whose firm of Douglas Aircraft was building the DC-3, and Howard Hughes.

Hughes' father had made a vast fortune in oil. Howard Hughes started his career in Hollywood, but turned to aviation, buying control of TWA. Working with Lockheed Aircraft, he crafted the Constellation airliner. Designed in 1940, it flew as fast as the fighter aircraft of the day, and could cross the nation nonstop. Donald Douglas had to match it, and did so with his own four-

engine aircraft, the DC-6 and DC-7. The rivalry between these airliners and the Constellation then spearheaded the development of advanced commercial airliners until the coming of the jets.

The first jet engines entered service with high-speed fighters late in World War II. Boeing took the lead in crafting large jet bombers: the six-engine B-47 and the eight-engine B-52. However, early jet engines gulped fuel at excessive rates, and airline executives distrusted them. Juan Trippe had different ideas. He learned that better engines were coming along, and he had enough money to order new engines that were better still. He proceeded to play Boeing against Douglas Aircraft, promising each that he would place extensive orders if either could build the long-range jetliners that he wanted. Douglas responded with the DC-8; Boeing came out with the 707. Boeing proved particularly capable at tailoring versions of the 707 that met the needs of individual carriers, and this company surged to the lead in sales.

But during 1956, as orders for the 707 and DC-8 mounted, the nation's airways were far from ready for the new jets. They needed radar and electronic aids to navigation, which were in short supply due to federal budget cuts. Then in June 1956, a DC-7 and a Super Constellation collided over the Grand Canyon, killing 128 people. This drove home the point that the air routes were unsafe even for fast propeller-driven aircraft. Congress responded, and soon the needed equipment was in place.

The new jets entered service in large numbers during the 1960s. Demand soared, leaping from 62 million passengers in 1960 to 169 million, nearly three times as many, in 1970. Juan Trippe expected that this trend would continue, as did William Allen, president of Boeing. Together they crafted an entirely new and very large commercial jetliner that was to serve this new era-the Boeing 747. However, it nearly wrecked both companies, as debt and delays plagued Boeing, followed by a national recession, which dried up demand. Boeing survived by offering new versions of earlier jets and came up with enough sales to survive. Still, it had a very close call with bankruptcy. The 747 was too large for most routes, which opened up an opportunity for an airliner of slightly smaller size. Lockheed came in with its L-1011, while McDonnell Douglas offered its DC-10. McDonnell Douglas won the competition and Lockheed stopped building airliners and became purely a military airplane builder. McDonnell Douglas stayed in the commercial world, but lacked the funds to develop anything more than variations of its DC-9 and DC-10. This raised the prospect that Boeing would hold a monopoly over the airlines. Competition eventually came from Europe.

Pan Am had its own problems. By 1970 it was losing money. It nevertheless took on additional debt to purchase 747s-and found itself paying very high interest rates. The recession hurt that airline as well. It survived, at least for a while, with help from the International Air Transport Association. IATA was a cartel, which enforced a worldwide agreement that kept fares high.

For half a century, the nation's airlines had been a heavily regulated industry in which competition was more in the way of service than in fares. This regulation prevented new airlines from entering the market while stabilizing those already operating. These arrangements came to an end in 1978, as the nation entered an era of deregulation. Airline executives won new freedom to introduce cut-rate fares and to serve new routes, as well as to abandon less lucrative routes. For travelers, the consequences brought a bonanza, with passengers saving $100 billion in ticket

fares during the first ten years. However, airline service was reduced, and flights to less attractive destinations were unavailable.

Some of the traditional carriers did not survive deregulation. For instance, already weak Pan Am needed new routes and new aircraft. Lacking money and credit, it declared bankruptcy and went out of business in 1991. A corporate raider, Frank Lorenzo, purchased control of Eastern Airlines. He worked vigorously to cut the pay of his employees-and soon found himself in a battle with his labor unions. When the smoke cleared, Eastern also was bankrupt.

Other airlines also fell short. Braniff Airways gambled that new aircraft would help it recover market share-only to fly into a time of high fuel prices, high interest rates, and a new recession which forced the airline to shut down. TWA was in and out of bankruptcy before finally folding in 2001, as it agreed to sell its assets to American Airlines. As the new century began, the nation counted only three strong surviving carriers: American, United, and Delta.

Among the airplane builders, Boeing faced an increasingly strong challenge from a European group, Airbus Industrie. Boeing and Airbus both offered airliners in a wide array of sizes and ranges to meet the needs of their customers. Boeing covered losses with profits from its 747; it has sold more than a thousand of them, at prices up to $177 million. Airbus, with close ties to the governments of Europe, has covered its own losses with subsidies. In addition, the Europeans now are building something new: the Airbus A-380, which will be the world's largest airplane, with two complete decks of seats.

In the United States, airline traffic topped 600 million passengers per year in 2001, for a fourfold increase in just 30 years. New airports could help relieve this congestion, but the nation recently has built only one large new one near Denver. Everywhere else, plans for new airports have faced stiff competition. It has also proven difficult to build new runways at existing airports although much effort is underway to expand on numerous airports around the nation.

The Government Role in Civil Aviation - An Overview--Edmund Preston, Agency Historian, Federal Aviation Administration

The American Government has played an important part in shaping the nation's air transportation. At the dawn of the 20th century, Langley's Smithsonian was a significant source of information for those interested in the possibility of heavier-than-air flight. The Institution distributed literature about aeronautical principals as part of its scientific mission, which was partly supported by federal taxes. Among those who studied this material were Wilbur and Orville Wright, whose own experiments led them to achieve controlled, powered flight in 1903.

Despite its early start, the United States soon lost aeronautical leadership. European enthusiasm for air power was sparked by an arms race and then by the outbreak of war in 1914. During the following year, Congress took a step toward revitalizing American aviation by establishing the National Advisory Committee for Aeronautics (NACA); an organization dedicated to the science of flight. Upon entering World War I in 1917, the U.S. government mobilized the nation's economy, with results that included an expansion of the small aviation manufacturing industry. Before the end of the conflict, Congress voted funds for an innovative postal program that would

serve as a model for commercial air operations.

With initial help from the Army, the Post Office in 1918 initiated an intercity airmail route. In 1925, new postal legislation authorized the Post Office to contract with private airlines to transport mail, which offered the hope of steady income to America's struggling air carriers. Many aviation leaders in the 1920s believed that federal regulation was necessary to give the public confidence in the safety of air transportation. Opponents of this view included those who distrusted government interference or wished to leave any such regulation to state authorities. To investigate the issue, President Calvin Coolidge appointed a board whose report favored federal safety regulation. Congress passed the Air Commerce Act of 1926, which assigned to the U.S. Department of Commerce the fundamental tasks needed for civil air safety. Among these functions were: testing and licensing pilots, issuing certificates to guarantee the airworthiness of aircraft, making and enforcing safety rules, and investigating air accidents. The Act also directed the department to take certain actions to assist the progress of aviation.

To fulfill its new aviation responsibilities, the Department of Commerce created an Aeronautics Branch. The first head of this organization was William P. MacCracken, Jr., whose approach to regulation included consultation and cooperation with industry. A major challenge facing MacCracken was to enlarge and improve the nation's air navigation system. The Aeronautics Branch took over the Post Office's task of building airway light beacons, and in 1928 introduced a new navigation aid known as the low frequency radio range. At the same time, NACA was producing benefits through a program of laboratory research begun in 1920. In 1928, for example, the organization's pioneering work with wind tunnels produced a new type of engine cowling that made aircraft more aerodynamic.

Under President Franklin D. Roosevelt, the Aeronautics Branch cooperated with public works agencies on projects that represented an early form of federal aid to airports. In 1934 it received a new name, the Bureau of Air Commerce. In 1935 the Bureau of Air Commerce encouraged a group of airlines to establish the first three centers for providing air traffic control along the airways. In the following year, the Bureau itself took over the centers and began to expand the control system. In 1938, the Civil Aeronautics Act transferred federal responsibilities for non-military aviation from the Bureau of Air Commerce to a new, independent agency, the Civil Aeronautics Authority. The legislation also gave the authority the power to regulate airline fares and to determine the routes that air carriers would serve.

In 1940, President Franklin Roosevelt split the authority into two agencies, the Civil Aeronautics Administration (CAA) and the Civil Aeronautics Board (CAB). The CAA was responsible for air traffic control, safety programs, and airway development. The CAB was entrusted with safety rulemaking, accident investigation, and economic regulation of the airlines. Although both organizations were part of the Department of Commerce, the CAB functioned independently. After World War II began in Europe, the CAA launched a Civilian Pilot Training Program to provide the nation with more aviators. On the eve of America's entry into the conflict, the agency began to take over operation of airport control towers, a role that eventually became permanent. During the war, the CAA also greatly enlarged its en route air traffic control system. In 1944, the United States hosted a conference in Chicago that led to the establishment of the International Civil Aviation Organization and set the framework for future aviation diplomacy. In the post-war

era, the application of radar to air traffic control helped controllers to keep abreast of the postwar boom in air transportation. In 1946, Congress gave the CAA the task of administering a federal-aid airport program aimed exclusively at promoting development of the nation's civil airports.

The approaching era of jet travel, and a series of midair collisions, prompted passage of the Federal Aviation Act of 1958. This legislation gave the CAA's functions to a new independent body, the Federal Aviation Agency. The act transferred safety rulemaking from CAB to the new FAA, and also gave the FAA sole responsibility for a common civil-military system of air navigation and air traffic control. The same year witnessed the birth of the National Aeronautics and Space Administration (NASA), created in the wake of the Soviet launching of the first artificial satellite. NASA assumed NACA's role of aeronautical research while achieving world leadership in space technology and exploration.

In 1967, a new Department of Transportation (DOT) combined major federal responsibilities for air and surface transport. FAA's name changed to the Federal Aviation Administration as it became one of several agencies within DOT. At the same time, a new National Transportation Safety Board took over the CAB's role of investigating aviation accidents. The FAA gradually assumed additional functions. The hijacking epidemic of the 1960s had already brought the agency into the field of civil aviation security. The FAA became more involved with the environmental aspects of aviation in 1968 when it received the power to set aircraft noise standards. Legislation in 1970 gave the agency management of a new airport aid program and certain added responsibilities for airport safety.

By the mid-1970s, the FAA had achieved a semi-automated air traffic control system using both radar and computer technology. This system required enhancement to keep pace with air traffic growth, however, especially after the Airline Deregulation Act of 1978 phased out the CAB's economic regulation of the airlines. A nationwide strike by the air traffic controllers union in 1981 forced temporarily flight restrictions but failed to shut down the airspace system. During the following year, the agency unveiled a new plan for further automating its air traffic control facilities, but progress proved disappointing. In 1994, the FAA shifted to a more step-by-step approach that has provided controllers with advanced equipment.

In the 1990s, satellite technology received increased emphasis in the FAA's development programs as a means to improvements in communications, navigation, and airspace management. In 1995, the agency assumed responsibility for safety oversight of commercial space transportation, a function begun eleven years before by an office within DOT headquarters.

As the new century began, issues facing the FAA included the progress of reforms aimed at giving the agency greater flexibility. Airline accidents, although rare in statistical terms, showed the need for further safety advances. The huge volume of flights challenged the capacity of the airport system, yet demonstrated the popularity of air travel. In September 2001, however, the air transportation system was challenged by terrorist attacks in which hijacked airliners were used as missiles that killed thousands of U.S. citizens as well as many others from around the world. The government's response included legislation, enacted in November, that established a new DOT organization. This new Transportation Security Administration received broad powers to protect

air travel and other transportation modes against criminal activity. Its creation was the latest step in the evolution of U.S. government's civil aviation role to meet changing needs and priorities.

General Aviation-an Overview Dr. Janet Bednarek

Perhaps the best way to define general aviation is to begin by listing what it is not. General aviation is not military aviation and it is not scheduled commercial aviation. To a great extent, all other uses of aviation in the United States fall into the category of general aviation. These uses include, but are not limited to, private and sport flying, aerial photography and surveying, cropdusting, business flying, medical evacuation, flight training, and the police and fire fighting uses of aircraft. The airplanes used in general aviation range from small, single-engine, fabric-covered aircraft to multi-million dollar business jets. They also include helicopters, restored warbirds, and homebuilt aircraft designed to use advanced composite technology.

The non-military and non-commercial airline uses of aviation date back to the very early history of powered flight. Shortly after Wilbur and Orville Wright's invention came to public attention, people in the United States began to dream what the new technology would bring. Many beliefs came to make up what historian Joseph Corn called the "winged gospel." One part of the winged gospel included a vision of a future in which the airplane would be as common a form of transportation as the automobile. Another part of the winged gospel included the hope that participation in aviation would allow women and African Americans to gain greater equality in American society. Aviation never completely fulfilled that promise- many areas of aviation activity, including military flying and commercial airlines, barred women and African Americans for much of the twentieth century. However, both women and African Americans found their first opportunities to participate in flight in general aviation.

What is now known as general aviation really did not emerge fully until after the mid-1920s. Nonetheless, even before then a number of individuals began to experiment with uses of flight technology that would later become important parts of general aviation. For example, the first uses of airplanes for crop treatment, aerial surveying, and corporate flying all dated before the mid-1920s. Also, the first production and purchases of aircraft for private uses also happened very early in the history of flight. Wealthy individuals and some early exhibition pilots purchased aircraft from such pioneer aircraft manufacturers as the Wright brothers and Glenn Curtiss. Just before World War I, Clyde Cessna, a self-taught exhibition pilot, briefly operated his first aircraft company, one he founded with the purpose of building and selling small, relatively inexpensive aircraft for personnel use.

Cessna and those who followed him in the 1920s and early 1930s faced a number of difficulties as they tried repeatedly to build the type of aircraft that would allow for the realization of the dreams of the winged gospel. One of the biggest obstacles to affordable aircraft was the engine. The relatively affordable engines available, such as the OX-5, were so large and heavy that they demanded the design of large aircraft. Smaller, lighter engines were both very expensive and hard to get as most of the best were produced in Europe. The dream of affordable, personal aircraft would have to wait.

As aviation grew as an activity in the late 1920s, government regulations at both the state and

federal levels worked to make access to flight a little more difficult. While the new programs did help give birth to the commercial airline industry, they also began to demand that pilots earn licenses and that aircraft receive certification. During the 1930s the Federal government initiated a number of programs supporters hoped would help spur general aviation. Eugene Vidal, who headed the Aeronautics Branch of the Department of Commerce, pushed for the creation of a government program to encourage the design and manufacture of a safe, affordable aircraft. Some new aircraft designs emerged from the program. Later in the 1930s, the newly established Civil Aeronautics Authority sponsored a pilot training program. This program increased the number of pilots in the United States-both men and women, and both whites and African Americans.

The late 1920s and the 1930s also witnessed the expansion of general aviation enterprises. Crop dusting, proved valuable in the South in fighting the boll weevil, soon spread throughout the United States and included the treatment of forested areas as well as the aerial seeding of rice fields. Business travel also greatly expanded, ensuring that the high-end of the general aviation aircraft manufacturing market became and remained healthy. During this time period the first affordable small aircraft-the Aeronca C-2, introduced in 1929-made its appearance. Soon thereafter American engine manufacturers, beginning with Continental, began to finally produce small affordable aircraft engines.

The coming of World War II proved both a challenge and an opportunity for general aviation. During World War II most of the general aviation fleet was grounded. However, both general aviation pilots and manufacturers found ways to participate in the war effort. Pilots organized the Civil Air Patrol, an organization that eventually became an auxiliary of the Army Air Forces (and later the United State Air Force). Civil Air Patrol pilots performed a number of duties during the war, flying coastal patrol missions looking for enemy submarines, acting as fire spotters over the nation's forests, and performing humanitarian missions such as emergency medical flights and dropping supplies to areas hit hard by natural disasters.

General aviation aircraft manufacturers provided a number of products for the war effort. First, they acted as sub-contractors, using their skilled work forces to produce aircraft components for the manufacturers of military aircraft. They also sold a number of aircraft to the Army that were used in the Aerial-Observation-Post program in which Army pilots flew small aircraft in order to spot targets for Army artillery. Some general aviation manufacturers modified their small aircraft so that they could serve as training gliders for the Army Air Forces combat glider program. Given the large number of individuals trained as pilots during the war, general aviation manufacturers hoped that the time when private aircraft would come into widespread use was finally at hand. However, as events unfolded, World War II marked not the beginning but the end of any golden age for general aviation.

In the decades after World War II certain segments of general aviation continued to grow and develop. Business aviation continued and important technological changes occurred, including the introduction of turbine engines, both jets and turbo props. These high-end business aircraft remained in demand. The late 1940s also saw the introduction of helicopters, which become very important in such activities as medical evacuation and law enforcement. The biggest advancements, though, came in avionics - the radio and navigation equipment available to

general aviation pilots.

In terms of personal flying, the post-war period witnessed a number of difficult times. First, the post-war boom in private aircraft purchases never materialized. Many companies, including some that had been very successful in the 1920s and 1930s, were forced out of the aircraft business. The survivors, such as Piper, Cessna and Beech, had to work hard to rebuild the personal aircraft market in the 1950s through the 1970s. They did see some successes as each company made the transition from fabric-covered to all-metal aircraft.

In the last two decades of the twentieth century, the general aviation industry, particularly in terms of personal aircraft, struggled as lawsuits against aircraft manufacturers escalated. The costs involved with these lawsuits, especially those associated with purchasing liability insurance, pushed up the price of personal aircraft. Despite Congressional efforts to help with the liability problem, the general aviation manufacturing industry still awaits recovery. Further, the number of licensed pilots in the United States peaked in 1980, and has declined since. Federal and state regulations in the late 1930s had all but made it impossible for individuals to build and fly (either from scratch or from kits) their own aircraft. In the early 1950s a group known as the Experimental Aircraft Association (EAA) formed to revive homebuilding. They were quite successful and though the factory production of aircraft has slowed considerably in the last twenty years, homebuilding has grown and thrived.

The four topics presented in this section give a broad overview of various aspects of America's aviation history, covering the U.S. Aircraft Industry, Air Transport-Commercial Aviation, the Government Role in Civil Aviation, and General Aviation-an Overview. These essays, slightly abridged here, can be found in full-length form at the U.S. Centennial of Flight Commission's History of Flight website in the overview of flight essay section.

Air Power

Major General William "Billy" Mitchell defined air power as " the ability to do something in the air. It [consisted] of transporting all sorts of things by aircraft from one place to another." Air power may also be characterized as the ability to fly where you want, when you want, and to prevent the enemy from doing the same. Air power planning and use requires that it operate as part of a national grand strategy using strategic planning and tactical operations according to the principles of war or commerce.

Air power has grown to consist of air forces, airlines, general aviation, the aircraft and ancillary industries, as well as fuel, manpower, and other supplies. Air power also requires management through command, control, communications and intelligence. When World War I broke out in 1914, air power was in its infancy, but it grew to be an auxiliary force to be reckoned with by 1918, adding offensive capability to the primary ground-based power (the Army). Most air operations took place over the Western Front in France and consisted of reconnaissance activities--obtaining information, photographic, and making maps for the armies, and fighting to prevent others from doing the same. Very late in the war, ground-attack began to be a significant air tactic. In the meantime, grand-strategic bombing of Britain by German Zeppelin airships and Gotha bombers had targeted cities and forced British forces to divert their antiaircraft guns and

fighters to defense functions. In this 1914-1918 struggle, the supply of aircraft of superior designs, of aircrew, mechanics, and fuel, was critical, as was salvage and repair.

In the inter-war years (1918-1939 for Europe and 1918-1941 for the United States) air forces and the infrastructure upon which they depended lay almost dormant except for French, British, Italian, and American colonial policing. Both the French and the British feared the air menace and talked of deterrence. Airlines began to develop, and these, though still very small by 1939, had made great technical strides in safety, speed, reliability, and comfort. Starting in 1934, modernization began with the technical revolution in machines--all-metal construction, high-octane fuels, airfields both fixed and mobile, electronics, jet propulsion, computers, and atomic bombs (nuclear weapons). These changes led to air power becoming a significant third service in the World War II battles. Not only air forces, but also air transport and the whole infrastructure were used in the war effort.

During World War II, air power was an instrument of policy in the grand strategic bombing of Britain, Germany, and Japan. It was the powerful handmaiden of the armies in the German blitzkrieg; of the lightning campaigns in the massive Soviet air armies along with all their arms; of the Allied armies; at sea in the Pacific, where both land-based air forces and carrier task forces operated; where aircraft patrolled the sea lanes in the North Atlantic; and also in the combination of armies and air transport in airborne paratroop and glider forces. Air power also used photo-reconnaissance, and wireless interception of messages proved to be a powerful intelligence tool. By mid-war, new advanced airfields could be built in three days using steel planks, and fuel could be supplied in places by pipeline. Further, a massive air logistics effort took place over "the Hump" between India and China. Equally important was salvage, repair, and maintenance in which the supply of spare parts was critical, as was POL (petrol, oil, lubricants) and tools.

World War II saw great debates over the proper use of air power. The Germans and Soviets used it essentially as part of the ground forces in blitzkrieg; the British and the Americans started out emphasizing grand-strategic bombing, whose tactics were a form of guerrilla warfare. A third aspect was defense and here the British used air power successfully in the 1940 Battle of Britain, while defense was forced upon the Germans after 1943 and the Japanese in 1945. The Soviets on the Eastern Front used massive air armies to lead and support their tank and infantry forces. Air power was used at sea against U-boats attacking convoys in the Atlantic, and in the Pacific: both as a judo blitzkrieg carrier force, striking quick, deadly blows, and to support and protect amphibious operations. These forces ultimately seized the island bases from which the grand-strategic bombing of Japan was launched in conjunction with carrier attacks and submarine assaults on shipping.

The dropping of atomic bombs on top of the fire raids on Japan showed that at last airmen had developed the deterrent power that had failed to prevent war in 1939. After Hiroshima and Nagasaki in 1945, which ended World War II, air power developed along a number of peaceful and warlike lines, each requiring its own technology and machines linked through technology, manufacturers, and transfers of personnel. The helicopter, which was probably invented by Louis Breguet in France in 1909 (credit for early development of the helicopter also goes to Igor Sikorsky and Juan de la Cierva), saw use in World War II by the U.S. Armed Forces, but really came into its own in the Korean and Vietnam conflicts, where it was used from everything from

scouting, troop transport and delivering the wounded to medical facilities. World War II also saw the first use of jet-propulsion aircraft-the first jet engines entered service with high-speed fighters late in World War II. The Germans flew the Heinkel He-178, the world's first turbojet airplane, at Rostock, Germany, just before World War II. Already by October 1, 1942, Robert M. Stanley flew the first U.S. jet plane, the Bell XP-5 Airacomet, at Muroc, California. The first jets in America were produced for the military. Lockheed, Republic and North American built the first jet fighters: the P-80, F-84, and F-86. The F-86 in particular stood up well against the Soviet built MiG-15s. During the Vietnam conflict the F-105 Thunderchief and F-4 Phantoms saw conflict (Over 20,000 combat missions were flown by the republic built Thunderchiefs in Vietnam) The jet has continued to be used by the U.S. Armed forces up to the present day.

The airlines had benefited enormously from the mass production of airliners during World War II, and the setting up of airways and airfields (airports) around the world. The London-Los Angeles nonstop reach of the big piston-engine airliners was overtaken after 1958 by the arrival of the big jets, followed in 1969 by the Boeing 747 jumbo jet. By 1970, ocean liners had been eclipsed by airliners, and in 1976 the supersonic Concorde entered service. On domestic routes, smaller variants of British, American, French, and Soviet airlines allowed air transport outside of Europe and Japan, where there were high-speed networks, to overtake the railways.

At the same time, civil and defense manufacturing had been, like the airlines, consolidated or merged into fewer and fewer companies such as Boeing and Lockheed-Martin in the United States, and Airbus in Europe. After the break up of the Soviet Union in 1990, the Russians ceased to be players, but the Chinese had by then become important. As far as air forces have been concerned, during the Cold War of 1947-1990, the U.S. Air Force and the Royal Air Force (RAF) in NATO faced off with deterrents against the Soviet and Eastern bloc (Warsaw Pact) forces. This standoff, which included both land- and sea-based air and missile forces, also saw the development of tactical doctrines and equipment that was exercised, mainly in the West, in a number of wars, more consistently and flexibly by the Israeli Air Force in a series of clashes with the Arabs that demonstrated astute use of the principles of war.

While early on, air power theorists such as the Italian Guilio Douhet and Amadeo Mecozzi, the British F.W. Lanchester, and Sir Hugh Trenchard, and the American Billy Mitchell shared the limelight, increasingly this work has become that of staffs, especially in the Gulf War of 1991. The road to space was traveled at roughly the same pace as that seen in the introduction of the steam warship and the airplane. Rockets were being tried out in the 1930s and led in World War II to the German V-2 weapon used against Britain. After 1945, this weapon and its scientists were moved to the United States as the basis of missile programs. Other German scientists were taken to the USSR to create the weapons that created the "missile gap" crisis of 1960. Already in 1957, the Russians had orbited the Sputnik satellite which spurred the United States' efforts to create intermediate range ballistic missiles (IRBMs) and intercontinental ballistic missiles (ICBMs), and in 1969, after men had been orbited in the early 1960s, the landing on the moon. This was followed by the Mir Soviet space station, and after the end of the Cold War in 1990, by cooperation in an international space station. In the meantime, the Strategic Arms Limitation Treaty (SALT) treaties from 1970 had gradually been eliminating ballistic nuclear weapons. Since 1945, air forces' budgets have risen dramatically, but the number of machines in an air force has declined. This has been made up in the increasing lethality of weapons and in the

number of people and amount of cargo that an aircraft can carry over a much longer distance, at speeds up to Mach 2.2 (1,400 miles per hour).

In contrast, airlines have merged and grown, so that a number are much larger than their neighboring air force. Airlines compete daily to make a profit from passengers and cargo. Increasingly in the latter 20th century and into the 21st, military and naval air power has been used for peacekeeping and humanitarian operations, while the airlines have demonstrated the enormous ability to make the world smaller, more peaceful, and commercial. In the years since 1903, air power has changed dramatically from a warlike infant to a pacific giant, from a mouse to an elephant.

Taken from Air Power-An Overview by Robin Higham. The original version of this essay can be found at the U.S. Centennial of Flight Commission's website.

Space

Interest in rockets goes back to ancient times when the Chinese used rockets that burned solid fuel for entertainment and for warfare. The British and other Europeans used rockets in the 19th century for military purposes. They were also used for peaceful purposes such as for launching life-saving equipment from shore into the water to rescue sailors. A major problem was that these early rockets used solid propellants, which lacked much power, and they were unguided, meaning that they rarely hit their target.

In the 20th century engineers began developing liquid-fueled rockets and guidance systems. In World War II the Germans succeeded in inventing rockets that could be guided to more distant targets with rough accuracy (the ability to hit city-sized targets 100 or more miles away). When the war ended, hundreds of German rocket experts came to the United States and were instrumental in developing the American space program. The Soviet Union also used German rocket experts, but did not incorporate these people into their own space program. After obtaining their knowledge, the Soviets confined them to Germany and allowed them to conduct only non-rocket research.

Three people are generally considered the fathers of modern spaceflight-Austrian Hermann Oberth, Russian Igor Tsiolkovsky, and American Robert Goddard. All three worked in relative isolation from each other during the early part of the 20th century. Oberth and Tsiolkovsky were largely theorists, writing about orbits and the possibility of space travel. Tsiolkovsky wrote about space stations. Both men's writings influenced many people, particularly in their own countries, to believe that spaceflight was possible. Unlike Oberth and Tsiolkovsky, Robert Goddard was more of a hands-on engineer than a theoretician. He was the first person to research liquid-fueled rockets and developed several gasoline-fueled experimental rockets that he fired at a test range near Roswell, New Mexico. But because he was reclusive he did not pass many of his accomplishments on to others and did not train younger engineers how to build rockets; this may have slowed the progress of rocketry in the United States.

Spacecraft and spaceflight missions fall into three main categories: human spaceflight, Earth-focused spaceflight, and astronomical and planetary spaceflight. The first vehicle launched into

space was Sputnik, which the Soviet Union shot into orbit in October 1957. Sputnik was the opening round in what became known as the "Space Race," where the United States and the Soviet Union competed to achieve various firsts in space in order to demonstrate the superiority of their political and economic systems and their way of life. The Space Race continued for the next three decades, but lost considerable momentum by the 1970s and 1980s. Spaceflight is flight that occurs beyond the Earth's atmosphere using vehicles called spacecraft. Spacecraft can orbit around another body-these are called satellites-and can also travel between and beyond planets into the distances of outer space. In common usage, satellites refer to spacecraft that do not have a crew on board. These are often called unmanned or robotic spacecraft, and robotic spacecraft that travel to other planets are often called space probes.

In 1961 the Soviets sent the first human into space-Yuri Gagarin. Human spaceflight quickly became the main aspect of competition in the Space Race, and the most expensive. Although the Soviets undoubtedly won the opening rounds of the Space Race, the United States caught up quickly and by the mid-1960s had passed them in terms of total hours of humans in space and other accomplishments. The ultimate achievement was the landing of Neil Armstrong and Edwin "Buzz" Aldrin on the moon in 1969. It was this Cold War competition, rather than a strong interest in science or the mysteries of space, that served as the incentive for both countries to invest the large amounts of resources that they have in their respective space programs, and especially in their human spaceflight programs. Once the Cold War ended by 1991 with the collapse of the Soviet Union, money for spaceflight decreased and in many ways, the continuing space programs of the United States and Russia are a result of political and bureaucratic inertia, with tens of thousands of jobs depending upon continuing spaceflight.

The most ambitious human spaceflight program, from both a technological and a financial standpoint, is the International Space Station, or ISS, now being developed by a consortium consisting of Russia, the United States, Europe, Japan, and others. The ISS involves extensive cooperation between the United States and Russia and is intended to symbolize the end of Cold War animosity. But it has proven to be an astoundingly expensive project and these costs have dramatically reduced its scientific potential. Because a significant amount of human activity in space involves fixing things that break, the ISS cannot produce any useful scientific data until it has a crew size greater than three, which can only be achieved at considerable new expense. As a result, even today, after the end of the Space Race, most human spaceflight remains more symbolic than beneficial or practical. Robotic, Earth-focused spaceflight offers the most direct benefits to those on Earth. Communications satellites, meteorological satellites and remote-sensing satellites fall into these categories.

Communications satellites enable audio, video and data signals to be transmitted around the globe quickly and efficiently, shrinking the size of the Earth as people around the world can communicate with each other almost instantaneously. Meteorological satellites enable scientists to "see" the Earth's atmosphere. Instruments on board meteorological and other atmospheric research satellites measure and sample the atmosphere from great distance, identifying areas that may lead to severe storms. These satellites allow meteorologists and researchers to forecast major weather events like hurricanes and track their development and movement, and warn people to get out of the way. They have saved countless lives. Atmospheric observation satellites are also used to monitor ocean currents and temperature and to analyze trends such as global

warming, ozone destruction, and pollutants in the atmosphere. They have played a major role in the debate over human impact on the environment.

Remote-sensing satellites view the Earth's surface. They are used for agricultural and land-use monitoring. But their primary use is military. Reconnaissance satellites, operating in polar orbits, are used to monitor troop movements, construction, and other military activities. Surveillance satellites in geosynchronous orbit watch for missile launches. Signals intelligence satellites in similar orbits listen for the faint whispers of electronic signals such as radio transmissions and radar.

Some spacecraft study the sun as well as its interaction with the atmosphere. This information can be of general scientific use and can also be important for understanding weather and global climate change. Astronomical spacecraft operate in Earth orbit and observe distant objects like stars and galaxies. Away from the distortions produced by the atmosphere, large observatories like the Hubble Space Telescope can see farther than any Earth-based telescope could ever see. They are investigating how the universe began, how it has evolved, its age and other mysteries.

Planetary exploration spacecraft leave Earth orbit to explore the inner and outer planets as well as other objects in the solar system. Spacecraft have been sent to every planet in the Solar System excluding Pluto, and more recently to several comets and asteroids. The Moon remains the only object besides Earth to have been visited by humans. Mars is the most heavily explored planet due primarily to its similarity to Earth and its relative proximity to Earth. Mars, which had abundant water millions of years ago, may have once supported life and evidence of past life on Mars would be a major scientific discovery. During the 1990s, scientists became increasingly interested in Jupiter's moon Europa, which has a vast ocean under its ice and is therefore a prime site in the search for life.

The Space Shuttle is a unique and highly versatile launch vehicle. It can be used to carry a payload in its cargo bay that is released and launched into space. The Space Shuttle presently is the only reusable launch vehicle, and in fact the only reusable spacecraft. Because expendable launch vehicles are so expensive, the Space Shuttle was intended to lower the costs of launching a pound of payload into space. It has dramatically failed to do this. The United States has spent considerable money trying to develop cheaper reusable launch vehicles, or RLVs, to lower the cost of launching payloads, but has not been successful so far. More extensive exploitation and exploration of space, including things like space tourism, is not possible until the cost of reaching space comes down dramatically.

Launch vehicles are virtually the same as rockets and missiles. The term "missile" is usually used when the vehicle does not actually enter orbit and when the payload-what the launch vehicle is carrying and propelling into space-is some sort of weapon. Most modern launch vehicles consist of more than one stage. This means that two or three rockets are joined together, each with its own rocket motor, to form a single launch vehicle. During launch, these stages fall off as the rocket motors are fired and as the payload is gradually maneuvered into its proper position. When a launch vehicle or rocket releases its payload, it is said to deploy its payload. Modern rockets are extremely expensive to operate, frequently costing thousands of dollars per pound of payload placed in orbit.

Although the United States and Russia (formerly the U.S.S.R.) have led in spaceflight, other countries have developed their own space programs and are also participating more and more in cooperative space missions. Astronauts from numerous countries have flown into space aboard Russian and American spacecraft and work on the International Space Station. By the late 1990s, China had started development of its Shenzou spacecraft to transport several humans into space, and was reported to be working on its own space station. Spaceflight has a unique ability to capture the imaginations of all kinds of people who will probably never go into space themselves.

A longer and unedited version of this essay, originally titled *Spaceflight-An Overview*, by Dwayne Day, can be found at the U.S. Centennial of Flight's *website*

List of Sites

Sites are listed chronologically within themes, corresponding to the essays above.
You can also explore these places using our List by State.

Wright Brothers

Dayton Aviation Heritage National Historical Park
Wright Brothers National Memorial
Fort Myer Historic District
Hawthorn Hill

Aviation Pioneers

Glenn Curtiss House
Pearson Field, Fort Vancouver National Historic Site
Stinson Field, Mission Parkway
William E. Boeing House
Gen. William "Billy" Mitchell House
Captain Edward V. Rickenbacker House
Gen. William C. Lee House
Larson Brothers Airport
Hangar No. 1, Lakehurst Naval Air Station
Shenandoah Crash Sites
Charles A. Lindbergh, Sr. House
Torrey Pines Gliderport
Goodyear Airdock
U.S. Naval Air Station Sunnyvale, California, Historic District
Amelia Earhart Birthplace
Pangborn-Herndon Memorial Site
Rogers-Post Site
Terminal Building, Old, Hangar and Powerhouse at Key Field

Air Power, continued

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McKinley Climatic Laboratory
Ladd Field
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United States Naval Base, Pearl Harbor
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World War II Facilities at Midway
Radar Station B-71
Dutch Harbor Naval Operating Base and Fort Mears, U.S Army
Southwestern Proving Ground Airport Historic District
Fairmont Army Airfield
Lewistown Satellite Airfield Historic District
Attu Battlefield and U.S. Army and Navy Airfields on Attu
Truk Lagoon Underwater Fleet, Truk Atoll
Orote Field
Tinian Landing Beaches, Ushi Point and North Fields, Tinian Islands
Second--Generation Norden Bombsight Vault
U.S. Naval Air Station Dirigible Hangar B
Lighter-than-Air Ship Hangars
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Modern Aviation

Building No.105, Boeing Airplane Company
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Felts Field Historic District
Floyd Bennett Field Historic District
Santa Fe Depot and Reading Room
Pan American Seaplane Base and Terminal Building
Rhode Island State Airport Terminal
Idaho Falls Airport Historic District
Administration Building
Newark Metropolitan Airport Buildings
Bowman Field Historic District
Marine Air Terminal
Washington National Airport Terminal and South Hangar Line

Air Power

College Park Airport
Naval Air Station, San Diego, Historic District
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TBM-3E "Avenger" Torpedo Bomber Warplane
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United States Air Force Academy, Cadet Area

Space

Goddard Rocket Launching Site
White Sands V-2 Launching Site
US Naval Ordnance Test Facilities, Topsail Island MPS
Cape Canaveral Air Force Station
Unitary Plan Wind Tunnel
Neutral Buoyancy Space Simulator
Propulsion and Structural Test Facility
Redstone Test Stand
Space Launch Complex 10
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Apollo Mission Control Center
Space Environment Simulation Laboratory
Rocket Propulsion Test Complex
Saturn V Launch Vehicle
Saturn V Dynamic Test Stand
Rendezvous Docking Simulator
Lunar Landing Research Facility
Nike Missile Site C47
Site Summit
Minuteman Missle National Historic Site
Air Force Facility Missile Site 8 (571-7) Military Reservation

LIST BY STATE

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Maxwell Air Force Base Senior Officer's Quarters Historic District; Building 800; Building 836
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Propulsion and Structural Test Facility
Redstone Test Stand
Saturn V Launch Vehicle
Saturn V Dynamic Test Stand

Alaska

Rogers-Post Site
Ladd Field
Dutch Harbor Naval Operating Base and Fort Mears, U.S. Army
Attu Battlefield and U.S. Army and Navy Airfields on Attu
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Arizona

Air Force Facility Missile Site 8 (571-7) Military Reservation

Arkansas

Southwestern Proving Ground Airport Historic District

California

Torrey Pines Gliderport
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Naval Air Station, San Diego, Historic District
Rockwell Field
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Rogers Dry Lake
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Lighter-than-Air Ship Hangars
USS *Hornet*
Unitary Plan Wind Tunnel
Space Launch Complex 10
Space Flight Operations Facility

Colorado

United States Air Force Academy, Cadet Area

Delaware

Building 1301, Dover Air Force Base

Florida

Glenn Curtiss House
Pan American Seaplane Base and Terminal Building
Pensacola Naval Air Station Historic District
Eglin Field Historic District
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Cape Canaveral Air Force Station
John F. Kennedy Space Center MPS

Hawaii

United States Naval Base, Pearl Harbor
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Opana Radar Site
Hickam Field
Wheeler Field

Idaho

Idaho Falls Airport Historic District

Illinois

Scott Field Historic District
U.S. Army Aircraft P-51D-25NA 44-73287

Indiana

B-17G "Flying Fortress" No. 44-83690
Nike Missile Site C47
Smith Field

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Amelia Earhart Birthplace
Administration Building

Kentucky

Bowman Field Historic District

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College Park Airport

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Goddard Rocket Launching Site

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Charles A. Lindbergh, Sr. House

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Terminal Building, Old, Hangar and Powerhouse at Key Field
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Lewistown Satellite Airfield Historic District

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Fairmont Army Airfield
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White Sands V-2 Launching Site

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Floyd Bennett Field Historic District
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Wright Brothers National Memorial
Gen. William C. Lee House
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Dayton Aviation Heritage National Historical Park
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Captain Edward V. Rickenbacker House
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Santa Fe Depot and Reading Room
Douglas DC-3 Airplane, N34

Oregon

U.S. Naval Air Station Dirigible Hangar B

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Rhode Island State Airport Terminal

South Carolina

USS *Yorktown*

South Dakota

Minuteman Missle National Historic Site

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Stinson Field, Mission Parkway
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USS *Lexington*
Apollo Mission Control Center
Space Environment Simulation Laboratory

Virginia

Fort Myer Historic District
Gen. William "Billy" Mitchell House
Washington National Airport Terminal and South Hangar Line
Variable Density Tunnel
Full Scale 30- by 60-Foot Tunnel
Eight-Foot High Speed Tunnel
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Lunar Landing Research Facility

Washington

Pearson Field, Fort Vancouver National Historic Site
William E. Boeing House
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Felts Field Historic District

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Larson Brothers Airport

U.S. Minor Islands

World War II Facilities at Midway

Utah

Wendover Air Force Base

Federated States of Micronesia

Truk Lagoon Underwater Fleet, Truk Atoll

Commonwealth of the Northern Mariana Islands

Tinian Landing Beaches, Ushi Point and North Fields, Tinian Islands

Guam

Orote Field

Dayton Aviation Heritage National Historical Park

Dayton Aviation Heritage National Historical Park commemorates the work of Orville and Wilbur Wright in the Dayton, Ohio, area where the brothers lived and worked. Historic sites at the park include the building which housed the Wright Cycle Company and Wright and Wright Printing; Huffman Prairie Flying Field; and the 1905 biplane, *Wright Flyer III.* Although the test flights at Kitty Hawk, North Carolina, represented a major breakthrough in humanity's conquest of the air, the Wright's attempts to conquer the air began when they were children in Dayton with the parental encouragement they were given to experiment and investigate whatever aroused their curiosity.

By the fall of 1896, the Wright brothers began tackling the problems of mechanical human flight. By July 1899, they had discovered the fundamental aeronautical principle of lateral control, among the Wright brothers' greatest achievements. The Wrights realized from the beginning that a key problem of human flight was how to control the machine in the air. Previous aviation experiments had determined how to control a craft in pitch (vertical control) and yaw (horizontal control), but no one before the Wrights had yet discovered or developed a principle of roll (lateral control). However, after more than two years of watching buzzards gliding over a hill in Dayton, the Wrights realized that by twisting the wings so that on one side a greater angle was made to the wind, and on the other side there was simultaneously less of an angle, an airplane could be rolled to one side or the other.

The Wrights set out to test this theory and in August 1899 they built their first aircraft, a bi-plane kite, and test flew it in a vacant lot in west Dayton. The wing-warping worked; the kite was controllable, and the Wrights went on in 1900 to build their first man-carrying glider. They made a dozen successful flights in Kitty Hawk and conducted an intensive aerodynamic program in their bicycle shop in the fall of 1901 which perfected a newer glider, and later, in the same shop, with the help of their mechanic, Charlie Taylor, they designed and built an engine for an airplane, which met with success on December 17, 1903, in Kitty Hawk.

Wright Cycle Company and Wright and Wright Printing: In this brick building, a National Historic Landmark, Wilbur and Orville Wright manufactured bicycles on the first floor and operated a printing press on the second floor from 1895 to 1897. The two years they spent working with sprockets, spokes, chain drives, tires, metals and machines were of inestimable value in preparing the brothers for their subsequent success with gliders and flying machines. In addition, the profits they made from their businesses helped finance their later aviation experiments. It was while the Wrights occupied the building at 22 South Williams Street that they became seriously and actively interested in solving the problems of heavier-than-air powered flight. The printing business on the second floor required access to national news wires, which carried word of Otto Lilienthal's death to the shop in 1896. Lilienthal, the famous German aviation pioneer known as the father of gliding and credited as the first man in the world to launch himself into the air and fly, died from injuries received in a glider accident and his death catalyzed the brothers' interest in developing a safe and practical flying machine. The shop, integral to the development of the airplane, has been restored and opened to the public.

Huffman Prairie Flying Field: Huffman Prairie Flying Field was designated a National Historic Landmark, for its role in the development and testing of the world's first practical airplane, the *Wright Flyer III*. Huffman Field, touted by some as the cradle of aviation and the world's first aerodrome, is the flying field where Wilbur and Orville Wright obtained the necessary practice and experience to master the principles of flight. Huffman Field was a farm meadow used for livestock in 1904 when the Wright brothers began their flying experiments here and constructed a hangar for that purpose. The low, wooden gable-roofed shed was converted into a livestock shelter in the winter of 1904 and torn down thereafter. A larger hangar was constructed in 1905 and replaced in 1910 when the Wrights built a new one near the intersection of the Yellow Springs and Springfield Pike for the Wright Company. The Wrights developed a derrick and weight launching system and positioned it on Huffman Field in 1904; this system rolled planes down a short launching rail. In 1910 the Wright brothers replaced this system with the use of airplane skids. Although previously operating a winter flying school in Montgomery, Alabama, Orville Wright, the principal instructor of the school, moved the permanent operations to Huffman Field in 1910. Among the most notable students trained at Huffman were Lt. Henry H. "Hap" Arnold, Commander of the U.S. Army Air Corps in World War II; Griffith Brewer, the first Englishmen to fly an airplane; Cal P. Rodgers, the first person to fly across the United States; A. Roy Brown, the pilot who shot down the Red Baron during World War I; and three daring women: Rose Dugan, Mrs. Richard Hornsby and Marjorie Stinson. While the terrain has changed little since the Wright brothers used Huffman prairie, no buildings dating from the Wright brothers' experiments remain on the site.

Wright Flyer III: This muslin-over-wood biplane, constructed in 1905, is one of three experimental flyers designed and built by the Wright brothers in their quest to develop a practical airplane, and is today a National Historic Landmark. Weighing 710 pounds and standing nine feet, five and one eighth inches tall and 28 feet long, the *Flyer III* carries a wing area of 503 square feet and a horizontal front rudder area of 83 square feet. Powered by a 20-horsepower modified automobile-type engine attached to twin pusher-type propellers, *Wright Flyer III* was the first airplane capable of sustained and controlled flight and suitable for practical application. The Wright brothers themselves, recognizing the significance of their 1905 machine, stated, "From the beginning the prime objective was to devise a machine of practical utility, rather than a useless and extravagant toy." With *Flyer III*, the Wright brothers perfected the technique of flying and designed a powered airplane completely controllable by the pilot; able to bank, turn, circle, and make figure eights; withstand repeated take-offs and landings; and remain airborne trouble free for more than half an hour. *Flyer III* was also the first airplane capable of scouting in warfare, carrying mail to isolated places, exploring and sport-uses the Wrights envisioned for their practical invention.

The Wright Brothers sites in Ohio are located within Dayton Aviation Heritage National Historical Park in Montgomery County, Ohio, and within the boundaries of the Wright-Patterson Air Force Base in Greene County, Ohio. The Wright Cycle Company is located at 22 South Williams St., in Dayton and the Huffman Prairie Flying Field Interpretive Center is located on Pylon and Marl Rd. at Wright-Patterson Air Force Base; both are open 8:30am to 5:00pm daily, closed major holidays. Wright Flyer III *is on display at the John W. Berry, Sr. Wright Brothers Aviation Center. It is open April-October, Tuesday-Saturday from 9:30am to 5:00pm; open Sunday and holidays from 12:00pm to 5:00pm. All sites require an admission fee. Please call*

937-225-7705 for further information or visit the park's website.

Wright Brothers National Memorial

The Wright Brothers National Memorial commemorates the site of the first successful powered air flight and the many achievements of Wilbur and Orville Wright in the Kill Devil Hills area of North Carolina. The Wrights, who had been experimenting with glider designs, required a wide, open area with steady winds in order to conduct their research. The closest, most practical site to the brothers' Dayton, Ohio, home was Kitty Hawk, North Carolina. In 1900 Wilbur and Orville Wright set up a tent camp at Kitty Hawk to test their first large glider, performing their first manned glides here. The following year, the Wrights returned to the area, building a more permanent camp including a combined workshop and storage building. The experimental flights of early August 1901 largely succeeded, resulting in glides of up to 389 feet; however, difficulties still existed and frustrated both brothers. Toward the end of August, the Wrights returned to Dayton for further work. In August 1902, the Wrights returned once again to Kitty Hawk to test improvements made on their glider where they gained increased control over their craft and logged a considerable number of hours of actual flight time, contributing to their later success as pilots.

By the end of the 1902 season, the Wrights had made great progress on the way to successful flight. These accomplishments did not go unnoticed. The scientific community began to hear of the Wright brothers' work and the military of several countries took an interest in the gliders. Wilbur and Orville, understanding the significance of their discoveries, applied for a patent in 1903. At the same time, the brothers began developing an engine for their flying machine in order to attain their goal of powered flight. On Monday, December 14, 1903, the brothers decided to test their machine-powered aircraft called the *Flyer*. The brothers tossed a coin to decide who would take the first turn. Wilbur, winner of the coin toss, experienced difficulties and stayed in the air for three and a half seconds. Although considered an unsuccessful attempt, the Wrights were optimistic about the *Flyer's* ability. At 10:00 am on December 17, despite high winds, the brothers set out to test the aircraft again. Orville flew approximately 100 feet in 12 seconds and at noon Wilbur made the fourth and longest flight of the day, covering 852 feet.

In 1932 a 60-foot granite monument perched atop 90-foot tall Kill Devil Hill was dedicated to commemorating the achievement of these two visionaries. One of the most significant changes to the site came in 1960 when the park added a new Visitor Center, one of several Mission 66 projects sponsored by the National Park Service to upgrade park buildings in anticipation of the 50th anniversary of the Service. Designed by the Philadelphia firm of Mitchell/Giurgola, later designers of the Liberty Bell Pavilion near Independence Hall, the new concrete visitor center suggested the form of an airport terminal and conveyed a sense of transportation, forming a connection between the achievements of the Wright brothers and the world of modern aviation.

The Wright Brothers National Memorial, administered by the National Park Service, is located on the Outer Banks of North Carolina in the town of Kill Devil Hills. About 15 miles northeast of Manteo, NC on US-158, the Visitor Center, which is itself a National Historic Landmark, is open daily during the summer from 9:00am to 6:00pm, and the rest of the year from 9:00am to 5:00pm. Please call 252-441-7430, or visit the park's website for further information. You can

also download (in pdf) the Wright Brothers National Memorial Visitor Center National Historic Landmark nomination.

Wright Brothers National Memorial is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Fort Myer Historic District

The first military airplane in the world, built by the Wright brothers for the Army Signal Corps, made its first flight at Fort Myer, Virginia, in September 1908. The Army established military aviation in the Signal Corps in August 1907 because observation and reconnaissance were the only functions for the airplane known to the military at that time. In December 1907, the Chief Signal Officer requested bids for a flying machine with requirements generally thought to be impossible. Many in the aeronautical community predicted that the Army would not receive any bids, but the Wright brothers signed a contract on February 10, 1908, and delivered the airplane to Fort Myer in August 1908. The specification required the "Heavier-than-air Flying Machine" to carry two people, fly 40 miles per hour, make a one-hour endurance flight and be portable by Army wagons. Flying instruction for two officers was also required.

Orville Wright was the pilot for the flights required to demonstrate performance. Less than a thousand people witnessed the first flight at Fort Myer on September 3, 1908, because the general public was still doubtful that powered flight had been achieved. Orville's subsequent flights during the next two weeks were watched by thousands, and finally convinced the American public that "man could fly." The flights at Fort Myer established a number of new world records for endurance, but the last flight on September 17 ended in disaster. A crack in the right propeller caused the plane to crash, seriously injuring Orville and killing Lt. Thomas E. Selfridge. Delivery of the new flying machine was postponed until the following summer, when Orville made additional demonstration flights at Fort Myer in a Wright *A plane*, an improvement of the 1908 design. The Army formally accepted *Signal Corps Airplane No. 1*, the world's first military airplane, on August 2, 1909. The Wright brothers fulfilled their contract in October and early November when Wilbur Wright provided flying instruction for three Army officers at College Park, Maryland.

Fort Myer had been established as Fort Whipple during the Civil War in 1863. It was renamed for Brigadier General Albert J. Myer, who established the Signal School of Instruction for Army and Navy Officers here in 1869. By the turn of the 20th century, the military had determined that Fort Myer should become a permanent army post, and an extensive building program was initiated. The buildings of the historic district date to this period of construction and include commodious senior officers' quarters known as "Generals' Row" that became home to the Army Chiefs of Staff including Generals Leonard Wood, Douglas MacArthur, George C. Marshall, Dwight D. Eisenhower and William Westmoreland. Fort Myer is also the home of the Air Force Chief of Staff and the Chairman of the Joint Chiefs of Staff.

The Fort Myer Historic District, a National Historic Landmark, is roughly bounded by Arlington Blvd (U.S. 50), Clarendon Blvd. and Arlington National Cemetery. Due to heightened security,

this active base in not open to the public. For more information visit the base's website.

Hawthorn Hill

Completed in 1914, Hawthorn Hill in Dayton, Ohio, was designed by Wilbur and Orville Wright with the aid of the Dayton architectural firm of Schenck and Williams. As the Wrights' fame grew so did their need for a larger home that could better accommodate their many guests. Therefore, with the consent of their sister Katharine, the Wright's purchased a 17-acre wooded tract named Hawthorn Hill for the many hawthorn trees covering the hillside. In 1912, shortly after approving the final plans for the house, Wilbur died. Orville dedicated himself to overseeing the construction of the residence, spending as many hours as possible at the construction site. The house was also equipped with many labor saving devices and gadgets of Orville Wright's design including a special system of chains and rods that allowed him to control the furnace from upstairs rooms and an early version of a water softener that purified water for use in a large shower. He fashioned special tools to aid in cleaning the residence, a toaster capable of slicing and browning bread, a buzzer system between the dining room and kitchen and an easy chair with a reading stand and matching adjustable footstool.

Hawthorn Hill, often called Orville's "machine for living," was host to many notable guests such as Thomas Edison, Alexander Graham Bell, Carl Sandburg, Admiral Richard Byrd, King Constantine of Greece and President Franklin D. Roosevelt. One of the most famous guests of Hawthorn Hill arrived on June 22, 1927. Charles Lindbergh, returning to St. Louis just weeks after his nonstop flight over the Atlantic Ocean, stopped in Dayton to visit Orville Wright. At the request of his financial backers Lindbergh was unable to make a public appearance. Disappointed Daytonians gathered outside Hawthorn Hill demanding a glimpse of their hero. Forced to appease the crowd, Lindbergh and Orville Wright made a brief appearance on the balcony and the satisfied crowd dispersed. Following Orville's death January 30, 1948, his family placed the home for sale. Edward Deeds of the National Cash Register Corporation (NCR) purchased the estate, which is still used as a guesthouse for overseas visitors and dignitaries.

Hawthorn Hill, a National Historic Landmark, is located at 901 Harman Ave. in Oakwood, Ohio. The house is privately owned and not open to the public, but it is visible from the street.

Glenn Curtiss House

The Glenn Curtiss House was constructed in 1925 for this aviation pioneer who had established his own airplane company before becoming the developer of Miami Springs, Florida. Located in his Miami Spring development, Curtiss lived in this large, two-story residence designed in the Pueblo Revival style until his death in 1930. Glenn Hammond Curtiss, born in 1878 in Hammondsport, New York, was a rival of the Wright Brothers. Like the Wright Brothers, Curtiss was interested in bicycles as a young man, opening a bicycle repair shop in 1900 after his marriage to Lena Pearl Neff. Interested in speed, he soon turned to motorcycles and designed a machine with a lightweight, high-power engine. He created the G.H. Curtiss Manufacturing Company in New York in 1902, and began producing the Hercules motorcycle. Although setting

records for motorcycle racing, his company also drew the attention of aeronautical experimenters--in July 1904 Thomas Scott Baldwin used a Curtiss two-cylinder engine to power the first successful dirigible to fly in the United States, the *California Arrow*.

Alexander Graham Bell, the famed inventor, was also impressed by the Curtiss engines, and invited Curtiss to join the Aerial Experiment Association (AEA). Curtiss turned to airplanes after Bell's man-carrying motorized kite was deemed a failure. The AEA designed and built several airplanes, including the Red Wing which first flew on March 12, 1908. This was followed two months later by the White Wing, which employed Bell-contrived ailerons for lateral control, a system that was superior to the wing warping used by the Wright Brothers. Curtiss became an enthusiastic flyer, and after the AEA disbanded in 1909, established his own airplane company in Hammondsport, New York. The second airplane company that Curtiss established, the Curtiss Aeroplane Company, became the world's largest aircraft manufacturer during the war. He developed an airplane that could land on water for the Navy, but he soon found himself in a legal battle with the Wright Brothers, who held a patent on their wing-warping system. While the Wrights won in court, Curtiss paid no penalty, and a Wall Street syndicate formed the Curtiss Aeroplane & Motor Company, with Curtiss as president. The most widely produced model during World War I was Curtiss's JN-4 "Jenny." When the company underwent major financial reorganization in 1920, Curtiss moved to southern Florida, where he became a real estate developer during the 1920s. As William M. Leary wrote in *American National Biography*, "Curtiss stands in the forefront of American aeronautical pioneers, second only to the Wright brothers in historical significance."

The Glenn Curtiss House is one of the largest and most architecturally distinguished of the Pueblo Revival residences associated with Curtiss's Miami Springs development. Its architect, Martin Luther Hampton, was one of Miami's most prominent architects during the 1920s--his designs include the former Miami Beach City Hall and the Congress Building in downtown Miami. The house is roughly V-shaped in plan and constructed of hollow clay tile with a rough textured stucco exterior. The roof is flat with very irregular parapet walls embellished by projecting waterspouts and irregular shaped openings. The main entrance to the residence is set within a deeply recessed T-shaped opening and marked by a flat-roofed porte cochere. The southeast central courtyard of the building features a later oolithic (rock consisting of small round grains) limestone facing on its first story pierced by modern windows and glass doors.

After Glenn Curtiss's death in the early 1930s, Lena Curtiss married an old friend and business associate of her husband, H. Sayre Wheeler. Wheeler served as mayor of Miami Springs from 1942 to 1944 and was also part owner of the Michaels and Wheeler Insurance Company. The couple lived in the house until the late 1940s. It was subsequently converted into the Miami Springs Villas House in 1953.

The Glenn Curtiss House, at 500 Deer Run in Miami Springs, Florida, is one block off of NW 36th St. It is currently not open to the public while it is being restored to serve as a museum honoring the life of Glenn Curtiss. The museum plans to open in 2005 or 2006.

Pearson Field, Fort Vancouver National Historic Site

Pearson Field, located in Vancouver, Washington, within Fort Vancouver National Historic Site, is one of the oldest active airfields in the West and a historically significant center of aviation in the Pacific Northwest. In 1905, the first aeronautical event took place here when Lincoln Beachey, one of the most talented early aviators, landed a dirigible on the parade grounds of the U.S. Army's Vancouver Barracks. The first airplane flight in the Vancouver-Portland, Oregon, region took place in 1910, and generated much public interest. By 1911 two local aviators, Charles Walsh and Silas Christofferson, began flying the first airplanes on the polo grounds with their Curtiss Pusher biplanes. Use of the field by local aviators increased in the years leading to World War I. During the war, a spruce mill was constructed at the Vancouver Barracks by the U.S. Army Signal Corps for the production of wood components needed to manufacture military aircraft. Completed in 90 days, the mill's production sustained the manufacturing of U.S. and Allied aircraft and played a crucial role in the expansion and modernization of American aircraft production.

In 1923, the Army established an airfield at the Vancouver Barracks and assigned the 321st Observation Squadron to the field, led by Lt. Oakley Kelly, to expand air reserve training. The squadron used four Curtiss JN-4 Jennies and one Dehavilland DH-4 aircraft to teach the Army Reserve Officers how to fly. Lt. Kelly was a major figure in the U.S. Army Air Service, and attracted national attention when he and Lt. John A. Macready completed the first transcontinental flight in April 1924. In 1925, Kelly pushed to rename the airfield in honor of Lt. Alexander Pearson, a Vancouver native and exemplary Army aviator who was killed in an aviation accident in 1924. Pearson had been commissioned by the Department of the Interior to make the first aerial survey of Grand Canyon National Park. Pearson Field was the last stopover in the Army's epochal Round-the-World flight in 1924, which demonstrated the range of military aircraft and allowed advocates of air power to promote Army aviation.

During Kelly's assignment to the airfield (1924-1928), he actively promoted the expansion of civilian involvement in aviation in Vancouver and was instrumental in the establishment of the adjacent commercial field. The Vancouver Chamber of Commerce worked with Kelly to establish this field in 1925. This expansion allowed a home for general aviation and for early commercial airlines, and enabled Pearson to bid for an airmail route. The original West Coast airmail service stopped at Pearson. Both Pacific Air Transport and Varney Airlines used the field, and later joined with two other airlines to become United Airlines.

In 1937, Pearson Field was the landing site of the courageous crossing of the North Pole by three Soviet aviators in the ANT-25, a single-engine aircraft designed by the Soviet Union for long-range flight. This important milestone in aviation--the first transpolar flight--prompted intense public interest and attracted national attention. A monument was erected to commemorate the flight. In 1941, the 321st Squadron was called to active duty, and Pearson ceased to be an active Army Air Corps base. The original grass field, surviving military structures and the backdrop of the Officers Row reflect the interwar period during which Pearson was an active aviation center. In the late 1940s, the City of Vancouver assumed responsibility for Pearson after it was declared surplus by the military, and since that time, the field has been an area for general aviation. The Army airfield and adjacent commercial airfield were joined and became known as Pearson Airpark which continues to serve the greater Vancouver-Portland area as an important general aviation center.

Pearson Field is located within the boundaries of Fort Vancouver National Historic Site, in Vancouver, Washington. The adjacent Pearson Air Museum, located at 1115 E 5th., depicts the pioneering days of aviation in the Northwest. It is open Tuesday-Sunday, 10:00am to 5:00pm. There is a fee for admission. Call 360-694-7026 or visit the museum's website for further information.

Stinson Field, Mission Parkway

Stinson Field, dating from the latter part of 1915, was San Antonio's first municipal airport. It has remained in operation since that time, being the only airport in San Antonio, Texas, for many years. It was established by the Stinson family of aviation pioneers. Hoping to finance her musical education with money earned from exhibition flying, Alabama native Katherine Stinson (1891-1977) convinced famed flight instructor Max Lillie of Chicago to take her on as a student in 1912. Katherine became the fourth licensed female pilot in the U.S., began touring as a stunt pilot and became one of the country's most famous female aviatiors. Her family--mother Emma, sister Marjorie and brothers Eddie and Jack--established the Stinson Aviation Company in Hot Springs, Arkansas. Marjorie and Eddie trained at the Wright Flying School in Ohio and also became pilots (Marjorie becoming the ninth licensed female pilot in the world). In 1913, Max Lillie encouraged the Stinsons to move to San Antonio where the army had granted him permission to use the parade ground at Fort Sam Houston. According to the *San Antonio Express* (December 1 and 5, 1915), Marjorie (age 19) and Edward Stinson ran the flying school, utilizing the drill field at Fort Sam Houston, from 1914 to 1915.

Marjorie Stinson petitioned the City Council to lease land for use as an airport. Once approved, the family leased 500 acres of farmland from the city in 1916 and established Stinson Field. Marjorie founded the Stinson School of Aviation, thus being the first woman to own and operate a flying school in the United States. During its first years in operation, the Stinson family flying school trained many World War I pilots. After the ban of civilian flights during World War I, Stinson Field became the city's civil airport in 1918. Charles Lindbergh kept an airplane and flew out of Stinson while he was stationed at Brooks Field.

Stinson Field's name was changed for nine years to "Windburn Field" following the October 15, 1927, airplane crash of reporter, Bill Windburn. It was into Windburn Field that the first scheduled airmail flight in San Antonio arrived on February 6, 1928. In the 1930s, commercial airlines began using the airport and construction of a new terminal building with Works Progress Administration funds enhanced the facility. On July 15, 1936, the airfield was renamed Stinson Field in commemoration of its original founders. During World War II it once again became an Army Air Corps training facility. Returned to civilian use after the war, Stinson Field became the primary general aviation airport for the city of San Antonio. Part of Stinson Field was utilized by the National Guard for a couple of years, accounting for the barracks still present on the southwestern portion of the field. Although the San Antonio International Airport is the primary airport in the San Antonio area today, Stinson Field has remained an important commercial and recreational air center.

Stinson Airport, part of the Mission Parkway, is located at 8535 Mission Rd. in San Antonio, Texas. It is still operated as a general aviation airport, open during normal business hours. Also

located at the air field is the Stinson Branch of the Texas Air Museum, presenting the history of flight from the early days of aviation to the present. It is open Monday-Saturday 11:00am to 5:00pm, closed major holidays; there is a fee for admission. For further information call 210-977- 9885 or visit the museum's website.

William E. Boeing House

William E. Boeing (1881-1956) was founder of the Boeing Airplane Company, the largest and most successful commercial aircraft manufacturer in the world. Starting from a base in the lumber industry, Boeing became a pioneer in the design and manufacture of airplanes just before America's entry into World War I. Expanding first into the production of military aircraft during the war and then into contracts for scheduled mail delivery and regular commercial passenger service, the Boeing empire eventually included all aspects of aviation, from technological development and aircraft production to international airline transportation systems. In 1934, forced by the Federal government to dissolve the interlocking partnerships between the manufacturing and transportation divisions, Boeing resigned from the industry he had pioneered and turned to other interests.

Boeing grew up in Michigan, attended Yale's Scientific School, and then spent five years learning the logging business in Grays Harbor, Washington, before arriving in Seattle in 1908 where he continued to manage his timber lands, establishing the Greenwood Timber Company. Around the same time, Boeing became interested in flying, took lessons, and purchased a Martin hydroplane. He founded his aeronautical products company shortly thereafter, established a production plant at the Red Barn and built his first airplane in 1916.

At the same time, Boeing was having a home built for him in The Highlands, a newly established exclusive residential community just outside Seattle. Charles Bebb designed his 19,000 square foot residence, which Boeing named Aldarra. Boeing moved in as a bachelor in 1914 but married Bertha Potter Paschall in 1921. Bertha had two young sons from a previous marriage, and the couple completed their family with their own son, William Boeing, Jr. Situated at the edge of a bluff overlooking Puget Sound, the impressive Mediterranean Revival residence has restrained detailing, a white stucco façade and red tile roof. The home was Boeing's principal residence until 1954, just two years before his death. Boeing had donated his home to a local hospital, which benefited from the sale of the estate to private owners.

The William E. Boeing House is located on Huckleberry Lane in The Highlands, Washington. It is a private residence and not open to the public.

Smith Field

Smith Field, a rare surving example of an early 20th-century airport, is historically significant for its association with air-related transportation and commerce in Fort Wayne and Allen County, Indiana. In 1919, the city of Fort Wayne inspected the site that eventually became Smith Field for its suitability as a municipal airport. The site was first used for pilot instruction beginning in 1923, and on June 25, 1925, was established as Baer Municipal Airport. Named for a native of

Fort Wayne, Paul Baer was the first American Ace of World War I. In February of 1928, a $100,000 bond issue allowed for the formal planning of runways and taxiways, a system that is still in use. Between 1930 and 1937, these were paved and widened by the Civil Works Administration and the Works Progress Administration. The airport became one of the first in the U.S. to have a nighttime lighting system, also funded by the bond, and the 82-foot tall Beacon Tower was constructed. Soon after the addition of several buildings and a commercial airmail carrier in 1930, Smith Field established passenger service. In 1932, the airport served 3,000 passengers, and the introduction of the Douglas DC-3 in 1936 created more flights, thus serving more people.

During World War II, the Army Air Corps received a large tract of land south of Fort Wayne for use as an airfield. In a compromise, the military field adopted Paul Baer's name, and the municipal airport changed its name to Smith Field, in honor of a Fort Wayne U.S. airmail pioneer, Art Smith. In 1944, Smith Field's Hangar 2, a rare example of hangars from the 1920s period, became a production center for Interstate Aircraft TDR-1 Assault Drones, an unmanned twin engine aircraft that was an early version of the "cruise missile."

In addition to its historic system of runways, Smith Field is home to several significant buildings. Hangar 2 features three large Truscon Steel Company Doors, a highlight unique to Smith Field in the U.S. at the time they were built. The Carousel Hangar, although outside the period of significance defined for Smith Field, is the only example of Clark W. Smith's patented design ever built. The hangar is characterized by an innovative rotating carousel door. Smith Field's tie-down area recalls the era before World War II when hangars were used for maintenance rather than storage, and the aircraft had to be tied down to spiral-shaped stakes in the ground. Smith Field also features ruins of a railroad freight platform, a remnant of the airport's easy accessibility to a transport for the TDR-1 missiles.

Smith Field is located at 426 W. Ludwig Ave., four miles north of Fort Wayne, Indiana. Entrance to the airport is between Lima and Coldwater rds. Still a functional terminal, the building is open during normal airport hours. Free flights for children and young adults (under 18 years of age) are offered monthly as part of the EAA "Young Eagles" program. Fly-Ins, Biplane Rides and Special Events are held throughout the flying season. For further information call 260-489-5518 or visit the airport's website .

Gen. William "Billy" Mitchell House

From 1926 until his death in 1936, General William "Billy" Mitchell, a dominant figure in American military aviation between the two world wars, resided at Boxwood, an approximately 120-acre country estate in Middleburg, Virginia. In 1898, when war broke out with Spain, 18-year-old Billy Mitchell left college to enlist as a private in a Wisconsin volunteer regiment and within three weeks he became a 2nd Lieutenant in a Florida-based U.S. Army Signal Corps. In 1901 he was appointed 1st Lieutenant in the Signal Corps and at age 24 he became the youngest captain in the Army. In 1913 he became the youngest officer ever appointed to the Army general staff. While serving as commander of the Signal Company at Fort Leavenworth, Mitchell developed an interest in aviation. During World War I Billy Mitchell played a leading role in launching the World War I American aircraft program. By 1917 Mitchell was promoted to full

colonel and subsequently to commander of the Air Service. The first U.S.-trained air squadrons arrived at the front in the spring 1918. Mitchell distinguished himself as the first American Army aviator to cross enemy lines and the first to be decorated. Upon his return to the United States in 1919, Billy Mitchell was named Assistant Chief of the Air Service. Amidst great opposition Mitchell set out to overhaul the national defense structure while equipping the Air Service with new bombers and dirigibles and initiating development of the first airways system in the United States.

Mitchell realized by 1921 that he needed to employ different techniques to convince America of the necessity of developing air power. He began giving speeches, contributing to newspaper and magazine articles, testifying in congressional and executive hearings, publicizing his and his airmen's flying stunt's and emphasizing the contributions air power could make to the defense of the United States. In 1921, Mitchell gained worldwide attention when he was granted the opportunity to demonstrate that air power would be a major arm of warfare. His bombers sank the captured ex-German battleship *Ostfriesland* within 21 minutes, then repeated the act on the obsolete American battleship *Alabama*. Seventeen years before the Japanese attack on the U.S. Naval Base at Pearl Harbor, Mitchell concluded that war with Japan was inevitable and the Pacific Islands would be crucial Japanese objectives because of their strategic value as air bases. He pushed for large-scale reinforcement of the Air Service in the Hawaiian Islands, but met much resistance. Mitchell continued to campaign for air power, writing his book *Winged Defense* and publishing articles, which he had been ordered to submit for War Department clearance before publication. The loss of a naval seaplane on a nonstop flight from San Francisco to Hawaii on September 1, 1925, and the destruction of the dirigible USS *Shenandoah* two days later, prompted Mitchell to published an article September 5, 1925, in which he blamed these aviation tragedies and others on the Navy and War Departments. Two weeks later he was court-martialed and sentenced to a five-year suspension from duty without pay. Mitchell resigned from the Army on February 1, 1926, but he continued to wage his battle for air power. He died on February 17, 1936, shortly before his ideas on air power were vindicated. He was posthumously restored to the service in 1942 with the rank of major general.

The Gen. William "Billy" Mitchell House, also known as Boxwood Farm, a National Historic Landmark, is located on Va. Rte. 626 south of Middleburg, Virginia. It is a private residence and is not open to the public.

Captain Edward V. Rickenbacker House

From 1895 to 1922, this was the Columbus, Ohio, home of famed World War I aviator Edward "Eddie" Vernon Rickenbacker. Eddie, a leading race car driver prior to World War I, joined the American Expeditionary Force as a sergeant and staff driver in 1917. He sailed to France the next month with John J. Pershing and his staff. Although overage and not a high school graduate, Rickenbacker, with the assistance of William "Billy" Mitchell, received an assignment to flight school. After 17 days at the French aviation school at Tours, Eddie received his wings and a commission as first lieutenant; however, he was assigned to the Advanced Flight School at Issoudun as an engineering officer, not a pilot. Eventually he was transferred to the 94th Aero Pursuit Squadron, where on April 14, 1918, he took part in the "first combat mission ever ordered by an American commander of an American squadron of American pilots."

Rickenbacker became commander of the squadron on September 24. The next day he single-handedly took on seven German planes over the German lines and shot down two of them--an act for which he was belatedly awarded the Congressional Medal of Honor in 1930. In six months he shot down 26 German aircraft--22 airplanes and four balloons.

Eddie Rickenbacker returned home after the end of the war as the idol of the American public, the "American Ace of Aces." He refused offers to make movies or endorse products, but he did publish his war memoir entitled *Fighting the Flying Circus*. He married Adelaide F. Durrant in 1922 and founded the Rickenbacker Motor Company, which went bankrupt in 1927. Eddie then joined General Motors where he worked in both their automobile and aircraft divisions. In 1938 he purchased Eastern Airlines from General Motors, making it the "first airline to operate without a subsidy from the Federal government." During World War II Rickenbacker toured American bases at home and abroad as a special civilian consultant for Secretary of War Henry Stimson. On one of these tours to the South Pacific, Eddie's airplane became lost, ran out of fuel and had to land in the ocean. His book *Seven Came Through* describes the 24 days he and the crew spent adrift on life rafts before being found. After the war, Rickenbacker returned to Eastern Airlines as Chairman of the Board, a position he held until his retirement in 1963 at age 73. In October 1972 Eddie Rickenbacker suffered a stroke, and he died in Zurich on July 24, 1973.

The Captain Edward V. Rickenbacker House, a National Historic Landmark, is located at 1334 Livingston Ave., in Columbus, Ohio, and was recently placed on the Ohio Preservation Alliance's Most Endangered Places List. The house is currently closed to the public, but is being renovated as part of the Rickenbacker-Woods Technology Center.

General William C. Lee House

The General William C. Lee House in Dunn, North Carolina, is named for the internationally-known aviator who lived there for 13 years. The home was constructed, however, about 1915 by Jefferson Davis Barnes, a prominent Dunn businessman and one of the early residents of the Harnett County town. William C. Lee (1895-1948) was born in Dunn and was the fifth of Eldridge and Emma Jane Lee's seven children. William attended both Wake Forest and North Carolina State colleges and graduated from the latter in 1917. With training in the R.O.T.C. program at N.C. State, Lee decided upon a career in military service. Commissioned as a second lieutenant, Lee began his active military career at age 22. Following his attendance at Infantry School, Lee entered World War I with the American Expeditionary Army in France where he served as platoon leader and company commander. After the war he continued his military training in the tank warfare schools at Fort Meade, Maryland, and Versailles, France. In the 1930s, Lee attended Command and general Staff School and was promoted to major. On one of two extended European tours, he observed the German parachute and glider operations which he believed would be an invaluable asset to the U.S. Army's military development. Returning home he was ordered to the Office of the Chief of Infantry in Washington, D.C., which gave him the opportunity to promote his ideas.

Major Lee encountered stiff opposition from the military high command until President Franklin D. Roosevelt took special interest in the concept of an airborne unit and ordered the creation of

such a division. A parachute school was established at Fort Benning, Georgia, with Lee as commander. Under his guidance, improvements were made to the German system and when World War II broke out, the airborne unit stood ready to play a vital role in the ultimate victory. By the time the United States entered the war, Lee had been promoted to general and placed in command of the 101st Division. From his division headquarters in Reading, England, General Lee directed America's airborne troops. As a military strategist and advisor to General Dwight D. Eisenhower, Lee wrote the airborne doctrine and devised the tactical plans employed in the D-Day invasion of the European Continent. Unfortunately, Lee suffered a heart ailment that forced him to return to the United States before the invasion began. He watched the successful implementation of his plans from his home in Dunn.

General Lee was in active military service when his wife, Dava Johnson Lee, whom he married in 1918, bought this house on West Divine Street in 1935. Upon returning here Lee, although officially retired, continued in the role of advisor and consultant. Numerous prominent figures visited his Dunn home, including General F.A.M. Browning, chief of Great Britain's airborne forces and later treasurer to Prince Phillip with offices in Buckingham Palace, who spent several weekends with Lee during his American tour. General Lee died on June 25, 1948. Two days later, the grandest funeral ever held in Dunn honored "the father of America's airborne troops." Surrounded by state and U.S. Army dignitaries and thousands paying homage, Lee was laid to rest in Greenwood Cemetery.

The Lee House is an imposing example of early 20th-century Neo-Classical Revival residential architecture. Built in 1915, the 4,5000-square foot home has a rough textured, variegated brick veneer and consists of a two-story, double pile main section with one-story rear wings. Monumental Tuscan columns support the deep but simple entablature of the full-façade hipped roof porch.

The Gen. William C. Lee House is located at 209 West Divine St. in Dunn, North Carolina. Now a museum, it is open Monday-Friday 10:00am to 4:00pm, and on Saturday from 11:00am to 4:00pm. There is a small charge for admission. Call 910-892-1947 for further information.

Larson Brothers Airport

The Larson Brothers Airport was the first airport in Winnebago County and one of the earliest Wisconsin airports outside Milwaukee. It housed the first Wisconsin agency selling government approved planes, and for 20 years served as a center for state aviators. This well-maintained airport represents one of the earliest forms of airport design in Wisconsin. The first airport in Wisconsin was established at Milwaukee in 1919, followed soon after by similar facilities at Green Bay, Janesville, LaCrosse and Racine. Among these early airports was the Larson Brothers Airport, which opened in the town of Clayton in 1922. It was the first of three in Winnebago County, followed by Oshkosh Airport in 1927 and Whiting Airport in the town of Menasha in 1928. Of those three airports the Larson Brothers Airport is the only one to mantain its original hangar and sod landing field. The Whiting Airport closed in 1930, the hangar now converted to retail use and the field subdivided. The Oshkosh Airport remains in use as Wittman Airport with greatly expanded facilities and paved runways.

Four young farmers developed the Larson Brothers Airport: Roy, Clarence, Newell and Leonard Larson. They began by clearing an 80-rod long runway behind the barn of their family farm. In 1924 they built a six-plane hangar modeled after designs in an aviation magazine. At first they only gave lessons and ran a flying circus, touring county fairs and "barnstorming" throughout the Midwest; with the construction of the hangar they were able to accommodate transient as well as local aviators. They also built and serviced planes, forming the Roy Larson Aircraft Company in 1926. In 1927 the Larson brothers incorporated all their activities under the name Wisconsin Airways. While modest in size and appearance, the facilities were comparable to those in more metropolitan areas. The Larson Brothers Airport also enjoyed a statewide reputation in spite of its rural location. Students Clyde Lee and Merle Zuehlke went on to instruct and manage at airports in Milwaukee. Lee attempted a trans-atlantic flight to Oslo in 1932. Major James Wood of Wausau and Howard Morey of Madison began airlines with airplanes purchased here. Elwyn West, another pioneer aviator, stored his airplane here. In 1924 Roy Larson flew from this airport barnstorming the state for the LaFollette-Wheeler presidential campaign, and in 1928 flew passengers and supplies to president Coolidge's camp on the Brule River. By 1932 the Larson Brothers Airport had achieved sufficient notice among state aviators to be lionized in the *Milwaukee Journal* as the "finest airport in the state."

Ultimately its rural location contributed to the airport's decline. After 1930 sod landing fields gave way to cinder runways, which in turn were paved and lengthened as airplanes increased in size and power. The high cost of these improvements caused many small airports to close, the fields returning to farms or lost to city expansion. The rapidly changing technology also transformed metropolitan airports, removing all traces of their modest origins. In the face of these changes the Larson Brothers Airport continued operation until closed by federal mandate at the outbreak of World War II. Leonrad Larson maintained the airport for his family's use. The hangar is a one-story rectangular building of frame construction with a gambrel roof, verticle lap siding, and fieldstone foundations.

The Larson Brothers Airport is located in the town of Clayton, Wisconsin, between the farming communities of Winchester and Larsen. Surrounded by fields of corn and clover, it is set behind a cluster of frame farm buildings, 350 feet from Hwy. 150. The site includes a six-airplane hangar and a sod landing field. The airport is open by appointment only. Please call 920-836-2886 to arrange this with Abe and Theda Eckstein, daughter of Leonard Larson, who are happy to meet visitors at the main road, take them to the airport and talk about the history of the airport and Wisconsin aviation.

Hangar No. 1 Lakehurst Naval Air Station

Lakehurst Naval Air Station (Naval Air Technical Training Center) presently occupies 7,400 acres of flat lowlands just north of Lakehurst, New Jersey. Commissioned in 1921, Lakehurst Naval Air Station, became the hub of naval lighter-than-air activity. Interest in airships in the United States began early in the 20th century. The first practical craft was the *California Arrow*, built by Thomas S. Baldwin in 1904. The U.S. Army purchased the first Federal airship from Baldwin five years later. Germany was the pioneer in the manufacture of rigid airships--airships that had the gas containers enclosed within compartments of a fixed fabric-covered framework--and during World War I maintained a fleet of Zeppelins, which it used primarily for patrolling

and secondarily for bombing missions. The success of these airships prompted interest in the United States to develop them for coastal patrol to detect enemy submarines and mines and as a scouting arm for naval fleets. In 1921 the Navy established Lakehurst Naval Air Station to serve as its headquarters for lighter-than-air flight. The new base became the center for experimentation and development of rigid airships for strategic and commercial purposes as well as the control station for all Naval lighter-than-air flights.

The first major facility at Lakehurst was Hangar No. 1, a gigantic structure built in 1921 to house the huge helium-filled dirigibles. Hangar No. 1 measures 961 feet long, 350 feet wide and 200 feet high. At each end are two pairs of massive steel doors, mounted on railroad tracks. These double doors are structurally separate from the hangar itself. Each door weighs 1350 tons and is powered by two 20 horsepower motors, although provisions were made to open the doors manually, which required the assembled manpower of nine men. Inside it, Naval engineers assembled the first American-built rigid airship, the *Shenandoah*. On September 4, 1923, the ship made its maiden flight from Lakehurst. The Navy obtained its second rigid airship in 1924. Built in Germany and delivered to the United States as a war reparation payment, the *Los Angele*s shared Hangar No. 1 with the *Shenandoah*. The Navy used the dirigible extensively for experimental work on flight and mooring problems--it was the first American-owned airship developed to catch and release airplanes in flight. Lakehurst was also the home port for the *Akron* and the *Macon*. In addition to Hangar No. 1 there were five other hangars in two clusters, which have all since been converted for training and testing activities at the Naval Air Station. Hangar Nos. 2 and 3 housed blimps, Hangar No. 4 housed balloons and Hangars Nos. 5 and 6 housed either rigid air ships or blimps. The area between the two clusters of hangars was formerly used for mooring the airships and maneuvering them into the hangars.

During the late 1920s, Lakehurst became internationally known as a port for commercial lighter-than-air flight. It was the only stopping place in the United States for German airships, and in 1929 it played host to the *Graf Zeppelin*, then in the process of making the first round-the-world trip. However, of the five rigid airships eventually owned by the United States after World War I, all but one--the German-built *Los Angeles*--crashed, and many federal officials were skeptical of the desirability of continuing the program. Nevertheless, the Navy and the general public still supported the venture, largely because of the success of the German Zeppelins. A change in public opinion occurred in 1937, when the German Zeppelin *Hindenburg*, the largest airship ever built, burst into flames at Lakehurst. Thirty-six passengers died and the crash of the *Hindenburg* marked the end of commercial airship travel and the end of experimentation with hydrogen as a lifting device.

With the onset of World War II, lighter-then-air activity increased at Lakehurst, as the Navy increased its number of non-rigid airships (from six to 125). Lakehurst became the headquarters of the Chief of Naval Airship Training and Experimentation and also of the Commander Fleet Airships, Atlantic. During World War II, the Navy used blimps for observational purposes and they played an important role in escorting coastal convoys and in protecting American ships from submarine attack. With the end of the war, naval airship activity decreased, only to be expanded upon at the outbreak of the Korean War and then reduced again. In 1961 the Navy halted all lighter-than-air activity and ordered the blimps deflated and stowed.

Hangar No. 1 Lakehurst Naval Air Station, a National Historic Landmark, is located off of Rte. 547, north of Lakehurst, New Jersey. The hangar can be seen from the road, but access to the air station itself is restricted. Group tours can be requested in writing at least two months in advance--please visit the base's public affairs office website for further information.

Shenandoah *Crash Sites*

The USS *Shenandoah*, the first rigid airship built in the United States and the first in the world to be inflated with helium, was a pioneer in the history of American airship aviation. Commanded and staffed by personnel from the U.S. Navy, it was intended for use as a scouting vessel, based on German Zeppelins used during World War I. In 1917 the Navy purchased its first airship, a non-rigid or blimp (one that consists of a single gas container similar to modern blimps). The Navy soon began to plan construction of several of its own rigid airships. These rigid airships possessed a rigid framework or hull that contained several multiple gasbags. The plans called for the use of helium in the gas bags, instead of highly flammable hydrogen, as the U.S. had the world's only known large deposits of helium in the petroleum fields at Fort Worth, Texas. Construction of the ZR-1 airship, which became the *Shenandoah*, was authorized in August 1919, but delays involved in the construction of Hangar No. 1 at the Naval Air Station at Lakehurst, New Jersey, needed to house it, kept it from being completed until the summer of 1923. The design was based on a German Zeppelin downed on a bombing raid over France in 1917, although modifications were made on the volume, the bow and controls. A new alloy called duralumin, consisting of aluminum, copper and several other metals, was developed for use in the *Shenandoah* frame. This alloy had the strength of steel but the lightness of aluminum. The *Shenandoah* was 680 feet long, its maximum diameter was 78.7 feet and maximum height 93 feet. Its five 300-horse power, six-cylinder Packard engines reached a top speed of 60 mph and could carry a useful load of 33 tons.

On September 4, 1923, the *Shenandoah* successfully completed its maiden voyage. The airship took part in a series of mooring exercises at Lakehurst and to a short mast on the fleet tender the USS *Patoka*, the only airship tender in naval history. Lieutenant Commander Zachary Lansdowne assumed command of the *Shenandoah* on February 16, 1924. The *Shenandoah's* most impressive flight occurred in October 1924 when it made a transcontinental flight from Lakehurst to the West Coast and back. The publicity from this trip, heralded as a forerunner of commercial airship service, caused the Navy to plan a Midwestern tour in the summer of 1925 for 40 city "fly-overs" and state fair visits. As a native of Ohio, Lansdowne realized that at that time of the year the Great Lakes region was subject to violent and dangerous storms.

On the afternoon of September 2, 1925, the *Shenandoah* departed from its Lakehurst hangar with a crew of 41 and two passengers. Traveling west across the Alleghenies into Ohio, the airship confronted a severe storm by the early morning near Ava in northern Noble County. Initially, the ship changed course slightly to fly around the storm; however, aware of the Navy's tight schedule and fearful of losing too much time, Lansdowne decided against flying south to clearer skies. At about 6:00 am on the morning of September 3, the *Shenandoah* was suddenly caught in a violent updraft of warm air, rising at the rate of a meter a second. At about 6,200 feet the ascent was checked, but the ship began to fall at a faster rate. When halfway to the ground it was hit by another warm air current and began to rise rapidly once more, but then descended again. On the

third ascent the ship was hit by a turbulent side wind, twisting the hull and breaking it. The control car with Lansdowne and six other crewmen broke loose from its position below the bow and dropped to earth near the Andrew Gamary tenant farmhouse, killing all occupants. Seconds later six more crewmen, who were either in the hull at the point of break-up or in the gondolas toward the stern, plunged to their deaths in the fields below. The stern section, over 400 feet long, glided to earth with 18 men aboard and hit the ground near the Gamary farm with the tail in the air, where it dragged along the ground near a treeline until it was momentarily snagged and four men were dumped out. The air then picked it up and lodged the stern against an opposite hillside.

The 200-foot bow section, with seven crewmen, quickly rose to 10,000 feet, but was brought under control by venting helium from the intact gas bags and releasing gasoline from the fuel tanks. Fifty-three minutes later it floated down about six miles to the south of the initial break-up. As it approached the ground it brushed the Ernest Nichols farmhouse west of the crossroads of Sharon, tore out a post and a pole and scraped over the garage roof. Nichols grabbed a line thrown from the bow and secured it to a pair of trees. Finally grounded, the crew jumped out, borrowed a shotgun from Nichols and burst the gasbags before the bow was blown any further. The Lieutenant Commander who had guided the bow to earth, Captain Rosendahl, used the Nichols's telephone to call the telegraph office at Caldwell and inform naval officers of the disaster. Twenty-nine members of the crew survived the break-up, although some received serious injuries.

Although the FBI attempted to guard the crash-site along with 40 Ohio National Guardsmen, wholesale looting of the site had already been accomplished. A court of inquiry was convened at the Gamary farm under Army Major C.W. Cook stationed at Fort Hayes in Columbus, and later naval officers in Washington, D.C., convened a formal court. The wreck of the *Shenandoah* had important consequences for the future of the American military and its airship program. Study of the disaster led to the conclusion that much stronger construction of future airship hulls was necessary. An improved "fineness ratio" or diameter to length ratio, was required, and control cars in the future were built into the keel instead of being suspended from struts as in the *Shenandoah*. Engine power was upgraded to allow airships to outmaneuver storms and an improved weather forecasting service was developed for the armed services.

The Shenandoah *Crash Sites are located in the hillsides of Noble County, Ohio. Site No.1, in Buffalo Township, surrounding the Gamary farmhouse (beneath the initial break-up). An early fieldstone and a second, recent granite marker identify where Zachary Lansdowne's body was found. Site No. 2 (where the stern came to rest) is a half-mile southeast of Site No. 1 across 1-77 in Noble Township. The rough outline of the stern is marked with a series of concrete blocks and a sign marking the site is visible from the freeway. Site No. 3 is approximately six miles southwest in Sharon Township at the northern edge of SR 78, and the part of the old Nichols farm where the nose of the* Shenandoah *bow was secured to trees. Although the trees have been cut down, a semi-circular gravel drive surrounds their stumps and a small granite marker commemorates the crash. The Nichols house was later destroyed by fire. Visit www.noblecountyohio.com/shenandoah.html for further information and photographs or contact one of two local experts to arrange a tour: Bryan Rayner at 740-732-2624 or John Powell at 740-732-2341.*

Charles A. Lindbergh, Sr. House

Charles Lindbergh, Jr. is renowned as the aviator who accomplished the first nonstop solo trans-Atlantic flight from New York to Paris in 1927. He became an overnight success after completing this milestone in aviation history. The Lindbergh House in Little Falls, Minnesota, is the sole extant property associated with both Charles Lindbergh, Jr. and Sr. Charles Lindbergh, Sr., who served in the U.S. Congress from 1907 through 1917. A reformer and independent, he was prominent in protest politics and opposed the nation's entry into World War I. The family occupied the house between 1907 and 1920, at which time Lindbergh, Jr. pursued a college education at the University of Wisconsin. However, after three semesters he dropped out of school to pursue his aspirations of flying. He started out barnstorming and not too long after joined the Army Air Service. By 1926 he was flying a mail route between St. Louis and Chicago and in 1927 made the decision to attempt the first trans-Atlantic flight. Raymond Orteig was offering a $25,000 prize to the person who completed this feat. Lindbergh successfully completed the first trans-Atlantic flight, flying from New York and landing in Paris on May 21, 1927, and became an internationally renowned figure as a result.

Lindbergh, Sr. purchased approximately 110 acres of land southwest of Little Falls in 1898. The elder Lindbergh constructed a two-and-a-half-story house on the property and moved into the house with his second wife in 1901. Linbergh, Jr., born in Detroit in 1902, was just three years old when the house was destroyed by fire in 1905. With only the original foundation remaining, the Lindberghs rebuilt the house between 1906 and 1907 a plain one-and-a-half-story frame farmhouse. Located on the western bank of the Mississippi River surrounded by wooded landscape, the residence was used primarily as a summer retreat until the advent of the World War I at which time they made the decision to reside in the house year round in order to raise food animals. The Lindbergh residence is covered with weatherboard and contains a gabled hip roof, measures approximately 40 by 50 feet and is authentically painted light grey with white trim. Plain Palladian-type windows are displayed in the west gable end of the front façade. A gable-roofed porch supported by two paneled white-painted wooden columns graces the front portion of the house.

The Charles A. Lindbergh, Sr. House, a National Historic Landmark, is located at 1620 Lindbergh Dr. S., in Little Falls, Minnesota. It is now the Charles A. Lindbergh Historic Site museum, open Monday-Saturday 10:00am to 5:00pm and Sunday 12:00pm to 5:00pm from May 1 through Labor day; from Labor Day through October, 10:00am to 4:00pm on Saturdays and 12:00pm to 4:00pm on Sundays. There is a fee for admission. Please call 320-632-3154 or visit the museum's website for further information. You can also download (in pdf) the Charles A. Lindbergh, Sr. House National Historic Landmark nomination.

Torrey Pines Gliderport

Torrey Pines Gliderport played an interesting role in the aviation industry of Southern California. Beginning in 1930, this site was used for motorless flight. Gliders were car-towed off the beach parallel to a 350-cliff so they could fly in the lift created by the prevailing westerly wind at Torrey Pines. The nearly flat land of the mesa east of the cliff was used for launching and

landing, providing a natural emergency runway. Many aviation pioneers flew at Torrey Pines. On February 24, 1930, Charles A. Lindbergh flew in the lift at Torrey Pines in a flight along the coast from Mt. Soledad to Del Mar, thereby establishing a claimed distance record. In 1936, Woodly Brown, who previously flew off the beach, was the first to launch and land on top of the cliff at Torrey Pines. In the late 1930s, Hawley Bowlus, construction supervisor of the *Spirit of St. Louis* and owner of his own sailplane manufacturing company in San Diego, began flying at Torrey Pines. Bud Perl and Bill Beuby flew at Torrey Pines; the former's Class A license was signed by Orville Wright. The first three-day glider meet at Torrey Pines was held on December 31, 1939.

Torrey Pines was also the location for the development of several new technologies. The Dead-man pulley take-off system (1938) launched sailplanes from cars, instead of the earlier method of several men pulling them off the slope. The Robinson variometer (1939) was a very sensitive instrument used to determine rate of climb or sink in a sailplane. John Robinson designed both of these systems, as well as several highly maneuverable sailplanes named *Robin #1* through *Robin #4* (1936-1939). Oversized control surfaces with more overall movement were used to give the pilots an advantage while circling in tight thermals, doing aerobatics or having more control on landings. John Robinson's *Zanonia* sailplane, built and designed by Harland Ross, was the first airplane in the nation to use spoilers (air brakes) on the wings (1939). The spoilers helped reduce lift and slow the aircraft down for landings. An aircraft parachute recovery system invented by Bob Fronius was flight tested here in 1947 to save a "disabled" sailplane. The gliderport is unique in that it was the only legal site where unlicensed aircraft could fly in a civil airway, a license granted exclusively for the Torrey Pines Gliderport in 1938.

Flight operations at Torrey Pines were interrupted in 1941 when the gliderport property became the Army's Camp Callan. Military operations were conducted here until the end of World War II. The first annual Pacific Coast Mid-Winter Soaring Championship was held at Torrey Pines in 1947. John Robinson became the first three-time National Soaring Champion as well as the first American to fly over 300 miles cross-country, the first in the world to fly over 30,000 feet in a sailplane and the first in the world to earn a Diamond "C" badge (the most respected award in soaring). Richard Johnson, who held the title of National Champion in soaring seven times, participated in the Pacific Coast Mid-Winter Championships in the late 1950s and early 1960s. In the late 1960s, radio-controlled model airplanes began operations at this location, and in the 1970s, hang gliders joined the flight operations. The Torrey Pines Soaring Council was established by the Parks Recreation Department, City of San Diego, in 1978 to provide advice and council regarding flight safety and other matters. Torrey Pines Gliderport remains in its natural condition, except for the addition of a runway, the foundation of a small army barrack, and areas graded for current sailplane operations.

The Torrey Pines Gliderport is located west of Torrey Pines Rd., bordering Torrey Pines Scenic Dr. and south and west of the Torrey Pines Golf Course, in La Jolla, California. Still an active site for motorless flight, year round paragliding and hang gliding are available, as is instruction. Find more information visit www.flytorrey.com or call 858-452-9858. The Torrey Pines Gliderport Historical Society also has further information

Goodyear Airdock

The Goodyear Airdock in Akron, Ohio, was constructed in 1929 by the Goodyear Zepplin Corporation from plans created by the Wilbur Watson Engineering Company of Cleveland, Ohio. Work began on April 20, 1929, and by November 25 the Airdock was completed at a cost of $2.2 million. With the construction of the Airdock, Akron became one of the centers for development and construction of lighter-than-air ships. Two dirigibles, the *Akron* (ZRS-4) and its sister, the *Macon* (ZRS-5), were built in the Airdock and launched in 1931 and 1934 respectively. The building later housed the photographic division of the Goodyear Aerospace Corporation. The semi-paraboloid shaped building has been described as "half a silkworm's cocoon, cut in half the long way." The maximum length of the Goodyear Airdock is 1,175 feet with a maximum width of 325 feet and a maximum height of 211 feet. At the ends of the building are identical semi-spherical doors, each weighing 600 tons. These doors are fastened at the top by hollow forged pins 17 inches in diameter and six feet long. The doors rest on 40 wheels set on curved railroad tracks.

On either side of the building, approximately 100 feet above ground level, is a row of 12 windows. Atop the building at the northeast end is a control tower and radio aerial. The airdock might be said to "breathe," as it is mounted on rollers to compensate for expansion and contraction due to temperature changes. At the time it was built, it was the largest building in the world without interior supports. Before starting the design of the Akron Goodyear Airdock, Dr. Karl Arnstein, director of engineering of the Goodyear Zepplin Corporation had extensive tests conducted on a model of the building in the wind tunnel of the Daniel Guggenheim School of Aeronautics of New York University. According to Wilbur J. Watson in his article *Building the World's Largest Airship Factory and Dock for the Goodyear Aerospace Corporation*, tests conducted on a model 1/240th of the size of the building, "demonstrated the superiority of this shaped building in offering minimum resistance to wind currents, and also furnished valuable information in regard to the magnitude and distribution of the suction forces caused by the action of the wind on the surface of the building." When World War II broke out enclosed production areas were rapidly needed, and the Airdock was used for this purpose. The Airdock has more recently served as the site of the 1986 kickoff rally for the United Way of Summit County and some 200,000 members of the public visited. President Clinton spoke here as a candidate in the 1992 election, bringing some 30,000 visitors to the site. Loral Corporation purchased Goodyear Aerospace Corporation and the Goodyear Airdock, in 1987 and it was later acquired by the Lockheed Martin Corporation in 1996.

The Goodyear Airdock is located at 1210 Massillion Rd., Akron, Ohio, and can be easily seen from U.S. Rt. 224 just east of downtown Akron. The airdock is not open to the public.

U.S. Naval Air Station Sunnyvale, California, Historic District

Admiral William A. Moffett is credited with the creation of the two Naval Air Stations commissioned in the early 1930s to port the two U.S. Naval Airships (dirigibles). The Naval Air Station Sunnyvale, California, was the Pacific coast location selected with help from northern Californian politicians and the leadership of the Chambers of Commerce from Mountain View to San Jose. More commonly known as Moffett Field, the U.S. Naval Air Station Sunnyvale, California, Historic District consists of a large number of buildings that were constructed from the 1930s on. By far the most famous and visible of these are Hangars #1, #2 and #3, which

dwarf the surrounding buildings, standing as testament to the engineering skills of their builders.

Towering majestically in the northeast corner of Santa Clara Valley is Hangar #1 constructed in 1933 to house the Navy dirigible USS *Macon*. Named as a Naval Historical Monument in the early 1950s, the hangar is constructed on an amazing network of steel girders sheathed with galvanized steel. It rests firmly upon a reinforced pad anchored to concrete pilings. The floor covers eight acres and can accommodate 10 football fields. "Number One," as it is popularly referred to, is 1,133 feet long and 308 feet wide. Its walls curve upward and inward, to form an elongated dome 198 feet high. Unique and spectacular are the "orange peel" doors, weighing 500 tons each. The doors are operated by an electrical control panel. Each door is powered by a 150-horsepower motor. One of the most recognizable landmarks in the San Francisco Bay Area, Hangar #1 and the original base are significant in the history of Naval Aviation, defense and in the development of the Santa Clara Valley. Making use of the facility location and landing field, NASA Ames Research Center is located to the north adjacent to the original plaza boundary and at the north boundary of the historic district. It was here that some of the original moon rocks taken from the Apollo lunar landings were studied by NASA geologists.

The hangar's interior is so large that fog sometimes forms near the ceiling. A person unaccustomed to its vastness is susceptible to optical disorientation. Looking across its deck, airplanes and tractors look like toys. Along its length, maintenance shops, inspection laboratories and offices help keep the hangar busy. Looking up, you can see a network of catwalks for access to all parts of the structure. Two elevators meet near the top, allowing maintenance personnel to get to the top quickly and easily. Narrow gauge tracks run the length of the hangar. During the lighter- than-air period of dirigibles and non-rigid aircraft, the rails extended across the apron and into the fields at each end of the hangar. This tramway facilitated the transportation of an airship on the mooring mast to the hangar interior or to the flight position. During the brief period that the USS *Macon* was based at Moffett from October 1933 until it was lost at sea in February 1935, Number One not only accommodated the giant airship but several smaller non-rigid LTA craft simultaneously. Hangar One is one of the most important hangars in the world. Hangars #2 and #3 are significant more for their size than their unique styling or design. Along with Hangar #1, these two buildings help define the South San Francisco Bay Area from all distant directions. The style of the other buildings on the base is largely Spanish Colonial Revival, mostly built in the 1930s, with some International style buildings constructed in the 1940s and beyond. The Moffett Field Historical Society was founded in May of 1993. Until recently, their museum was located in historic "Hangar One."

Naval Air Station Sunnyvale is located near Mountain View and Sunnyvale, California, 35 miles south of San Francisco. From Highway 101 use the Moffett Field exit. The Moffett Museum has been located in Hangar One for several years, but relocated to an adjacent building after the hangar was closed due to potential toxic chemicals. If you plan to visit, inform the guard at the main gate that you are going to the museum and follow his instructions. Call 650-603-9827 or visit the Moffett Field Museum's website for further information.

Amelia Earhart Birthplace

The accomplishments of Amelia Earhart in the field of aviation were many. She is best

remembered as the first woman to make a solo flight across the Atlantic, May 20-21, 1932. For this achievement Vice President Charles Curtis awarded her the Distinguished Flying Cross on July 29, 1932. Some of her other achievements included: setting the women's altitude record, the women's speed record, the first person to fly solo from Honolulu, Hawaii to Oakland, California, and she was the first woman to make a solo round trip of the United States. On July 2, 1937, she and her navigator, Fred Noonan, while on a round-the-world flight, disappeared over the Pacific Ocean.

The house where Amelia Earhart was born and raised was built in 1861 by her grandfather, Judge Alfred G. Otis, in Atchison, Kansas. Amelia was born in the southwest bedroom on the second floor. Although there is some disagreement as to the date of her birth, records of the Trinity Episcopal Church of Atchison indicate the date was July 24, 1897. Her father, Edwin Stanton Earhart, was a lawyer whose position as claims agent for a railroad required him to travel a great deal. Consequently Amelia and her sister Muriel stayed with their grandparents much of the time. In one of her books Amelia mentioned that she had attended grammar school in Atchison until the eighth grade and had skipped two grades in the process. Even though she lived in many different cities, Amelia considered Atchison her hometown. It is probable that she spent more time in the house she was born in, called the Otis House, than anywhere else. The Amelia Earhart Birthplace represents one of the few remaining tangible associations with this famous aviation pilot.

The house faces east and overlooks the Missouri River from the crest of a bluff. The front portion of the house is two stories high and constructed of wood and horizontal lap siding; the rear portion is one story and is constructed of brick masonry. A one-story, flat-roofed frame porch runs the length of the east front and is supported by six hexagonal columns, of which the four center ones are paired. The roof is a double pitch gable with an intersecting gable on the east side. Most window openings have a semicircular arched head.

The Amelia Earhart Birthplace is located on 223 North Terrace St., in Atchison, Kansas. The museum is open Monday-Friday 9:00am to 4:00pm, Saturday 10:00am to 4:00pm and Sunday 1:00pm to 4:00pm; on holidays by appointment. There is a fee for admission. Please call 913-367-4217 or visit the museum's website for information. Another valuable online source of information on Amelia Earhart are the George Palmer Putnam Collection of Amelia Earhart Papers at Purdue University.

Pangborn-Herndon Memorial Site

The Pangborn-Herndon Memorial Site northeast of East Wenatchee, Washington, commemorates the first successful nonstop flight across the Pacific Ocean from Japan to the United States by aviators Clyde Pangborn and Hugh Herndon II. Designed by artist Walter Graham, the monument is a column of native basalt found in Moses Coulee about 20 miles from the memorial site near East Wenatchee, Washington. The column is approximately 14 feet high with a three-foot concrete base, is roughly 36 inches in diameter and weighs 14 tons. It is roughly hexagonal in shape, and slants at the top, with 36-inch molten aluminum wings placed at the highest point on the column.

Taking off from Sabishiro Beach, Japan, aviators Clyde Pangborn and Hugh Herndon II flew 4,558 miles in 41 hours and 34 minutes, landing at Fancher Field on October 5, 1931. The flight was made in a small, single-engine plane--a Bellanca "Skyrocket" they named *Miss Veedol*. Since retractable landing gear had yet to be invented, the landing gear was jettisoned over the ocean after take-off in order to lighten the load and decrease wind resistance. Their landing without gear was so smoothly accomplished that the only damage to the airplane was a bent propeller, which is now in the North Central Washington Museum, in Wenatchee, along with other momentos of the event. The two men were seeking a $25,000 prize offered by a Japanese newspaper, the *Asahi Shimbun*, to the pilots who could make the first nonstop flight from Japan to the United States.

Eight other aviators had attempted the trans-Pacific flight, but all had failed to complete the trip. The Japanese erected a monument at the site of the take-off at Sabishiro Beach, and sent a delegation to the dedication ceremony of the Pangborn-Herndon Memorial at Wenatchee on May 5, 1969. The delegation included Governor Shunkichi Takeuchi, of Aomori Prefecture, who had been a reporter for a Japanese newspaper in 1931 and covered the story of the flight for his paper at that time. The seven acres of property owned by Douglas County used for the memorial included the actual spot on which Clyde Pangborn and Hugh Herndon landed their airplane upon completion of their nonstop flight across the Pacific Ocean from Japan, and according to estimates the monument stands within 50 feet of the actual landing spot.

The Pangborn-Herndon Memorial Site stands on the brow of a hill overlooking the Wenatchee Valley, the Columbia and Wenatchee rivers, and the snow-covered Cascade Mountains three miles northeast of East Wenatchee, Washington. From East Wenatchee, take Hwy. 2 to Grant Rd. east; take Eastmont Rd. north for 3 miles to the memorial. For further information about this call the Wenatchee Valley Convention & Visitors Bureau at 509-663-8551. The nearby Wenatchee Valley Museum and Cultural Center, located online at www.wenatcheevalleymuseum.com, *provides further information on this historical event*.

Rogers-Post Site

Two monuments at the Rogers-Post Site in Barrow, Alaska, memorialize the fatal August 16, 1935 aviation crash that claimed the lives of prominent Americans Will Rogers and Wiley Post. Will Rogers--actor, author, pundit and homespun philosopher, once called by the *New York Times* "the most widely-known citizen of the U.S. . . . and the best beloved" was also preeminent in the advancement of air transportation. Wiley Post, holder of two around-the-world aviation flight records, had contributed prominently to the advance of international aviation, including the study of the sub-stratosphere. Both Houses of Congress suspended deliberations upon learning of Rogers and Post's deaths, and a period of national mourning followed with messages of condolence issued by leaders and governments throughout the world.

Neither Rogers nor Post was a stranger to Alaska. This particular flight was described by the Associated Press as a "happy-go-lucky aerial tour of Alaska," which would be a prelude to a planned important pioneering trans-Siberian flight to Moscow. The two men had visited several Alaskan cities. On August 16, Rogers and Post were flying from Fairbanks to Barrow when they encountered fog and low-visibility. The two friends located a hole in the fog at Walakpa Bay,

landed, spent some time with a small party of Alaska Natives and received directions for the short distance remaining to fog-shrouded Barrow. The final flight was barely airborne--perhaps 50 feet--when the motor failed. The aircraft plummeted into the lagoon and overturned. The Post-Rogers crash was the first fatal air accident Barrow had known.

Born in Texas in 1899, Wiley Post's internationally recognized career followed his unexpected win as an unknown of the 1930 National Air Race from Los Angeles to California. In the years preceding the crash, Post had stopped in Alaska for refueling during his two round-the-world flights. In 1931 he landed his plane, *Winnie May*, at both Fairbanks and Solomon Beach, near Nome with his navigator Harold Gatty. Then in a solo flight that bettered his time by almost a day he landed *Winnie May* at Fairbanks again, and at Flat, in the summer of 1933. The airplane that Post and Rogers were flying in 1935 was an advanced version of the *Winnie May*, but designed by Post. It was a low-wing cantilever monoplane of wood and fabric construction using a 55-horse power, Pratt and Whitney Wasp Engine. The fuselage was Lockheed Orion and the wing Sirius, similar to the airplane flown across the Pacific to Japan earlier by Charles and Ann Lindbergh. For Alaskan and Siberian conditions, in addition to landing wheels, it carried interchangeable skis and pontoons, and was described by the Army Signal Corps radio out of Barrow to Seattle as a "red, Arctic Sky Crusier."

The first monument at this site was dedicated just three years after the tragic crash, organized through public subscription from thousands of Americans. The Will Rogers-Wiley Post monument was designed in Oklahoma and built on the site with poured concrete using local aggregate. The design was essentially two cubes--the smaller atop the larger--with a pink granite memorial marker quarried near the Rogers' family homestead at Claremore, Oklahoma. The elaborate dedication ceremonies involved a four-way Columbia Broadcasting radio program from the Nation's capitol, the statehouses of Oklahoma and Texas and from Barrow and Walakpa, Alaska. The second monument was built 15 years later by Jesse Stubbs. More slender and almost 10 feet taller than the first, it was constructed as an obelisk entirely of poured concrete in four rectangular, diminishing blocks. Little is known of Stubbs, who arrived in Anchorage with the intention of walking from there to Barrow in the summer of 1953. Claiming to be a childhood friend of Rogers, although no records attest to this, the 72-year-old man personally erected the obelisk. It memorializes not only Rogers and Post, but also the Alaskan veterans of World War II. Both monuments overlook the lagoon crash site.

The Rogers-Post Site is located on the north side of Walakpa Bay near the mouth of the Walakpa River about 13 miles southwest of Barrow, Alaska, in the northwest portion of the state. Barrow is accessible by airplane only.

Old Terminal Building, Hangar and Powerhouse at Key Field

The Old Terminal Building, Hangar and Powerhouse at Key Field form the earliest surviving airport complex in the state of Mississippi. Key Field (originally the Meridian Regional Airport) opened in November of 1930 with the completion of the Terminal, Hangar, Powerhouse and a graded and packed dirt runway. It was run by brothers Algene and Frederick Key, pioneers of aviation who established and still retain the flight endurance world record. Algene and Frederick also operated the Key Brothers' Flying School at Bonita Field several miles outside Meridian.

With the onset of the Great Depression, the City of Meridian considered abandoning the airport because of the cost of maintenance. However, the Key brothers devised a scheme to keep the airport operating. They hoped that by breaking the standing flight endurance record of 23 days they would focus worldwide attention on Meridian and its airport.

To accomplish this feat they modified a small single-engine Curtis Robin airplane, which they named the *Ole Miss*, by adding an extra 150-gallon fuel tank and a catwalk for mid-flight repairs and refueling. The plane's seats were removed to provide room for the tank, and a new pilot's seat was built into the forward end of the tank. When off duty, one of the brothers could crawl over the tank to the rear luggage compartment, which housed a thin mattress. In the 1930s, air-to-air refueling was still a dramatic and dangerous innovation. It had been done on other endurance flights, but if gasoline from the hose spattered the exhaust area during refueling, the gas would ignite. To avoid that possibility, a Meridian mechanic, A.D. Hunter, designed an automatic cutoff valve for the hose nozzle. James Keeton, one of Al Key's students, piloted the refueling airplane and Bill Ward was in charge of lowering the fuel hose and supplies to the endurance airplane. To solve the problem of communications, the Keys had Ben Woodruff, a local radio repairman and part-time inventor, build and install a two-way radio in the airplane that needed batteries and a wind-driven generator. This was the first use of a very high frequency (VHF) air-to-ground and ground-to-air radio outfit, which is now the most popular band for aviation communication and navigation.

After two unsuccessful attempts to break the record, the brothers launched their third attempt on June 4, 1935. They flew a figure eight pattern over Meridian, and as their time aloft mounted, the flight attracted worldwide attention. On July 1, the Key brothers landed at the Meridian airport to a cheering crowd of about 35,000 people after completing 27 days in flight. They had flown nonstop for more than 52,000 miles (a distance roughly equal to twice around the world) in 653 hours, 34 minutes. To date, no airplane has beaten that record. Not until NASA's Skylab II mission in 1973 did man stay above earth longer than the Keys, but the brothers' intra-atmospheric flight record has not been broken for the class of aircraft they flew. Upon breaking the endurance record, the airport was renamed Key Field in the brothers' honor.

The Key brothers later served as bomber pilots in the Pacific theater during World War II. Fred was awarded the Distinguished Flying Cross, and Al earned a Distinguished Flying Cross, a Distinguished Service Cross, an Air medal, a British Distinguished Service Cross and seven bronze stars for participating in combat. They both had distinguished careers--Al remained in the Air Force until his retirement in 1960 at the rank of full Colonel and Fred ran the Key Brothers Flying Service at Key Field until his death in 1971. The cutoff valve developed for the Keys by A.D. Hunter was an important innovation for national defense, being the precursor of those used by modern tanker airplanes that keep bombers and fighters in the air. Today, with only slight modifications, U.S. Air Force and Strategic Air Command airplanes use the valve that Hunter invented.

Facing east toward the highway, the Old Terminal is a two-story, brick building with single-story, one-by-one bay, front entrance pavilion and side wings. To the north of the Terminal is the Hangar, a large, rectangular, brick building resting on a concrete foundation and crowned by an asbestos-clad gable roof with parapeted end walls. The Hangar was built to accommodate 10

airplanes, which gain access through either the south or north end through eight large sliding metal doors. On the east side of the Hangar is the diminutive brick Powerhouse. The one-story, one-by-one bay building has a gable roof with parapeted end walls with concrete copings.

The Old Terminal Building, Hangar and Powerhouse at Key Field are located at 2525 U.S. Hwy. 11 South, roughly one half mile south of I-20 and I-59, in Meridian, Mississippi. Still an airport, it is open during normal business hours. For more information visit www.meridianairport.com

Building No. 105, Boeing Airplane Company

Building No.105, better known as the "Red Barn," south of Seattle, Washington, documents the humble origins of what is today the world's largest airplane manufacturer. In 1910, 28-year-old William Boeing purchased this balloon frame building, built one year earlier, to house construction of the yacht he was having built for himself. Boeing's interests shifted from the sea to the air in 1916, and his fledgling Pacific Aero Products Company converted the Red Barn into its engineering offices and manufacturing plant. The construction of its first airplane, the 1916 Boeing and Westervelt (B&W) aircraft, reflected the building's first use: it was assembled by a team of carpenters, cabinetmakers, seamstresses and shipwrights. Soon after the B&W, the company produced the B-1, which became the first airplane to carry international mail. The firm also changed its name to the Boeing Airplane Company in 1917 after completing a large military contract to construct 50 Navy training aircraft. However, the company struggled financially throughout the 1920s and 1930s.

In 1935, new federal laws prohibited airmail contractors from associating with aircraft manufacturing firms, but instead of choosing which business to pursue, Boeing sold all of his stock and left the airplane business altogether. The company later secured its future when engineers working in the Red Barn designed the famous B-17 and B-29 bombers that helped the Allies win World War II. The Boeing Company quickly outgrew the open bay on the ground floor of the Red Barn and expanded to form a vital industry in the Pacific Northwest. Boeing sold Building No. 105 to the Port of Seattle in 1970. The simple two-story, gable roofed barn was restored and reopened as the Museum of Flight in 1983.

The Boeing Airplane Company Building No. 105 was moved from its original location in the 1970s, and is now located south of Seattle in the city of Tukwila, Washington, in the 9400 block of E. Marginal Way South, on the grounds of the Museum of Flight. The Museum of Flight is open daily from 10:00am to 5:00pm, and 10:00am to 9:00pm on the first Thursday of every month; closed on Thanksgiving and Christmas. There is a charge for admission. Call 206-764-5700 or visit the musem's website for further information.

Smith Field

In 1919, the city of Fort Wayne, Indiana, inspected the site that eventually became Smith Field for its suitability as a municipal airport. The site was first used for pilot instruction beginning in 1923, and on June 25, 1925, was established as Baer Municipal Airport. Named for a native of Fort Wayne, Paul Baer was the first American Ace of World War I. In February of 1928, a

$100,000 bond issue allowed for the formal planning of runways and taxiways, a system that is still in use. Between 1930 and 1937, these were paved and widened by the Civil Works Administration and the Works Progress Administration. The airport became one of the first in the U.S. to have a nighttime lighting system also funded by the bond, and the 82-foot Beacon Tower was constructed. Soon after the addition of several buildings and a commercial airmail carrier in 1930, Smith Field established passenger service. In 1932, the airport served 3,000 passengers, and the introduction of the Douglas DC-3 in 1936 created more flights, thus serving more people.

During World War II, the Army Air Corps received a large tract of land south of Fort Wayne for use as an airfield. That field, originally named Smith Field after Fort Wayne U.S. airmail pioneer Art Smith, then became Paul Baer Army Airfield, and the airport became Smith Field, as it is known today. In 1944, Smith Field's Hangar 2, a rare example of hangars from the 1920s period, became a production center for Interstate Aircraft TDR-1 Assault Drones, also known as "cruise" missiles.

In addition to its historic system of runways, Smith Field is home to several other unique buildings. Hangar 2 features three large Truscon Steel Company Doors, a highlight unique to Smith Field in the U.S. at the time they were built. The Carousel Hangar, although outside the period of significance defined for Smith Field, is the only example of Clark W. Smith's patented design ever built, characterized by a rotating carousel door. Smith Field's tie-down area recalls the era before World War II when hangars were used for maintenance rather than storage, and the aircraft had to be tied down to spiral-shaped stakes in the ground. Smith Field also features ruins of a railroad freight platform, a remnant o f the airport's easy accessibility to a transport for the TDR-1 missiles.

Smith Field is located at 426 W. Ludwig Ave., four miles north of Fort Wayne, Indiana. Entrance to the airport is between Lima and Coldwater rds. Still a functional terminal, the building is open during normal airport hours. Free flights for children and young adults (under 18 years of age) are offered montly as part of the EAA "Young Eagles" program. Fly-Ins, Biplane Rides and Special Events are held throughout the flying season. For further information call 260-489-5518 or visit the airport's website .

Felts Field Historic District

Felts Field, established in Spokane, Washington, in 1926, was the Inland Northwest's first airport and one of the oldest Federally designated airports in the nation. It served as the region's principal commercial and military airport through the 1940s and was the location of the region's first National Guard Air Unit. In the wake of World War I, former army pilots and surplus airplanes led to a national surge in aviation activities. Felts Field was designated a municipal air field (under the name Earl Hoisington Field) by the city and in February 1919, the Northwest Aircraft Company leased 1,000 acres at the field from the city. Before the end of the year, the firm was flying passengers to Lewiston, Tacoma and Seattle. Other air firms followed, such as the Spokane Aviation Company and the United States Aircraft Company, setting up operations at

the field in the early 1920s. In 1924, the region's first National Guard formed and located here and in 1927, construction began on a new headquarters building that still stands. The real growth of the airport began with the arrival of airmail service in 1929. On August 15th,1929, Lt. Nick Mamer and Art Walker took off from Felts Field in their *Spokane Sun-God* and stayed in the air for 120 hours travelling from Spokane to New York and returning to Felts Field on August 20th. This 7,200-mile trip set several records, including the first transcontinental refueling, the first refueling above 8,000 feet and the world's record nonstop mileage.

The buildings and airfield of the Felts Field Historic District illustrate the formative years of commercial and military aviation from the late 1920s through 1941. The airfield, surrounded by expansive open space, remains almost unchanged since the runways were first paved around 1940. The historic buildings of the district--three aircraft hangars, a passenger terminal, the National Guard headquarters, a small storage building, clock tower and a free-standing metal and neon sign--are located along Rutter Avenue parallel to the landing strip. At one end of this row of buildings is the Northwest Airlines Company hangar, a large wood frame building from the mid-1930s with Art Deco details. The 1932 Terminal Building also reflects the streamlined motifs of the Art Deco period, and a bas-relief molding of Pegasus ornaments the central entry. The terminal reflects the growth in commercial aviation during this period and originally housed United Airlines offices (which began operating here in 1931), ticket and waiting areas, as well as the weather bureau. The dramatic moderne clock tower was constructed in 1939 as a memorial to pilot Lt. Mamer and nine others killed in a commercial airplane crash the previous year.

As the airport became busier with military and general aviation traffic in the years leading to World War II, it became apparent that Felts Field was not large enough to accommodate the increased activity. Another airport was constructed in 1940 and by 1949, military and commercial traffic had moved permanently to what was later named Spokane International Airport. Felts Field continued to serve as a general aviation facility.

Felts Field Historic District is located along Ruttler Ave. bounded by Fancher and Dollar rds. in Spokane, Washington. It is an active general aviation facility. The Skyway Café is located in the historic Terminal Building and is open Monday-Friday 6:00am to 3:00pm, Saturday 6:30am to 3:00pm, and Sunday 7:30am to 3:00pm.

Floyd Bennett Field Historic District

Floyd Bennett Field, on Barren Island, Jamaica Bay, was the first municipal airport in New York City. Constructed between 1928 and 1931 by the City Department of Docks, the airport was designed to divert the increasing volume of air traffic to New York City away from Newark Airport where the vast majority of New York bound flights terminated. By 1933, Floyd Bennett Field was the second busiest airport in the country, with 51,828 landings and takeoffs, but only a minor percentage of this actively consisted of the mail, freight and commercial passengers which generated revenue. The field was named in honor of naval aviator Floyd Bennett, pilot of the first flight over the North Pole in 1926. Bennett later died in 1928 from pneumonia that developed following extensive injuries from an earlier crash. Following the opening of Idlewild Airport in 1939, Floyd Bennett Field was closed to commercial use and conveyed to the U.S. Navy in 1941. Although the Navy enlarged the field, the original complex of steel frame and brick hangars and

support buildings has not been substantially altered, and thus Floyd Bennett Field retains the architectural design and historic integrity of an early municipal airport.

Floyd Bennett Field is also important for its association with significant early aviators. Because of its unusually long runways and fair weather conditions, Floyd Bennett Field became noted as a prime airport for the experimental fliers who sought to establish speed and distance records. In 1933 Wiley Post broke his previous record for an around-the-world flight landing at Floyd Bennett Field seven days, 18 hours and 49 minutes after he took off from there on July 15. In 1938, Howard Hughes with a crew of four made an around-the-world flight starting and finishing at Floyd Bennett Field. This flight, which covered 14,791 miles in three days, 19 hours, eight minutes and 10 seconds, was made to collect navigational data. Shortly after Hughes's flight, Douglas Corrigan embarked from Floyd Bennett Field supposedly on a flight to California. Corrigan flew instead to Ireland, thus fulfilling his wish to make a Trans-Atlantic flight. For this apparent lack of orientation, Corrigan lost his experimental license and earned the nickname "Wrong-Way." Interest in these records reflected public enthusiasm about aviation and contributed to improving technical aspects and piloting skills.

The first and most important buildings to be erected at the field were the complex of four pairs of hangars built between 1929 and 1931. The basically identical hangars are of steel frame construction with steel trussed arched roofs and wooden decks. Each hangar has a concrete slab floor and is supported by 45-foot-long precast concrete piles, which have been sunk into the ground. The inside dimensions of each hangar are 120 feet by 140 feet. Attached to the exterior side of each hangar is a two-story service wing, constructed of buff colored brick, which measures 20 feet by 120 feet. Between 1936 and 1938, the Works Progress Administration (WPA) constructed central service wings between the paired hangars, creating one continuous line of hangars. These two-story wings were made of the same brick and along the same lines as the side wings and housed machine shops and other maintenance facilities. The administration building, constructed in 1931, is a red and black brick building, two stories high and constructed in a neo-Georgian style. The eastern façade, which faces the runway, is dominated by a semi-octagonal projecting bay, three stories tall and topped with the steel framed and glass enclosed control booth. There is a small deck, enclosed with aluminum railing, surrounding the control booth. On either side of the projecting bay, at the first-story level, there is an observation deck, enclosed by balustrades and reached by a granite stairway.

From 1929 through 1931, following the creation of the 387-acre area, two reinforced runways were laid. Both runways were 100 feet wide; one was 4200 feet long and oriented on a northeast-southwest axis and the other was 3,110 feet long and oriented on a north-northwest-south-southwest axis. The runways, located to the east of the building complex, formed a T, with the intersection slightly south of the administration building site. A concrete taxiway was also constructed at this time--it was parallel to the shorter of the runways and located to the west of it and east of the hangars. Two more runways were constructed by the WPA from 1937 to 1938. The shorter of these runways was laid on an approximately north-south axis, extending 4000 feet north from its intersection with the southern end of the earlier, 3100 feet runway. The longer of the new runways extended southeast for 5,500 feet from the northern terminus of the 3,100-foot runway. The rest of the airfield was planted with grass, to prevent drifting.

Floyd Bennett Field Historic District is part of the Jamaica Bay Unit of the National Park Service's Gateway National Recreation Area in New York, across the Marine Parkway Bridge from Jacob Riis Park and the U.S. Coast Guard Station and U.S. Military Reservation Fort Tilden. The Floyd Bennett Field administration building is now the Ryan Visitor Center, open daily 8:30am to 5:00pm. The public is welcome to observe the Historic Aircraft Restoration Project--the restoration of 12 aircraft in Hangar B--on Mondays, Wednesdays and Saturdays. Call 718-338-3799 or visit the park's website for further information. More information and photos of Floyd Bennett Field can also be found at www.geocities.com/floyd_bennett_field

Floyd Bennett Field is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Santa Fe Depot and Reading Room

The Santa Fe Depot and Reading Room in Waynoka, Oklahoma, played an important role in the inauguration of the nation's first transcontinental air passenger service. Transcontinental Air Transport, a new and struggling commercial air carrier, hired Charles A. Lindbergh in 1929 to establish this new service that more than halved the 100-hour all-rail travel time between New York and Los Angeles by combining a rail route with air transportation. On August 7, 1929, Lindbergh, sat in the office of California Governor C.C. Young and sent a telegraph across the nation to start the Pennsylvania Railroad's "Airway Limited" journey out of New York station. A band played "California, Here I Come" and 20 pioneer ticket holders began, at 6:05pm, a unique transcontinental trek. The next morning, the travelers arrived in Columbus, Ohio, and were transported to a plush Ford Tri-Motor airplane for a flight to Oklahoma. After a breakfast of strawberry shortcake and tea on the flight, they arrived in Waynoka, Oklahoma, at 6:24pm. The passengers were then taken to one of Fred Harvey's famed "Houses" and served a good meal by the equally famed "Harvey Girls"--Fred Harvey's name was synonymous for genteel travel, and his waitresses earned a reputation for serving good food. After the meal, they boarded the Santa Fe Railway's "Missionary," at Waynoka's Santa Fe Depot for an overnight passenger train run to Clovis, New Mexico. Here they were again tri-motored to Los Angeles, California, arriving at 5:52 p.m. The trip across the continent had required a total of 48 hours. On December 20, 1929, the service was extended to San Francisco. A new record was set January 31, 1930, when 79 people flew between Waynoka and Columbus, calling for use of an extra aircraft. Lindbergh and Amelia Earhart came to Waynoka April 11, 1930, in connection with the introduction of a Curtiss Condor to the run. Waynoka played only a short role in transcontinetal air service, as the service to this route was suspended October 17, 1930 after Transcontinental Air Transport and Western Air Express joined to form TWA, or Trans World Airlines.

The Santa Fe Depot and Reading Room (originally the Harvey House) sit side by side parallel to the Santa Fe main line tracks on the west edge of the Waynoka business district. Both substantial brick buildings were constructed in 1910; the depot itself is a long, narrow, one-story building, 84 feet long and 22 feet wide. The Reading Room adjacent to the depot is a roughly H-shaped two-story building, measuring 95 feet north/south parallel to the tracks and approximately 100 feet east/west. A 15-foot porch facing the tracks runs the length of the building. The Harvey House closed in 1937, and was remodeled in 1949 to serve as a dormitory and reading room for

crewmen staying over at the Santa Fe Depot.

The Santa Fe Depot and Reading Room is located along the Santa Fe Tracks, in Waynoka, Oklahoma, along the western edge of the business district. The depot was recently restored and now houses a museum, gift shop and cafe. Visit the Waynoka Historical Society's website for further information.

Pan American Seaplane Base and Terminal Building

The Pan American Seaplane Base in Coconut Grove, Florida, is important in the history of the aviation industry. Dinner Key was a small island in Biscayne Bay, and was joined to the mainland during World War I to provide a training field for the U.S. Navy. After the war, the base was used by non-scheduled commercial fliers, until the Navy facility was destroyed by the 1926 hurricane. In 1930, a newly formed airline company, known as Pan American Airways (Pan Am), symbolized by eagles and globes, acquired the New York-Rio-Buenos Aires Airline which flew twin-engine Commodore flying boats between Miami and Buenos Aires. The former naval air base at Dinner Key was selected by Pan Am as the base for its inter-American operations with the inaugural flight from Dinner Key to Panama taking place on December 1, 1930. Charles Lindbergh, who was a technical advisor to Pan Am, surveyed some of the early air routes. Because of inadequate landing facilities along the South American route, flying clipper ships were utilized by Pan Am, forming a vital link between North and South America.

Pan American opened the first hangar in 1931. The first passenger "terminal" at the Dinner Key seaplane base was a houseboat obtained in Havana, Cuba, towed by tugs to Miami and anchored to pilings with barges at each end. That same year expansion of the facilities at Dinner Key was undertaken. Additional land was filled in, and a deeper channel, one mile long and 700 feet wide was dredged. The dredging of the channel was a significant event, marking the first time an appropriation was approved by the Congressional Rivers and Harbors Committee "expressly for dredging to create a navigable channel for marine aircraft." The present terminal building and several additional hangars were also constructed during this period of expansion. By 1938, all major structures called for in the plans were completed and operative. During World War II, the Key again served as a base for the U.S. Navy, as well as continuing to serve the needs of international air travelers. With the appearance of landing fields in Latin America came a decrease in the need for seaplanes. Pan Am's final flight to Dinner Key took place August 9, 1945.

The two-story terminal building is rectangular in shape with one-story extensions on each side, white stucco exterior walls and a flat roof. Extending around the building just below the cornice is a frieze of winged globes and rising suns, connected at the corners by sculptured eagles. A restaurant and cocktail lounge originally existed in the building, and takesoffs and landings were observed from an outer promenade on the second floor. At the first-floor level were waiting rooms, an international mail office, customs, public health offices, immigration and ticket counters. A giant, three-and-one-half ton revolving world globe in the lobby once attracted thousands of visitors to the building. In 1946, the City of Miami purchased 39 acres of the Dinner Key site. In 1954, the terminal building was adapted for use as the Miami City Hall. Recent renovations to the building include restoring the original decorative features of the

terminal including the beams, wall murals and ceiling, which consisted of panels depicting the signs of the zodiac painted in a modern style. The murals near the ceiling depict the history of flight from Leonardo Da Vinci's designs to the Clipper planes flown by Pan American.

The Pan American Seaplane Base and Terminal Building is located at 3500 Pan American Dr., Coconut Grove, Miami, Florida. Now Miami City Hall, the building is open during normal business hours.

Rhode Island Airport Terminal

The original State Airport Terminal at Hillsgrove, now Theodore Francis Green State Airport, was the first state-owned airport in the United States. The airport was constructed in 1932 and opened for business in 1933. The state-owned terminal provided an example of early modern architecture associated with the developments in transportation, commerce and public works in early 20th-century Rhode Island. Providence area businessmen believed that a publicly owned and operated airfield was necessary to attract National airlines to Providence and to ensure that the capital city would be part of the aviation age. Warwick officials were also convinced that a state-owned airport would promote local commercial and industrial development. The state responded by establishing the first state-owned airport.

The site for the new airport was chosen in 1929 and dedicated on September 26, 1931. The number of spectators, 150,000, who attended the first two inaugural air shows at the facility indicates the importance of the airport. This was the largest crowd known to attend any public event in Rhode Island up to that time. Designed by the Providence architectural firm Jackson, Robertson and Adams, the terminal is one of the earliest buildings erected in the state that reflects the influence of International style architecture of the 1920s and the decorative principles of the Art Deco and Art Moderne styles. It adopted the futuristic image of early aviation and reflects the optimistic attitude toward progress and technical achievement, which characterized the 1920s and 1930s.

The terminal is a stucco-covered masonry building composed of several flat-roofed, rectilinear blocks arranged symmetrically. A two-story central block with truncated front corners rises above a one-story central mass flanked by shorter one-story wings. A control tower connects to the rear (south) of the two-story block and rises above it. Ornamented with tubular steel railings around the roofs and stringcourse-like bands painted blue-green to contrast with the cream-colored stucco walls, the terminal's exterior appears sparse and unadorned. The entrance is articulated with a stepped parapet mirroring the polygonal corners. All windows and entrances are untrimmed.

Over time other buildings were added near the terminal including a second terminal built in 1938 and altered in 1953 and the present (third) terminal off of Post Road that opened in 1961. The original terminal at 572 Occupasstuxet Road has been used for offices, including the official U.S. Weather Service office for Providence. The first State Airport Terminal embodies the aspirations and sentiments of its era. It is a symbol of the state's commitment to provide up-to-date public facilities that would promote modern commercial and industrial development in Rhode Island.

Rhode Island State Airport Terminal is located at 572 Occupasstuxet Rd. in Warwick, Rhode Island. It is part of the T.F. Green International Airport complex, as headquarters for the Operations Unit of the Rhode Island Airport Corporation (RIAC). It is not open to the public. For further information, contact RIAC's Public Affairs office at 401-737-4000 ext. 283.

Idaho Falls Airport Historic District

The Idaho Falls Airport Historic District is associated with the beginning of commercial aviation in Idaho Falls and the surrounding communities. Built between 1930-1937, Idaho Falls Municipal Airport was a fully operational air transport facility capable of servicing planes, peoples and airmail. This facility functioned both as a final destination and as a link in the ever-increasingly connected communities of the West from 1930 on. The historic district consists of a hangar, administrator's cabin, a beacon tower and the surrounding landscaped area, representing the original site of operations of the Idaho Falls Airport. State Aeronautics Director Arthur C. Blomgren, along with U.S. Department of Commerce officials, visited Idaho Falls in 1929, inspecting sites for a proposed local airport. Work on new airport facilities began later that same year under the leadership of Idaho Falls Mayor Brazilla Clark when the City acquired the present airport property. The first landing strip and beacon tower were completed in 1930. Passenger service to Yellowstone National Park started from Idaho Falls in 1935, but it wasn't until 1937 that the City offered more than just a gravel landing strip and water.

The Idaho Falls Airport Historic District was constructed by the Works Project Administration (WPA). The WPA in Idaho, and across the country, placed a high priority on airport and airway projects, both to support the new and booming air transport business and to better prepare local facilities for anticipated national defense needs. In 1935, the City of Idaho Falls partnered with the WPA to produce the plans and funding needed to build a true airport in Idaho Falls. The hangar and administrator's cabin were built in 1936 of hand-hewn, peeled, native white pine. The hangar provided for maintenance, repair and shelter for aircraft, as well as support for the pilots. Its interior space was divided between the airplane storage and maintenance area and the small administrative area. The gable-roof building contained two, 40-foot doors segmented into eight, five-foot panels with one window in each panel. The cabin is a single-story, hipped-roof, rectangular building with a single-bay garage and small workshop built into the basement. The beacon tower is a simple, four-sided building rising 67 feet above the surrounding landscape, with four legs spread nine and one-half feet square and stands on a two-foot-high mound of soil. The airport facilities were completed by 1937, including extended and improved runways and new underground fueling tanks and pumps. On June 8, 1938, the Idaho Falls Municipal Airport was given its first operation permit. By 1941, the WPA helped build two new Idaho airports and had improved three others as part of a national program that pumped over $200 million into airport facilities across the country.

After a new administration building at Idaho Falls was completed in the early 1960s, the old log administration building was removed. However, both the hangar and cabin still perform their original functions for a private flying service. They remain, intact and well maintained, as testaments to the early development of aviation in Idaho and the important role the WPA played in that development. The desert climate of eastern Idaho, tight airport budgets, and the quality of their original craftsmanship, have combined to preserve both buildings. No other WPA aviation

structures known in the State retain this level of integrity.

The Idaho Falls Airport Historic district is part of the Idaho Falls Regional Airport, just off I-15. Call 208-529-1221 or visit the airport's website for further information.

Administration Building

Construction of the Administrative Building at McConnell Air Force Base, originally Wichita's Municipal Airport terminal, began on June 28, 1930. On that date city officials and local aviation leaders participated in groundbreaking ceremonies designed to make Wichita, Kansas, a center of the aviation industry and a stopping place for passenger and airmail service. Wichita already had connections with aviation history; the Swallow Company began the first commercial aircraft manufacturing in Wichita from 1919 to 1920. By 1929 Wichita had 11 firms engaged in aircraft manufacturing plus a wide variety of support industries. By that time some 25 percent of the aircraft in use in the country were made in Wichita. To further their position in the aviation industry, it was necessary for Wichita to have an airport with refueling capabilities, maintenance hangars and administrative buildings to handle passengers, and 640 acres were purchased for this purpose by the city park board in 1928. By the spring of 1929 Wichita's Municipal Airport was well on its way to becoming a top grade airfield.

Because of financial difficulties during the Great Depression, the terminal building for the airport was not completed until 1935. Dedication ceremonies were held March 31, with an estimated crowd size of 10,000 to 15,000. Rain did not damper an abbreviated air show, and speeches were held to dedicate the building. Wichita's municipal airport was cited over and over again as an exemplary complex. Charles Lindbergh stated in 1929 during one of his visits to Wichita that there was no reason "why Wichita should not continue to be one of the most widely known of air centers." In 1936 Captain James B. Gordon, procurement planning representative of the material division of the U.S. Army Air Corps, called Wichita's airport the best in the country. During World War II the War Production Board used part of the facility. In December of 1944 Wichita's airplane factories were reported to have constructed 22,334 airplanes and 750 gliders. The terminal building consists of a central three-story portion built from 1930 to 1935 with flanking two-story wings built in 1942 and 1943. Typical of the Art Deco style are broad, flat wall surfaces broken by step-backs that emphasize doors, windows and the progression from one section of the building to another. Art Deco elements also include the stepped corners of windows, the inset stepped and faceted stones at the corners of the end bays and in the panels of stylized airplanes surrounded by chevron patterns. Some outstanding decorative features of the building surround the entrance; three large cast stone window spandrels in the three central bays that depict an eagle with spread wings superimposed over a stylized pattern of airplanes, and a large cast stone mural that runs the entire length of the three recessed bays. The three stone panels reflect both the nationalism of the 1930s and the stylization of Art Deco. The large panel was designed by L. W. Clapp, a prominent public figure in Wichita who was instrumental in bringing the aviation industry to the city. The color in the mural was obtained by crushing colored bottles in the cast stone mixture. The control tower is situated at the western end of the original building. Originally four stories tall, it had a glass-enclosed fifth story added in 1940.

The terminal building was managed by the city park department from the time of its construction

until the municipal airport was sold to the Federal government in 1951. The base was known as Wichita Air Force Base until the name was changed to McConnell Air Force Base in honor of two Wichita brothers who were B-24 pilots in World War II. From 1951 to 1958 the facility was used primarily for testing SAC B-47 crews. The Boeing Aircraft Company had a lease on part of the building from 1956 to 1963 and used it for engineering, management and production of the B-52 aircraft. From 1963 to 1971 it was used by the Tactical Air Command for training F-105 crews. After that it served as the administrative center for personnel and transportation at McConnell. The control tower was used for training tower personnel. Today the Administrative Building houses the Kansas Aviation Museum, which documents the history of flight in Kansas from the earliest days to contemporary times and beyond.

The Administration Building is located at the corner of 31st St. South and George Washington Blvd. near the West Gate of the base in Wichita, Kansas. It is now the Kansas Aviation Museum, open Tuesday-Friday, 9:00am to 4:00pm, Saturday, 1:00pm to 5:00pm, closed Sunday and Monday. There is a fee for admission. For further information please call 316-683-9242 or visit the museum's website.

Newark Metropolitan Airport Buildings

Newark Metropolitan Airport in New Jersey was the first great commercial airport in the United States. Development began in 1928, and during the early years of the airport's existence, one-third of the world's air traffic passed down its runways. Reflecting the early development of the airport, the trio of Art Deco airport buildings that remain today include the Administration Building, Brewster Hangar and the Medical Building. On July 11, 1927, Major Thomas L. Raymond of Newark gave his support to the construction of a municipal airport. A special commission appointed by then Secretary of Commerce, Herbert C. Hoover, announced that the proposed site of Newark Airport, adjacent to Newark Bay and U.S. Route 1, provided an excellent location in the metropolitan area for a central air terminal since many railway connections were available and weather conditions were favorable. In February 1928, construction of an aviation field of 420 acres of meadowland was begun. In less then seven months, the first unit, which consisted of about one-half of the total acreage, was opened. In August 1928, a small, four-passenger Ryan monoplane from Washington, D.C., made the first landing on a completed section of 1,600-foot-long runway, the first hard-surfaced strip of any commercial airport in the nation. In 1929, Newark was designated as the metropolitan airmail terminus and by 1930 Newark was the busiest airport in the world.

During the 1930s, the New Jersey State Military Air Unit, a division of the National Guard, maintained a squadron at Newark. In addition to military personnel, Newark Airport has been associated with many famous aviators including Wiley Post , Amelia Earhart and Howard Hughes who housed experimental airplanes in one of the hangars. As new safety aids for flying were developed, Newark provided a testing ground. Night lifting, paved runways, air traffic control, radio transmittal from land to air and instrument flying were all pioneered at Newark.

To replace a temporary Administration Building built in 1929, an engineer named Wall State received permission from the Army to build the permanent Administration Building in 1934. Work on the building was continued by the Federal Civil Works Administration and it opened in

1935, dedicated by Amelia Earhart. It is a long, relatively narrow building of concrete construction faced with horizontal bands of poured concrete alternating with bands of windows articulated with brick inserts. The main entrance façade consists of a two-story, three-bay central entrance block with two wings angled back from the airfield elevation, suggestive of the movement of an airplane. The Adminstration Building was recently restored.

Construction of the Brewster Hanger began in 1937 and continued through 1938. Its design was promoted as the most advanced of the time. The Brewster Hangar is of steel-frame construction with hollow tile walls finished on the exterior with stucco. There are four three-story pylons on the field side, designed as office space for the individual airlines. At the rear of the hangar, which happens to be the street façade, are three separate one-story shop sections, the center one housing a central heating plant. The hangar is divided into three entirely separate airplane-storage areas by two sets of 12-inch-thick firewalls spaced five feet apart. A dozen DC3s could be stored inside any one of the Hangar's six bays. The small Art Deco style Medical Building was built between 1934 to 1938. The two-story building is constructed of load-bearing brick, three bays wide with the end bays subdivided into two and four bays deep with each bay also divided into two sub-bays. Two-story brick pilasters, square in section, mark the major division of the bays.

Until 1939, Newark remained the world's busiest airport, but in that year Mayor LaGuardia of New York City completed construction of an airport at North Beach. Because of ongoing disorganization in the management of Newark Airport, three major airlines immediately moved their operations to LaGuardia's North Beach airport. Mayor Ellenstein closed his Newark Airport for reorganization. In the spring of 1942, the War Department took over Newark Metropolitan Airport for military use. When World War II was over, the airport was returned to the city. In 1948 the Port Authority of New York and New Jersey assumed administration of the Newark Airport and began its major expansion programs, which included much land acquisition.

Newark Metropolitan Airport (now Newark International Airport) is located in Essex and Union Counties between the New Jersey Trnpk. (accessible from Exits 13A and 14), U.S. Rtes. 1 and 9 and I-78. The airport is about 16 miles from midtown Manhattan. The Administrative Building, Brewster Hanagr and Medical Building are located in the northern administrative section of the airport. Visit Newark International Airport's website for further information.

Bowman Field Historic District

The Bowman Field Historic District in Louisville, Kentucky, includes three adjacent buildings related by history, function and physical proximity. They are the airport Administration Building, the Curtiss Flying Service Hangar and the Army Air Corps Hangar. Although these buildings, along with their surrounding greenspace and service areas, comprise only a small portion of the present total acreage of Bowman Field, they constitute the airfield's historic core. These buildings were designed in the Art Deco/Art Moderne style and were constructed of brick, stone and concrete. They possess a high degree of integrity. The dominant landmark of Bowman Field is its terminal, more commonly known as the Administration Building, appropriately styled in aerodynamic Moderne. As constructed in 1929, it was a fairly modest two-story building with one-story wings, housing administrative and communications offices, a weather station and restaurant. From 1936 to 1937 it nearly tripled in size, and the east wing was demolished to make

way for a larger building attached to two-story central section and west wing. The Administration Building is now a symmetrical five-part composition, with a three-story central block flanked by slightly recessed two-and one-story wings, resulting in a stepped-ziggurat-like design. The interior of the Administrative Building retains much of its original 1930s flavor.

Both of the airplane hangars included in the Bowman Field Historic District are typical of aviation-related structures of the 1920s and 1930s in their use of metal construction, masonry veneer, and restrained Moderne-inspired detailing. The earlier of the two, the Curtiss Flying Service Hangar, was built concurrently with the Administrative Building in 1929. The hangar is constructed of steel faced with light-yellow smooth-surface brick in common bond and features pilasters that culminate in concrete capitals featuring stylized geometric designs. The Army Air Corps hangar, built from 1931 to 1932, is located opposite the Curtiss Flying Service Hangar on the west side of the airfield. It is a massive double-gabled structure divided by a partition wall and adjoined on the north and south by lower one-story wings. Like the Curtiss Flying Service Hangar, it is built of steel and faced with yellow brick, which has since been painted ivory.

The land on which Bowman Field was built was previously owned by a German national, Baron Klaus von Zedtwitz, and seized during World War I by the U.S. government under the Alien Property Act. Once peace returned, part of the land was leased from the government by aviation enthusiast Abram H. Bowman, who hoped to establish an airport on the property. Bowman, proprietor of a local trucking company, became interested in aviation after World War I. Although he never learned to fly, he purchased a Canadian JN-4 airplane formally owned by pilot Robert Gast. After securing the Von Zedwitz property, he offered the public rides in the JN-4, which was piloted by a colleague. Local tradition has established 1919 as the year the first airplane landed at what would eventually become Bowman Field. During its early years, Bowman Field appears to have been a rather modest operation. A chronology of Louisville included in the popular *Louisville Panorama* lists 1921 as the year "the airport opened at Bowman Field." During that year, the airport's first substantial structure, a wooden hangar, was constructed with salvage lumber. When the wooden hangar was destroyed in a windstorm, a discouraged Bowman talked of abandoning a private airport scheme all together, but friends persuaded him to revive it in a new form, as the home of a military air unit. During the early 1920s, the Army was attempting to stimulate national interest in aviation by establishing "Army Airways." In 1922 a Louisville delegation including Mayor Huston Quinn, Abram Bowman and others approached the Army about establishing a base at Bowman Field. Their efforts were successful, and later in the year Bowman's lease on the property was taken over by the Army. The airfield then became the home of the 465th Army Pursuit Squadron, and its new identity as a combination military/civilian facility was established. Bowman Field was officially dedicated on August 25, 1923, and the Squadron remained the airfield's principal tenant for the next five years.

During the 1920s benches were installed at Bowman Field to accommodate crowds of tourists who flocked there to watch the airplanes. One of the high points in the airport's history took place in 1927 when 10,000 spectators flocked to see famed aviator Charles Lindbergh and his *Spirit of St. Louis*. By 1928, the city of Louisville had acquired clear title to the von Zedtwitz property with the intention of developing it as an airport, since the city's only other aviation facility had long since closed. During the late 1920s the Air Board initiated an ambitious

improvement program in conjunction with the Army, which saw the construction of the Administrative Building and the hangars. By 1940 the government increased the size of Bowman Field, and during World War II the training of air evacuation flight nurses and combat glider pilots occurred here. During the postwar era, Bowman Field shared in the unprecedented growth of commercial aviation. In 1957 Bowman Field was recognized by the Federal Aviation Administration as the nation's busiest general aviation airport.

Still an active airport, the Bowman Field Historic District is located in the southwest corner of the airport, visible from Taylorsville Rd. in eastern Louisville, Kentucky, ¼ mile west of the Watterson Expressway (I-264).

Marine Air Terminal

The Marine Air Terminal at La Guardia Airport in New York City remains the only active airport terminal dating from the first generation of passenger travel in the United States--the "Golden Age of the Flying Boat." The Marine Air Terminal, an Art Deco building designed in 1939 by William Delano of the firm Delano & Aldrich, is comprised of a central circular core of two stories with an attic from which a rectangular entrance pavilion and two symmetrically opposed one-story wings project. Inside the terminal hangs "Flight," a mural measuring 12 feet in height and 237 feet in length. Completed by James Brooks in 1940, "Flight" depicts the history of man's involvement with flight.

By the early 1930s, commercial airlines and airports were developing due to the Federal government's use of private contractors for postal transport and Charles Lindbergh's famous transatlantic flight. New York was in dire need of a new airport by 1934 when Fiorello H. La Guardia was elected mayor. Plans for the airport, which was to be federally sponsored and funded through the Works Progress Administration (WPA), were approved by President Roosevelt on September 3, 1937. Only six days later, the Mayor presided over groundbreaking ceremonies and construction proceeded rapidly. At 558 acres with nearly four miles of runways, the $40,000,000 airport was the largest and most expensive in the world. New York City Airport--La Guardia Field opened on October 15, 1939 and the Marine Air Terminal was dedicated in March 1940. The first flight from the Marine Air Terminal by a Clipper departed on March 31, 1940, carrying a crew of 10, nine passengers and over 5,000 pounds of mail and landed in Lisbon 18 hours and 30 minutes later. These Clippers--with a wing span of 152 feet, a cruising speed of 200mph and a capacity to carry 72 passengers--were luxurious. The two-deck interior featured dining rooms, private compartments and sleeping sections. However, this glamorous era of the Clippers was brought to an abrupt halt by the outbreak of World War II. By the end of the war, technological advances in airplane design had made the Clippers obsolete and the Marine Air Terminal was converted for the newer airplanes. Today the Marine Air Terminal is used by commuter airlines, air taxis, private aircraft, Signature Flight Support (a fixed-base operator) and a weather service.

The Marine Air Terminal is located at La Guardia Airport in New York City. It is still an active terminal, open during normal hours of operation. Please visit the airport's website for further information.

Washington National Airport Terminal and South Hangar Line

The Washington National Airport Terminal and South Hangar Line, products of New Deal initiatives, were milestones in American aviation technology. Washington, D.C.'s first airport, Washington-Hoover, was deemed inadequate in 1927. In July of that year, a joint airport committee voted to approve Gravelly Point as the site for a new airport. After 11 years of debate, President Roosevelt authorized federal sponsorship of a government-owned airport at Gravelly Point. The Terminal was opened for operation on June 16, 1941, blending three distinct styles--Art Deco/Steamlined Moderne, Colonial Revival and Stripped Classical. Its architecture is also a striking example of architectural resolution; its form--a combination of streamlined horizontal massing overlayed with a dominant vertical portico--mirrors the architectural polemic of the pre-World War II era, the debate on American architecture's future as Modernist or Neoclassical. The stepped massing, banded fenestration, sidewalk canopies and stylized ornament speak of the Art Deco/Moderne movement. The building's portico-and-wing composition draws upon the regional Colonial architecture of 18th-century Virginia. However, the execution of the portico as a "stripped" expression of Classicism promotes the ideals of World War II-era government buildings.

Within six months of its opening, airport operations were dominated by military uses. With the onset of World War II, civilian aircraft were appropriated by the military and civilian flights fell by 50 percent. By 1946, newspaper accounts described Washington National Airport as the third busiest postwar airport. The airport also served as the home airport for the airplanes of Presidents Roosevelt, Truman and Eisenhower. The footprint, massing, floor plan and diamond-shaped control tower design of the Terminal building, as well as the runway configuration, runway lengths and advanced lighting and instrument landing systems were innovations that influenced airport design throughout the country. Its functional clarity and provisions for spectatorship were particularly influential in later terminal designs.

The South Hangar Line, constructed between 1941 and 1948, consisted of seven hangars designed to accommodate advances in airplane technology. The South Hangar Line employed innovations such as a new door design, unit heaters with blowers used to maintain the hangar's standard 60-degree temperature and a sprinkler system. For many years the Washington National Airport Terminal and South Hangar Line, the nation's first federally constructed commercial airport, served as the Civil Aeronautics Authority's model airport. Historic Terminal A is undergoing renovation to restore the terminal to its original appearance.

The Washington National Airport Terminal and South Hangar Line are located in Arlington, Virginia. The terminal building is still in use for commercial airlines and is open during normal operating hours. The history of the airport is presented in the Exhibit Hall. Please visit the airport's website for further information.

College Park Airport

Many events in the history of aviation, including countless record-breaking flights and important developments in aerial technology, took place at the College Park Airport in Maryland. The

facility began as the training site for the first military pilots in the U. S. Army. On August 1, 1907, the Army's Chief Signal Officer established an Aeronautical Division in his office. He also contracted with the Wright brothers to build a flying machine, which was delivered to Fort Myer, Virginia, in August 1908. The contract required flights to demonstrate performance and flying training for two Army officers. Orville Wright circled Fort Myer's parade ground in Signal Corps Airplane No. 1, the first military airplane in the world, but he was seriously injured when the plane crashed. Delivery of the airplane and training of the Army pilots had to be postponed until 1909. By that time, the Signal Corps has leased a field in College Park, selected by Lt. Frank Lahm based on observations during a balloon flight, and built a small hangar for the airplane. On October 8, 1909, Wilbur Wright began flying training for Lt. Lahm and 2nd Lt. Frederic E. Humphreys. Lt. Benjamin Foulois reported for training later in October. Wilbur made 55 flights at College Park, including his last record-setting flight, 46 miles per hour over a 500 meter course. His last flight on November 2 was the last time he ever flew in public and also one of his last flights as a pilot.

Continuing successful flights at College Park proved to be newsworthy and captured the attention of the Nation. Notable flights during the facility's formative years include the first woman in America to fly as a passenger in an aircraft, Mrs. Ralph H. Van Deman, on October 27, 1909. A nine-minute flight on November 3, 1909, enabled the Navy to enter aviation history when Lt. George C. Sweet, USN, became the first Naval officer to fly. Flying at College Park was suspended on November 5, 1909, when the Army's only aircraft was damaged during landing. Congress made its first appropriation for Army aeronautics in March 1911, $125,000 for the 1912 fiscal year. Some of these funds were used immediately to buy five more airplanes and to establish the Army's first real flying school at the former training field in College Park. The new planes arrived at College Park during the summer of 1911, and this site became the Signal Corps Aviation School and the center of Army aviation until the end of the year. In addition to flying training, Army pilots also conducted experiments in radiotelegraphy, photography, automatic weapons firing, signaling systems, and bombing devices. In late November, the Army airmen and airplanes relocated to Augusta, Georgia, for the winter. Although they returned to College Park in April 1912, they relocated again in November for the winter to North Island, San Diego, California, and never returned. The Signal Corps' lease on the property expired in June 1913.

From 1912 to 1917 the Washington Aeroplane Company maintained facilities at College Park and there built its Columbia Biplane. On August 12, 1918, the College Park field became the Washington terminus for the first U.S. Post Office commercial airmail service. Emile and Henry Berliner, credited with inventing the first helicopter possessing maneuvering capabilities, arrived at College Park in 1920 and began testing their helicopter. The site at College Park has witnessed such tests as the first bomb sight and dropping mechanism and the first aerial machine gun. On this site Americans took their first aerial photographs, experimented with wireless radio communications, made the first nighttime landing with the aid of runway lights and experimented with radio navigation aids. Of less dramatic impact but of great importance to aviation history are the inventions and improved designs for such items as sparkplugs and mufflers that were given trials at College Park. As the world's oldest continually operating airport, the College Park Airport has cemented its place in aviation history.

Both an operating airport and museum, College Park Airport is located at the north side of Calvert Rd. between U.S. Rte. 1 and Kenilworth Ave. on Cpl. Frank S. Scott Dr. in College Park, MD. The College Park Aviation Museum is open daily from 10:00am to 5:00pm (except major holidays) for self-guided tours. Guided tours can be scheduled for groups of 10 or more. For further information call 301-864-6029 or visit the museum's website.

Naval Air Station, San Diego, Historic District

The Naval Air Station, San Diego, Historic District, located on North Island in California, is associated with broad national and regional themes in the history of military aviation, representing the principle administrative and residential core of one of the earliest naval air stations in the United States, and the first on the West Coast. Climatic conditions, and the characteristics of flat terrain, good beaches and protected stretches of water, attracted the aviation pioneer and Wright Brothers' competitor, Glenn H. Curtiss, to North Island in 1910. Through the intervention of a local flying club, the landowner, the Coronado Beach Company, was persuaded to permit Curtiss to use North Island for his Aviation School. In January 1911, the Navy assigned its first pilot, Lt. T.G. Ellyson, to be trained by Curtiss at his school on North Island. Later that year, the Navy established its first naval aviation unit at Annapolis, Maryland, in September 1911. However, because winters in the Northeast precluded flight operations, North Island was chosen for the aviation unit's winter quarters. In 1912 "Camp Trouble," as it was called, was established on the northeast corner of North Island, a site now encompassed by the Naval Air Station, San Diego, Historic District. Consisting of three airplanes, three pilots, three tents and some mechanics, this group stayed until April, then returned east. The Navy would not return to North Island until 1917.

The Army's Signal Corps Aviation School relocated from its original location at College Park, Maryland, to North Island, San Diego, from November to December 1912. The Army flyers established a tent camp at the north end of North Island, and for about a year, the Signal Corps Aviation School rented airplanes and hangars constructed for the Curtiss school. This was the first Army school to provide flying training for military pilots, and North Island was the school's first permanent location. None of the buildings from this early period, constructed on the north end of the island, are still extant. In July 1917, Congress authorized the President to proceed with the taking of North Island for Army and Navy aviation schools. There was a desperate needed for trained military pilots as the United States had entered World War I earlier in the year. President Woodrow Wilson signed an Executive Order in August 1917 for condemnation of the land, which was still privately owned. The Army turned over the north end of the island to the Navy and relocated to the south end of North Island, the location of the Rockwell Field Historic District. The Navy's first occupancy of North Island occurred on September 8, 1917, but Congress did not authorize the purchase of North Island, for $6,098,333, until July 1919. Construction began on the permanent San Diego facilities in mid-1918. Naval Air Station, San Diego was completed too late to play any substantial role in World War I. After conducting the first-ever carrier takeoffs and landings in the Atlantic, the USS *Langley* was assigned to Naval Air Station, San Diego, berthing there for the first time in November 1924. This began a continuous use of North Island as the home port for Pacific Fleet carriers, and Naval Air Station, San Diego took on the duties of providing service and training to the personnel of these new components to the Fleet.

Throughout the late 1920s and early 1930s, military pilots worked hard at trying to make the public more aviation-conscious. The Naval Air Station, San Diego continued as an important player in this ongoing effort, due to its proximity to Hollywood, which allowed it to play a unique role in the promotion of air power. Several movies, among them *Flying Fleet, The Flying Marine* and *Hell Divers*, were filmed at the air station, with the full cooperation of the Navy. The Navy wanted to add the Army's Rockwell Field to Naval Air Station, San Diego, and tried for many years to acquire it. The effort was finally successful when President Roosevelt was persuaded to issue an Executive Order that required the Army to vacate North Island by 1935, in spite of the Army's struggle to remain there. At the same time dredge spoils were dumped into the tidal flats which increased the area of North Island by some 620 acres. By 1935 North Island was home to all four of the Navy's carriers--the USS *Langley*, USS *Lexington*, USS *Saratoga* and USS *Ranger*. During the 1930s activities at the air station were of fundamental importance to the development of combat tactics and logistical support systems that became the foundation for the subsequent success of the Pacific carrier war against Japan during World War II.

The principle historic buildings in the Naval Air Station, San Diego, Historic District consist of more than 20 military administrative, residential and operations buildings constructed with stucco-clad walls, red tile roofs and simple California Mission or Mission Revival style design elements. The visual focus of the historic district, and perhaps its most recognized edifice, is the Administrative Building, a two-story building with a monumental, 110-foot-tall central tower. This tower was functionally designed to carry aerological equipment, serving as the air station's pre-radio control tower. Of other aviation interest are the Seaplane Hangars, three buildings that are single-story, rectangular, open bay buildings and the Garage, a simple, one-story, flat-roofed, rectangular building that functioned to service the air station vehicles.

Naval Air Station, San Diego, Historic District is located in San Diego, California, on North Island, which in fact is not an island, but rather the extreme northwestern end of the Peninsula of San Diego. The historic district is roughly bounded Saufley St., I-4th St. N., Roe St., Murray St., Maxfield Blvd., Carson St., Quentin Roosevelt Blvd, Wright St. and Bay St. The Navy had contracted with the Old Town Trolley Tours of San Diego to provide windshield tours of the base. These tours were suspended due to security concerns, but may resume shortly. Visit www.historictours.com/sandiego for further information.

Rockwell Field

Rockwell Field, located on North Island in San Diego, California, was originally called the Signal Corps Aviation School. It was the first U.S. Army school to provide flying training for military pilots, and North Island was the school's first permanent location. The Aviation School was officially established on North Island in 1912; existing historic and architecturally significant buildings reflect the use and development of Rockwell Field from 1918 to 1935. In 1910, climatic conditions, flat terrain, good beaches and protected stretches of water attracted Glenn H. Curtiss, aviation pioneer and Wright Brothers' competitor, to North Island, where he soon founded his Aviation School. In January 1911, Curtiss signed a contract with the owner of North Island to use the land for three years for a flying school, which was established in February 1911. Curtiss invited the Army and the Navy to send officers to his new school for flying training. The Army sent three airmen to the Curtiss school in early 1911, but they were

ordered to Texas before completion of their training. During the winter of 1911 to 1912, the Navy sent three pilots to the Curtiss school for flying training. The Army's Signal Corps Aviation School relocated from its original location at College Park, Maryland, to North Island, San Diego, during November to December 1912. The Army flyers established a tent camp at the north end of North Island, and for about a year, the Signal Corps Aviation School rented airplanes and hangars constructed for the Curtiss school. None of the buildings from this early period, constructed on the north end of the island, are still extant.

On July 20, 1917, the Signal Corps Aviation School was named Rockwell Field in honor of 2nd Lt. Lewis C. Rockwell, killed in a crash at College Park in 1912. Also in July, Congress authorized the President to proceed with the taking of North Island for Army and Navy aviation schools. There was a desperate needed for trained military pilots as the United States had entered World War I earlier in the year. President Woodrow Wilson signed an Executive Order in August 1917 for condemnation of the land, which was still privately owned. The Army turned over the north end of the island to the Navy and relocated to the south end of North Island, the location of the Rockwell Field Historic District. The Navy's first occupancy of North Island occurred on September 8, 1917, but Congress did not authorize the purchase of North Island, for $6, 098,333, until July 1919. The Army selected well-known Detroit industrial architect, Albert Kahn, to develop a site and building designs. Permanent construction of Kahn's design began in mid-1918. During World War I, Rockwell Field provided training for many of the pilots and crews sent to France. It also was the source of men and aircraft for the Sixth and Seventh Aero Squadrons, which established the first military aviation presence in Hawaii and the Panama Canal Zone, respectively.

After World War I, construction came to a complete standstill. Rockwell Field did not fare well into the early 1920s. It was demoted from one of the major Army Air Service training fields on the West Coast to an Aviation General Supply and Repair Depot in 1920 and redesignated again as Rockwell Air Intermediate Depot in 1922. By 1922 there were only 10 officers, two warrant officers, 42 enlisted men, and 190 civilians employed at the airfield. Lt. Jimmy Doolittle landed there in September 1922 after establishing a new record for the first transcontinental flight within a single day. The first nonstop transcontinental flight, originating at Roosevelt Field, New York, was accomplished by Army pilots and ended at Rockwell Field in May 1923. In June of that year, pilots from Rockwell Field conducted the first complete mid-air pipeline refueling between two airplanes. As the Navy's emphasis began shifting from seaplanes to the land planes used on aircraft carriers, its requirement for land increased. Eventually, agreement was reached within the War Department to grant the Navy complete control of North Island. After visiting the air station and the Army airfield on an inspection tour in October 1935, President Franklin Roosevelt issued an Executive Order transferring Rockwell Field and all of its buildings to the Navy. The Army moved most of their aircraft to March Field in Riverside, California, but it took another three years to completely phase-out Army activities at North Island.

The historic and architecturally significant buildings of Rockwell Field form the southeastern quadrant of what is today the Naval Air Station, North Island (NAS North Island). The buildings were designed in the Mission Revival and Spanish Colonial Revival styles. The Kahn-designed Mission Revival Field Officers Quarters (later married officers quarters) are reinforced concrete-framed, in-filled with hollow terra cotta tile and finished in buff color stucco. Kahn's Mission

Revival Hangars (Buildings 501, 502 and 503 from 1918) are similar in materials with red clay-tile, gabled roofs. They were built to the same plan: a rectangle, 135 feet by 70 feet, with 30 feet clear to the ceiling. A low, flat-roofed, lean-to on the east side of each contained offices. Located on the bluff edge at the North Island end of the Coronado-North Island causeway, the Army-Navy Gate House/Meter Room (Building 505, 1918; later Meter House) functioned as the gatehouse for both Rockwell Field and NAS San Diego. This group of buildings reflects the War Department's plan to create buildings that would be appropriate for Southern California, and illustrates Kahn's "Spanish military" design implemented at Rockwell Field.

Rockwell Field is roughly bounded by McCain Blvd., Wright Ave., J Rd. E and Quentin Roosevelt Blvd. in San Diego, California. The Navy had contracted with the Old Town Trolley Tours of San Diego to provide windshield tours of the base. These tours were suspended due to security concerns, but may resume shortly. Visit www.historictours.com/sandiego for further information.

Pensacola Naval Air Station Historic District

Pensacola Naval Air Station was the United States' first permanent naval air station, the first Navy pilot training center and the first naval installation to send pilots into combat. In 1911 the Navy secured an appropriation from Congress for a naval air service and within two years Secretary of the Navy Josephus Daniels ordered the creation of the first permanent naval air station at Pensacola, Florida, where the climate favored year-round flying. The entire command that arrived at Pensacola Naval Aeronautic Station in January 1914 consisted of six qualified pilots, 23 enlisted men, seven seaplanes, some spare parts and a few canvas hangars. During the station's first three years it produced many firsts, including altitude records, the first catapult launch of an aircraft from a ship and the Navy's first fatal crash.

With the onset of WWI, naval aviation expanded rapidly, leading to the establishment of additional training bases. Pensacola remained a major flight center and the first aerographical officer reported for duty here, the Navy's first aircraft carrier conducted experiments here and the Navy's aerial photography school relocated here. Between 1935 and 1939 the air station expanded its facilities to include aviation mechanics and aviation medicine. Within the historic district are 55 frame and brick buildings, including residential, administrative and maintenance facilities. Particularly notable are the octagonal Armory and Chapel (1854) and six metal seaplane hangers (1916-1918).

Within nine days after the Japanese attack on Pearl Harbor Pensacola Naval Air Station adjusted its training schedule to accommodate 2,300 students per month, a 300 percent increase that produced nearly 20,000 pilots by mid-1943. These Pensacola-trained Navy and Marine fliers sank 63 German submarines and 161 Japanese warships and destroyed more than 15,000 Japanese aircraft while losing 451 aircraft to Japanese fliers. Pensacola made similar contributions to the U.S. military effort in Korea and continues its leadership role today as the headquarters for the Chief of Naval Education and Training. For a complete copy of the National Historic Landmark registration form for Pensacola Naval Air Station, click here.

Pensacola Naval Air Station Historic District, a National Historic Landmark, consists of 55

historic structures on 82 acres roughly bounded by Soufley St., Jaynes, Ave., and East Ave. in Pensacola Fl. There is a self guided tour available from the Public Affairs Office, 191 Radford Blvd., 2nd floor, or call 850-452-2311. Please visit the base's website for further information. You can also download (in pdf) the Pensacola Naval Air Station National Historic Landmark nomination.

Scott Field Historic District

Scott Field began when Shiloh Valley Township, Illinois, leased 640 acres to the War Department for use as an aviation site in June 1917. The War Department named the site after Corporal Frank S. Scot--the first enlisted man to die in an aircraft accident--on July 10, 1917. The layout of Scott Field was typical of aviation fields built during World War I. Construction began in June 1917, and the Unit Construction Company was required by the Signal Corps to build approximately 60 buildings, lay a mile-long railway spur to connect the field with a main line on the Southern Railroad and level off an airfield in 60 days. Scott Field began as an aviation-training field for World War I pilots in August 1917 when the 11th and 21st Aero Squadrons from Kelly Field, Texas, arrived. Later the 85th and 86th squadrons arrived, and more than 300 pilots and many ground units were trained for service by the war's end in 1918. Flying was discontinued at Scott Field after the war and the base population dropped. The War Department purchased Scott Field in 1919 for $119, 285.84

Scott Field was transformed into a lighter-than-air (LTA) station in 1921. Lighter-than-air ships were used at Scott Field to research the capabilities of aerial photography, meteorology and conduct altitude experiments. In the late 1920s, emphasis shifted from airships to balloons. In 1929, the 12th Airship Company was deactivated and replaced the next day by the 1st Balloon Company. Airplanes began to dominate activities at Scott Field, and in 1937, the lighter-than-air activities officially came to an end. Scott Field's central location was advantageous when it was considered for the relocation site of the General Headquarters Air Force, which managed the combat arm of the U.S. Army. Scott Field grew from 628 acres in 1938 to 1,882 acres in 1939. Most of the frame World War I and lighter-than-air constructions were torn down--only a few, such as the 9th Airstrip Squadron headquarters/barracks building, a brick theater and nine sets of brick noncommissioned officers' quarters at the south end of the field were saved.

New housing, industrial and administrative buildings were completed by May 1939. The expansion program continued into 1940 with the construction of 21 more buildings, including a 200-man barracks, a 300,000-gallon elevated water tank, a 43-bed hospital, Hangar No. 1 and a General Headquarters Air Force office. During World War II Scott Field's main mission was to train radio operator-mechanics. By June 1945, Scott Field had trained 77,370 technicians who went on to be responsible for vital command and control communication throughout the Air Force. In January 1948, Scott Field was redesignated Scott Air Force Base. Scott AFB continued as a major training base for the Air Force until 1957. The 1405th Air Base Wing maintained the base properties and served as the base's home unit, which as of 1990 housed the 375th Military Airlift Wing.

Scott Field (now Scott Air Force Base) is located 25 miles east of St. Louis, Missouri, in Shiloh Township, Illinois. The base is located off Hwy, 158, two miles south of I-64 (Exit 19). Individual

tours are not available, but group tours can be arranged by calling the Scott Air Force Base Public Affairs Office at 618-256-4241.

Kelly Field Historic District

Kelly Air Force Base, in San Antonio, Texas, has been a vital center for American military aviation throughout its history. As World War I raged in Europe, the United States began to build up and expand its military aviation forces. In his search for a new army aviation training site, Maj. Benjamin Foulois found 700 acres of flat farmland with a water supply near the Missouri-Pacific rail line, then seven miles south of San Antonio. Aviation operations began here on April 5, 1917, the day before the United States declared war on Germany. Kelly Field, named for George Edward Maurice Kelly, the first military pilot killed in an airplane crash at nearby Fort Sam Houston in 1911, was one of 14 schools in the country conducting primary flight training during World War I. The school trained aviators, mechanics and support personnel for war duty. After additional land was acquired, the field was divided into Kelly Number 1 (later renamed Duncan Field) and Kelly Number 2. The Air Service Advanced Flying School, which headquartered at Kelly Number 2, trained pilots including Charles Lindbergh, Curtis LeMay and numerous future Air Force chiefs of staff. By the end of World War I, more than 250,000 men had passed through the facility. After World War I, rapid demobilization followed, and primary training at Kelly was discontinued. In 1922 the U.S. Air Corps decided to consolidate its flight training at two fields, Kelly Field and Brooks Field, named the Air Corps Training Center. Later, in 1931, all primary training was consolidated at the newly completed Randolph Field, to the north of San Antonio, Texas.

The area designated as the Kelly Field Historic District reflects the base's strategic importance during the late 1930s and early 1940s as a training center for America's military pilots, and contains buildings from the "new permanent area" or "reconstruction" of Kelly Field. The base experienced growth at this time to meet the needs of a developing air force and, later, a nation at war. In the time period between the two world wars, the organization and role of the air arm of the U.S. military was the focus of heated debate--whether or not the Air Service should function as an independent military branch and whether or not the Air Service should undertake bombardment operations independent of surface operations. As a result of this debate, Kelly Field was reconstructed on the eve of World War II, and that addition is the core of the Kelly Field Historic District. The district is located near the center of the present-day base, and contains a mixture of 39 buildings. Most of these were constructed between 1940 and 1943 to provide training, administrative, repair, supply and residential facilities for recruits, instructional and maintenance personnel, and both commissioned and noncommissioned officers. The buildings are constructed from a variety of materials including concrete, hollow-clay tile and stucco, and wood frame. Many are well designed examples of Art Moderne, Mediterranean or Spanish Colonial Revival architecture, while others reflect more utilitarian International style elements.

During World War II, Kelly saw a tremendous increase in its civilian and military workforce, including women, who were known as "Kelly Katies." Kelly Field continued to serve an important role in the war effort after it was consolidated into the San Antonio Air Depot in January 1943. By 1943, it had become the largest maintenance and supply facility in the country.

At that time supply depot activities became the primary mission of the base and flight training activities were transferred elsewhere. After the Air Force was established as an independent military service in 1947, the field became known as Kelly Air Force Base. Personnel at Kelly were significantly involved with air transport and maintenance during the Korean conflict, the Cold War, Desert Shield and Desert Storm. Once the largest employer in San Antonio, Kelly Air Force Base was realigned in 2001 in response to peacetime defense spending priorities. Part of the base has been converted into an industrial center for both commercial and military businesses and the rest has been combined with neighboring Lackland Air Force Base.

The Kelly Field Historic District roughly encompasses the 1600 and 1700 areas of the former Kelly Air Force Base, roughly between Billy Mitchell Blvd., Wagner and Luke Drs. in San Antonio, Texas. Lackland Air Force Base is not open to the public.

Hangar 9, Brooks Air Force Base

Brooks Field, in San Antonio, Texas, was one of a number of U.S. Army airfields established during World War I to train Army pilots. Construction began at the site in December 1917, which was officially established as Brooks Field in February 1918. In addition to providing primary training for flying cadets, Brooks also trained flying officers as instructors in the Gosport Method of flying, a system developed in England to improve the high mortality rate of fliers. Hangar 9 is the only surviving building of more than 60 constructed here during World War I. Many renowned airmen graduated from the Primary Flying School at Brooks Field during the 1920s, including Generals Nathan F. Twining, fourth chief of staff of the Air Force, 1953 to 1957, and first Air Force officer to be chairman of the Joint Chiefs of Staff; Curtis E. LeMay, chief of staff of the Air Force, 1961 to 1965; and Colonel Charles A. Lindbergh, who made the first solo nonstop transatlantic flight, New York to Paris, in 1927. Rapid demobilization followed World War I, and most of the Army's wartime airfields were abandoned. From 1919 until 1922, Brooks Field was the site of an Army Balloon and Airship School. In 1922, the Army Air Service consolidated primary flying training at Brooks Field, which continued until 1931 when all primary training was transferred to Randolph Field, north of San Antonio. Randolph was an entirely new Air Corps station, conceived and designed as a model airfield for flying training. It also became the headquarters location of the Air Corps Training Center.

Hangar 9 was hastily constructed in December 1917 and January 1918 to house the Curtiss JN-4 airplane, the "Jenny," which became the basic training plane for thousands of American pilots during World War I. The hangar was one of 16 constructed at Brooks and is recognized as the oldest existing airplane hangar on a U. S. Air Force installation, although a brick hangar at Langley Air Force Base, Virginia, also completed in 1918, is a rival for this distinction. Hangar 9 was considered temporary construction when it was built, but its solid wood frame construction insured its longevity. It has a bolted wood truss roof in a modified gambrel form, with large sliding wooden doors at the ends that slide open to the full width of the building by means of exterior door carriers. The side walls are framed with stacked double sash windows with exterior braces or buttresses.

In the summer of 1926, the School of Aviation Medicine relocated from Mitchel Field, New York, to Brooks Field. The school trained medical personnel in the specialized field of aviation

medicine, and also conducted research to improve physical and technological problems experienced by fliers. The School of Aviation Medicine also transferred to Randolph Filed in 1931, but returned to Brooks when a new expanded school opened in August 1959. In October 1959, Brooks became the headquarters for the Aerospace Medical Center, a single organization to address all fields of science related to aerospace medicine. It combined aerospace medical research, education, training, and a clinical facility at one location.

Hangar 9 was restored in 1969. It currently houses the U.S. Air Force Museum of Aerospace Medicine, an extensive collection of photographs and equipment related to aviation and aerospace medicine, as well as information on the early history of Brooks Field. The museum was dedicated as a memorial to Edward H. White II, a native of San Antonio who was the first American to walk in space in June 1965 on Gemini IV. White died in 1967 in a flash fire inside the Apollo command module during training for the first manned flight of the Apollo program. For a complete copy of the National Historic Landmark registration form for the Hangar 9, Brooks Air Force Base, click here.

Hangar 9, Brooks Air Force Base, a National Historic Landmark, is located at 8008 Inner Circle Dr. in San Antonio, Texas. The Museum of Aerospace Medicine is open Monday-Friday from 8:00am to 4:00pm and Saturday by special arrangement, groups larger than 10 please call 210-531-9767. For further information call 210-536-2203 or visit the museum's website. You can also download (in pdf) the Hangar 9, Brooks Air Force Base National Historic Landmark nomination.

Crissy Field, Presidio of San Francisco

Crissy Airfield was established as a U.S. Army Airfield along the San Francisco Bay in 1919 and was the sole airfield in the United States to remain in constant operation between 1919 and 1936. It became the first Air Coast Defense Station established on the Pacific Coast. The airfield is named after Mayor Dana H. Crissy who lost his life while participating in an army test flight. Crissy Airfield is renowned as the site of many aviation firsts during the 1920s and for its connection with many notable aviation pioneers. The airfield is closely associated with Henry H. "Hap" Arnold, an important figure in World War II aviation who was appointed as the first Air Service Officer for the Western Department as well as the first commanding General of the Army Air Forces. Arnold was instrumental in the establishment of Crissy Airfield which was completed by 1921. Other notables associated with the airfield are Carl A. "Tooey" Spaatz, George H. Brett, and Delos C. Emmons, all important figures in the development of air power during the interwar years and World War II. Among its many notable events were the June 23,1924 dawn-to-dusk transcontinental flight performed by Lt. Russell L. Maughn, and the first attempt to fly from the mainland United States to Hawaii, led by naval Commander John Rodgers, on August 31, 1925.

The field is located on the northern shoreline of the San Francisco Presidio facing the Bay and on the site of a previous landfill completed for a 1915 exposition. Crissy Airfield is the only intact Air Coast Defense Station airfield in the Nation with the majority of its associated buildings still remaining as well. The buildings associated with the airfield include administrative buildings, buildings used for storage/technological purposes, three massive hangars and housing quarters.

The housing is located west of the former airstrip along the elevated bend of Lincoln Boulevard with breathtaking views of San Francisco Bay. The buildings were primarily constructed in the Spanish Colonial Revival style. By 1936, operations at Crissy Field were taken over by Hamilton Field in Marin County.

Crissy Field, part of the Presidio of San Francisco and a National Historic Landmark, is administered by the National Park Service's Golden Gate National Recreation Area. It is located on the north shoreline facing the San Francisco Bay in San Francisco, California. The site is open daily from dawn to dusk. Admission is free of charge. Please call 415-561-4323 or visit the park's website for information.

Miller Army Airfield Historic District

Miller Army Airfield, on New York's Staten Island, was established from 1919 to 1921 as part of the aerial coast defense system formed to supplement existing coast defenses, and reflects early, experimental years in aviation history. The field was well located for harbor defense purposes as it was centrally situated between Fort Wadsworth and Fort Hamilton on either side of the narrows, Fort Hancock on Sandy Hook and Fort Tilden on the Rockway Peninsula. The Miller Army Airfield Historic District includes a double seaplane hangar and lighthouse. The double seaplane hangar, constructed in 1920, is the most important building remaining at Miller Field because of its direct association with early aviation history. The Monitot Type hangar was constructed by Smith, Hansen and MacIssac and Rangely Construction Company, both of New York. The seaplane hangar was constructed as part of the Hangar Group of Buildings which included an airplane hangar, an aero repair shop, a boiler house, an aero store-house, a motor test house, an armorers house, a fuel additive house, a pier and boat house, a gasoline pumping system, a water supply system and sewer system. Of these buildings only Hangar #38 remains. It is a steel frame structure with stuccoed walls, originally consisting of two bays, side by side, each measuring 110 by160 feet with full-width lift doors on the northeast end. From 1935 to 1939, the Works Progress Administration built several additions. A two-story, flat-roofed west wing was built of steel and concrete, as was the boiler room, and extends halfway along the southern side of the hangar. On the eastern side is a similar wing, one-story high, with a slightly pitched roof on steel beams, which extends around to the southern side as well. Seaplane Hangar #38 is believed to be a unique design among early military aviation bases. A survey of seaplane hangars revealed that although several early hangars with varying degrees of alterations could be found along the Eastern Seaboard, a hangar located at Crissy Field, in San Francisco most closely resembled the Seaplane Hangar at Miller Army Airfield.

In 1923, one of the first of a series of tests made at Miller Field by private aircraft manufacturers was conducted on the Remington-Burnelli aircraft. Bellanca Aircraft Corporation utilized the hangars at Miller Field during the summer of 1928. In the spring of the following year, the American Aeronautical Corporation assembled and tested two Italian seaplanes, one SS-55 twin hulled Savoia-Marchetti flying boat and one S-62 Savoia-Marchetti flying boat. In 1926 a training session for eight Army Air Service pilots who were preparing for a good will Pan-American flight through North, Central and South America was held here. One of the planes to be used, a Looning Amphibian, was tested at the field. Popular aviation heroes also visited and used Miller Field. Famed Arctic pilot Floyd Bennett arrived at Miller Field in the spring of 1928

to prepare for an emergency flight to rescue downed fliers on Greenly Island, Canada. Bennett and his party left Miller Field on April 19. During the flight Bennett contracted pneumonia and died in a hospital in Quebec later that month.

The Elm Tree Light, a light station that operated throughout the 19th and early 20th centuries, replaced a large elm tree at the foot of New Dorp Lane that served as a mark in the late 18th century for sailing vessels going from New York, Middletown and Brunswick. Although the light station was abandoned in 1924, the lighthouse remains on its site to the rear of the hangars. The Elm Tree Light is a significant part of the historic setting and reflects the 200-year long history of continued land use at its site.

In 1973, Miller Field was acquired by the National Park Service as part of the Gateway National Recreation Area. At that time, about 24 buildings and structures from the air field remained. All of the buildings were in deteriorated conditions at the time of the acquisition, especially the two hangars. The condition of the airplane hangar (Building 33) in particular had reached such a state of deterioration that renovation was no longer practical and the hangar was demolished. Other buildings were renovated to provide housing and today the Elm Tree Light and Hangar #38 best reflect the history of the airfield.

Miller Field is located on Staten Island, New York, and is part of the National Park Service's Gateway National Recreation Area, a 26,000-acre recreation area located in the heart of the New York metropolitan area. Access to Miller Field is from community streets (Hylan and Father Capodanno blvds. and connecting sts.). Miller Field is a heavily used recreational area throughout the year and provides half of the recreational field use available to Staten Islanders. The Staten Island Bicycling Association meets weekly at Miller Field to begin their cycling tours. The current bicycle path runs from South Beach to Midland Beach and plans call for bicycle connections from St. George at the Staten Island ferry terminal through Fort Wadsworth and Miller Field to Great Kills park and Tottenville at the south end of the island. There is no fee for admission. Call Miller Field/Staten Island at 718-351-6970 or visit the park's website.

Pope Air Force Base Early Expansion MPS

Pope Air Force Base (AFB) in Fayetteville, North Carolina, has played a leading role in the development of U.S. air power. Established within 15 years after the first successful powered flight in 1903, Pope Field is one of the oldest installations in the Air Force. Pope Field was officially established on April 1, 1919, by the War Department and named after Lt. Harley Halbert Pope, who was killed in an airplane accident on January 7, 1919. The 267th Aero Squadron was the first unit stationed at Pope Field, and many of its members were veterans of World War I. Their primary mission was to support the Artillery Regiment at Camp Bragg. Initially, balloons and hand-made, single-engine biplanes were stationed at Pope Field. Until 1927 the aircraft at Pope Field were used in passive roles, such as aerial photography, mapping of local terrain, spotting for artillery, reporting forest fires and carrying the mail. In 1927, Maj. Carl Spaatz led a flight of 14 Keystone B-1 Bombers from Pope to demonstrate the practicality of destroying bridges with aerial bombs. The destruction of a condemned bridge on the Pee Dee River confirmed his theory, and its application during World War II significantly shortened the war.

Pope Field was enlarged during the 1930s, and the 32 buildings comprising the Pope AFB Historic District were built during that period of expansion in 1933 and 1934. The district includes two distinct property types: administrative buildings and residences. Common architectural features of these buildings include hollow tile masonry walls, painted stucco exteriors, reinforced concrete foundations and, originally, Spanish tile roofing. One of the most noted buildings, Fleming Hall, which served as Command Headquarters during World War II, is a Georgian Revival, three-story building. The Old Fire Station, building 300, is a one-story building with Spanish tile roof and painted stucco facade--this site later became a Medical Supply building. The Old Family Housing units at Pope AFB consist of 21 one-and two-story dwellings on Etheridge, Maynard and Virgin streets--all characterized by hollow tile masonry set on concrete foundations, with wood floors, painted stucco exteriors, tile roofs, small rear stoops/porches and basements.

Throughout World War II, air and ground crews trained at Pope Field with Army airborne units in preparation for airborne and aerial resupply missions. In 1941 Generals Marshall, McNair and Clark visited Pope Field and witnessed one of the largest air maneuvers in history up to that time: the first mass paratroop drop (more than 500 paratroopers) undertaken in the western hemisphere. In February 1942, a squadron of A-20s based at Pope Field located and sank the first German submarine off the shores of the United States near Cape Hatteras and Cape Lookout. The 317th tactical Airlift Wing at Pope Field, which saw extensive service in the Pacific during World War II, was one of the first carrier-based fighter groups formed. After World War II, the Continental Air Command took over Pope Field and maintained control until 1950, when the Tactical Air Command assumed control. In October 1954, the 464th Troop Carrier Wing was transferred to Pope Field and a major period of facility expansion ensued. In 1958 the Wing converted from C-119s to C-129 aircraft, enabling it to establish tactical airlift capability.

During the 1960 earthquake disaster in Chile, Pope AFB was one of two primary areas used to provide medical supplies and personnel assistance to this country. Airlifts of men and materials were sent from Pope AFB to Florida in 1962 during the Cuban Missile Crisis, and the Wing received the Air Force Outstanding Unit Award in 1961 and 1963 for assistance to the Vietnamese Air Force. An increase in the Wing's operational capacity occurred with the arrival of the first Lockheed C-130 Hercules aircraft in 1963, enabling the Wing to carry U. S. Strike Command paratroopers and equipment to any war zone in the world. In 1971, the 464th TAW was deactivated and the 317th TAW administratively moved to Pope AFB. Today Pope Air Force Base is home to the 43rd Airlift Wing and two tenant units: the 23rd Fighter Group and the 18th Air Support Operations Group.

The Pope Air Force Base Historic District includes buildings located along Academy, Ethridge, Maynard and Virgin sts. in Fayetteville, North Carolina. Due to heightened security, the base is not accessible to the public; military or Department of Defense identification card holders and their guests are welcome. Please call Pope Air Force Base Public Affairs at 910-394-4183 for further information.

Maxwell Air Force Base Senior Officers' Quarters Historic District; Building 800; Building 836

Maxwell Air Force Base, historically known as Maxwell Field, is one of the earliest sites used for aviation purposes in the United States. In 1910, Wilbur Wright selected old cotton fields west of Montgomery, Alabama, as a flying field for student pilots training to be Wright-Fliers, an exhibition team organized to promote the Wright brothers' new airplane manufacturing company (The Wright Company). The field was only used by the Wrights from March until May, when pilot training relocated to Huffman Prairie in Dayton, Ohio.

The Federal government leased the former "Wright Field" during World War I to provide an engine and repair depot for the Army Air Service, and purchased the land in January 1920. Almost all Army air stations and depots developed during World War I were leased properties with temporary construction, built to last two to five years. By the mid-1920s, dilapidated wartime buildings had become a national disgrace. Congressional investigations also showed that the strength of the Army air arm was deficient. This critical situation eventually led to the Air Corps Act of 1926 and two major programs that dramatically transformed Army airfields. The Air Corps Act changed the name and status of the Army Air Service to the Army Air Corps, and authorized a five-year expansion program. In the late 1920s and early 1930s, this program and its companion, the 1926 Army Housing Program, produced well-designed, substantial, permanent buildings and infrastructure at all Army airfields retained after World War I.

Maxwell Field benefited greatly from these new building programs. Maxwell's first permanent building, completed in 1928, was a barracks for 163 enlisted men (Building 836). The Air Corps expansion program also caused the Air Corps Tactical School to relocate to Maxwell Field. New construction required for the school included an academic and administration building (Building 800--Austin Hall), a large number of Officers' Quarters (Senior Officers' Quarters Historic District), quarters for Non-Commissioned Officers, two more large barracks for enlisted men, hangars and a number of support buildings. Austin Hall was completed in June 1931 and officially opened with a dedication ceremony in September. A large addition to the south facade doubled the size of the building in 1934.

The Air Corps Tactical School was the first school in the world to teach the tactics and techniques of military aviation. When the Air Service Field Officers' School (its initial name) opened in 1920 at Langley Field, Virginia, it was also the Army's first school to provide professional education for its air officers. The Tactical School played a critical role in the development of Army air doctrine. Unlike the land and sea forces, the fledgling air arm did not have traditions, training principles, and war doctrines developed over centuries. In the 1920s, Langley Field was the breeding ground for visionary and revolutionary ideas of air power that were developed and refined as official air doctrine at Maxwell Field in the 1930s. A significant number of "TAC School" teachers and graduates became key military leaders during World War II and the early Cold War. Austin Hall is also significant because the Order of Daedalians was founded here in March 1934. The organization was established initially for World War I military pilots, with new categories of members and eligibility added after World War II.

TAC School classes were suspended indefinitely in the summer of 1940. Expansion of the Army Air Corps for World War II required huge personnel increases and major reorganization of Air Corps training programs. Austin Hall became the headquarters of the new Southeast Air Corps Training Center, one of three regional centers established to provide pilot, navigator and

bombardier training for all new aviation cadets. By the end of World War II, the center at Maxwell was responsible for the training of more than 100,000 cadets.

After the war, a new school called Air University was established at Maxwell to provide professional military education for air officers. In September 1946, classes began at the Air War College and the Air Command and Staff School, two of the first schools established at Air University. Since that time, the university has expanded to include a large number of schools; its Air University Library is the Department of Defense's largest library and the largest Federal library outside of Washington, D.C. Air University continues to be the U.S. Air Force's center for professional military education, also providing academic education, graduate education and professional continuing education for officers, enlisted personnel and civilians.

The Senior Officers' Quarters at Maxwell were constructed from 1932 to 1935 to house teachers and students at the Tactical School. Architects of the Army Quartermaster Corps designed 99 elegant residences for the high-ranking officers and placed them in a neighborhood setting with winding streets, sidewalks, shade trees and open grassy areas. Standardized plans designed for the Army Housing Program were based on historic architectural styles that reflected a region's history and local building materials. At posts on the Atlantic seaboard, buildings were designed in the Quartermaster's version of the "Colonial" style; construction in the Southwest was based on Spanish Mission architecture. The strong French influence in the Deep South during the colonial period inspired Quartermaster architects to design buildings in the Senior Officers' residential area at Maxwell in a style they called French Provencial, also used in the design of buildings at Barksdale Air Force Base in Shreveport, Louisiana.

Maxwell Air Force Base Senior Officers' Quarters Historic District is roughly bounded by West Dr., N. Juniper and S. Juniper sts., Inner Circle, Center Dr., Sequoia and East drs. Building 800-Austin Hall is located on Second St. and Building 836--Community College of the Air Force Building is located on Maxwell Blvd, near Montgomery, Alabama. All are on Maxwell Air Force Base, an active base. Tours are available but must be scheduled in advance. Please call 334-953-6201 or 334-953-2014 for further information.

Randolph Field Historic District

Randolph Field, Texas, played an exceptional role in the development of the air arm of the U.S. Army, which eventually achieved its independence as the U.S. Air Force in September 1947. It was conceived and designed as a model airfield for flight training in the mid-1920s for the fledgling Army Air Corps. The completed "Air City" became the site of unique Air Corps schools for flying training and aviation medicine, as well as a landmark in airfield planning and design. In addition, administrative headquarters at Randolph Field, including the Air Corps Training Center, the Gulf Coast Air Corps Training Center and the Army Air Forces Central Flying Training Command, were keystones in the organizational structure of the Army Air Corps and the Army Air Forces. Their roles were pivotal in the Army air arm's 40-year campaign to become an independent branch of the U.S. armed forces.

The Army began a flying training program soon after delivery of its first airplane to the Signal Corps in the summer of 1909. By the end of World War I there were 27 flying fields for training

in the United States, however, all instruction at the schools ceased immediately with the signing of the Armistice (November 11, 1918). Rapid demobilization followed and flying training during the postwar period was erratic for several years. The Army eventually established a flying training system with two levels. Primary Flying Schools were located at Carlstrom Field in Arcadia, Florida, and March Field in Riverside, California. Three Advanced Schools were planned to provide training for pilots specializing in pursuit, bombardment, and observation. However, the Observation School at Post Field at Fort Sill, Oklahoma, was the only one to provide advanced training during this period because funds for training were so scarce. To conserve resources, the Army Air Service decided to centralize its flying training in 1922 at two fields about seven miles apart in San Antonio, Texas. Brooks Field provided primary flying training and the Advanced Flying School was located at Kelly Field. Passage of the Air Corps Act in July 1926 led to further reorganization of the flying training program, and the schools at Brooks and Kelly Fields became part of a new organization, the Air Corps Training Center.

Brig. Gen. Frank P. Lahm, one of the two assistants to the Chief of the Air Corps authorized by the Air Corps Act, became the Training Center's first commanding officer. Lahm was a pioneer in American aviation history, the first military officer taught to fly by Wilbur Wright in 1909 and the first American to win an international balloon competition (1906). On April 18, 1927, Lahm appointed a board of five officers to submit plans for a model field for flying training, including housing, administrative and school buildings, hangars, and associated support buildings and infrastructure. War Department General Order No. 12 (September 27, 1928) designated the planned flying field as Randolph Field, named in honor of Captain William M. Randolph, killed in an airplane accident at Gorman, Texas, on February 18, 1928. The dedication ceremony for Randolph Field was held on June 20, 1930, even though less than half of the construction was completed. The Air Corps Primary Flying School opened at Randolph Field on November 2, 1931. Flying training was no longer conducted at Brooks Field, but the Advanced Flying School remained at Kelly Field.

The Air Corps' need for an airfield specifically for flying training led to a radical new concept of airfield layout and design. It broke all previous precedents at Army posts and air stations. Over several years, the original idea for a field with a circular shape evolved into a model airfield for flying training that also incorporated the most advanced principles of the new profession of city planning. The final plan for Randolph Field produced a unique military installation that was an exceptional achievement for Army architects, planners, and Air Corps officers. Buildings and structures were generally constructed in the Spanish Colonial Revival style with hollow core tile and concrete block covered with stucco and roofs of Mission red clay tile. Hangars, however, were built in the Art Deco style and originally had checker-board painted roofs. Most of the buildings were built according to standardized plans designed by the Army Quartermaster Corps in the late 1920s. However, Randolph Field's most prominent buildings--the Administration Building, Chapel, School of Aviation Medicine and Cadet Academic Building--were designed by local architects. This was partly because the Quartermaster Corps did not have standardized plans for these special types of buildings, local architects were more familiar with local building conditions and materials, and the timetable for completing the Air Corps' new field. The entire installation was built in less than three years.

In the 1930s, Randolph Field was the location of the administrative Headquarters for the Air

Corps Training Center, as well as the Air Corps Primary Flying School. The Air Corps Training Center was in charge of the entire Army pilot training program in the United States from 1931 to 1939. The Air Corps Training Center developed an efficient, well-coordinated flying training program that focused on the quality of its pilots.. The program was not only critical to the development of military flight training, but also to the training of American pilots, who after graduation spread out over the world, some to commercial airline jobs in Latin America and the Phillipines, others to government or industry occupations that took them to Europe and Asia. However, the program only produced about 200 pilots a year. Hitler's actions in Europe and America's belated recognition of the importance of air power led to a rising demand for rapid expansion of the Army Air Corps. The subsequent growth of the Air Corps prior to Pearl Harbor was phenomenal. Randolph Field's exceptional facilities allowed it to become the largest school for basic flight training in the United States until the Air Corps Training Center was broken up and flying training was expanded with new training centers in the southeast (Maxwell Field, Alabama) and on the west coast (Moffett Field, California).

Randolph Field Historic District, a National Historic Landmark, is located at the center of Randolph Air Force Base, in San Antonio, Texas. Requests for tours must be received in writing at least three weeks prior to the tour date. Tours may be tentatively scheduled by calling 210-652-4407. For more information visit the base's website or contact the 12th Flying Training Wing Public Affairs Office at 210-652-4410.

March Field Historic District

March Field in Riverside, California, was important in the development of the Army Air Corps, serving as the key training and bombardment facility on the West Coast between 1928 and 1943. The airfield is an example of incorporating city planning principles in the layout of military bases and as the first complete aviation post laid out and constructed during peacetime by the Quartermaster Corps and the Army Air Corps. The base is associated with architect Myron Hunt and stands as the only known military base to have been designed by him. On March 20, 1918, the airfield was named in honor of 2nd Lt. Peyton C. March, Jr. who was killed in an aviation accident at Fort Worth, Texas.

The field was utilized as a primary aviation training facility during World War I and continued serving in this capacity thereafter until 1921, one of only two primary pilot schools in operation after the war. However, after the passage of the Air Corps Act, March Field once again became a primary aviation facility from 1927 until 1931, when primary training was consolidated at Randolph Air Force Base. March continued to be the central base for West Coast bombing and gunnery training until 1941. Through the Air Corps expansion program March Field began its second phase with the construction of permanent facilities to reflect the regional topography, climate and history of the area, a trend incorporated into Army base construction during the mid-1920s. The new facilities were constructed in the Mission Revival style and are now believed to be the world's largest group of hollow-wall concrete buildings. Hangars, officers' quarters, industrial buildings, a hospital and base theater, are just some of the 228 buildings, structures and objects which comprise March Field Historic District. The buildings are generally surfaced in concrete, either stucco or poured concrete, and display clay Mission tile roofs.

March Field Historic District is bounded by Meyer and Riverside drs. and Graeber St. in Riverside, California. The March Field Air Museum is located adjacent to the March Air Reserve Base and is open 9:00am to 4:00pm daily, excluding major holidays. Please call 909-697-6602 or visit the museum's website.

Hamilton Army Air Field Discontiguous Historic District

Hamilton Army Airfield, in Novato, California, was built as a bombardment base and the headquarters for the 1st Wing of the Army Air Corps, one of only three bases established for this purpose nationally. The base was utilized for the defense of the western section of the country until 1940. Hamilton Field also played a significant role during World War II in training and national defense by serving as an overseas staging area, acting as one of three major bases of the west coast wing of the Air Transport Command's Pacific Division and for its role in the Operational Training Unit Program. The base was named after Army Air Corps aviation pilot, First Lieutenant Lloyd Andrew Hamilton, originally from Marin County, California, killed while serving his country in World War I. However, the base had been previously known as the Air Corps Station, San Rafael. Construction of Hamilton Airfield commenced on July 1, 1932, with the majority of first phase construction complete by 1935.

Architecturally Hamilton Airfield is significant for its deviation in form and style from other airfields heretofore in existence. The airfield was designed in the Spanish Eclectic style and included planned landscapes which integrated natural oak groves, knolls and hills. However, perhaps most impressive of all was the development of the base as a planned community, an innovative approach in construction of Army bases which had only been adopted in the mid-1920s. Hamilton Field represented a growing trend in construction that reflected the climate, topography and history of the region in the architectural style of the base. Hence the buildings are of hollow tile or reinforced concrete construction with stucco exterior and Mission tile roofs. Architecturally the buildings consist of Spanish Eclectic with Mission, Moorish and Spanish Churrigueresque, Renaissance and Art Moderne elements. The district includes facilities such as officers' housing, a base hospital, a post theater and hangars. After the base's contributions in WWII the base was reassigned several times until buildings and land were transferred to the Navy, Army and Coast Guard. However by 1989 the Army was mandated to close its facilities on Hamilton Air Force Base.

Hamilton Army Air Field Discontiguous Historic District is located primarily on the southwest part of Hamilton Army Air Field in Novato, California. Much of deactivated base was transferred to the city, and Hamilton Field is now a residential community, please visit its website further information.

Rogers Dry Lake

Rogers Dry Lake (also known as Muroc Dry Lake), at Edwards Air Force Base in California, has been used by the U.S. military since 1933 when a small advance party from March Field in Riverside came to design a bombing range for the Army Air Corps. The area proved ideal for flight, with 350 days a year of flying weather and the lake providing a ready-made emergency

landing field; four years later the entire Air Corps was performing bombing and gunnery maneuvers here. The south end of the lake was used during World War II for training P-38 Lightning fighter pilots and B-24 Liberator and B-25 Mitchell bomber crews. A realistic 650-foot replica of a Japanese Navy heavy cruiser, dubbed "Muroc-Maru," was used for strafing, identification and skip bombing practices before being removed in 1950.

Col. Benjamin W. Chidlaw and Lt. Col. Ralph P. Swofford chose Muroc Dry Lake in 1942 as the testing location for the then secret Bell-built XP-59A jet airplane. In September, America's first turbojet arrived at Muroc. Since 1942, Edwards Air Force Base (Muroc Air Force Base) and its tenant, the NASA Ames-Dryden Flight Research Facility have played a leading role in advancing the capabilities of aerospace technology. Lakebed Runway 18 was typically the landing facility for the X-15, a hypersonic research vehicle that flew for nearly a decade at Edwards. Edwards Air Force Base also served as a support facility for flight operations of the NASA Space Shuttle Orbiter. NASA Space Shuttles, launched from Kennedy Space Center, have utilized Lakebed Runway 23 as a landing strip. Many participants of Edwards Air Force Base's flight testing programs have also played major roles in the American manned spacecraft program, notably NACA-NASA administrator Dr. Walter Williams and test pilot-astronauts Donald Slayton, Michael Collins, Neil Armstrong and Joseph Engle. Rogers Dry Lake made possible the development and testing of generations of American aircraft, leading to the Space Shuttle.

Rogers Dry Lake, a National Historic Landmark, is located at Edwards Air Force Base in California. Due to heightened security, tours have been suspended until further notice. For a virtual tour please visit the base's website.

Variable Density Tunnel

First operational in 1922, the Variable Density Tunnel at the Langley Research Center in Hampton, Virginia, was the first wind tunnel in the world to use the principle of variable density air pressure to test scale model aircraft and it established the National Advisory Committee for Aeronautics (NACA) as a technically competent research facility. Max Munk, a German NACA technical assistant who was familiar with European wind tunnel design, designed the Variable Density Tunnel--the first pressurized wind tunnel in the world. The Variable Density Tunnel was able to predict flow characteristics of test aircraft models more accurately than any other tunnel in existence at that time. In 1927 the Variable Density Tunnel was partially destroyed by a fire that damaged its interior. The tunnel was rebuilt and operational by 1930.

The Variable Density Tunnel was deemed obsolete by the standards of the day in the 1940s and was gutted. It was then used as a pressure tank to support the operation of the Vertical Wind Tunnel and Low Turbulence Wind Tunnel. Although declared potentially unsafe for further operations in 1978, all modern Variable Density Tunnels are merely an extension of this idea first formulated and put into operation by Munk in 1921. The Variable Density Tunnel was a technological jump that rejuvenated American aerodynamic research which had fallen behind European countries prior to World War I and eventually led to the development of the best aircraft in the world.

The Variable Density Tunnel, a National Historic Landmark, at Langley Research Center is located at 100 NASA Rd. in Hampton, Virginia. It is closed to the public. Please visit Langley's website for further information.

Full Scale 30- by 60-Foot Tunnel

Almost all high performance aircraft used by the United States before and during World War II were tested at the Full Scale Tunnel at the Langley Research Center in Virginia. By 1929 the National Advisory Committee for Aeronautics (NACA) wind tunnel complex at Langley was completed and producing useful high quality aerodynamic research data, but NACA engineers realized there was a gap in their wind tunnel inventory--a full scale wind tunnel. The design of the Full Scale 30- by 60- Foot Tunnel began in 1929 under the leadership of Smith J. De France. With funds having been appropriated before the start of the Depression, NACA was able to buy materials at bargain prices and utilize talented, unemployed aeronautical engineers. Work on the Full Scale Tunnel progressed quickly and by 1931 the tunnel was complete. Soon a large procession of military aircraft was dispatched to Langley for drag cleanup tests.

During most of World War II the Full Scale Tunnel at Langley, the only tunnel in the world capable of performing these tests, operated 24 hours a day, seven days a week. In recent years the Full Scale Tunnel has tested aircraft such as the Harrier VTOL fighter, the F-16, the American supersonic transport, the Space Shuttle and the Lunar Landing Vehicle. In 1995, the National Aeronautics and Space Administration (NASA) terminated its operations at the Full Scale Tunnel and turned the facility over to Old Dominion University for use as an engineering research laboratory.

The Full Scale 30- by 60- Foot Tunnel, a National Historic Landmark, is located at Langley Research Center in Hampton, Virginia. The facility is closed to the public. Please visit Langley's website for further information.

Eight-Foot High Speed Tunnel

Completed in 1936, the Eight-Foot High Speed Tunnel at the Langley Research Center in Hampton, Virginia, was created by the National Advisory Committee for Aeronautics (NACA), the parent agency of the National Aeronautics and Space Administration (NASA). It was the first continuous-flow high-speed wind tunnel able to test large models and actual working parts of airplanes. It could also operate indefinitely, giving engineers sufficient time to run their tests and check their results. For the first time NACA engineers had a research tool that could supply high-speed test results on a large scale.

Over the years NACA engineers continued to modify the Eight-Foot High Speed Tunnel, specifically attempting to improve performance in the transonic range (Mach 0.7 to Mach 1.4). The "slotted throat" design, a partially open or slotted wind tunnel wall, added in 1950 made it possible to obtain meaningful test results in the transonic range. Renamed the Eight-Foot Transonic Tunnel, this landmark in wind tunnel design allowed NACA engineers to accurately determine the affect of the transonic range on supersonic fighters and bombers. Although phased

out of service in 1956 the Eight-Foot High Speed Tunnel provided the technology upon which the United States constructed rockets that eventually flew to the moon and beyond.

The Eight-Foot High Speed Tunnel, a National Historic Landmark, at Langley Research Center is located at 100 NASA Rd. in Hampton, Virginia. It is closed to the public. Please visit Langley's website for further information.

Wendover Air Force Base

Wendover Air Force Base, located just south of the town of Wendover, Utah, played an important role in training heavy bombardment crews and ushering in the atomic age. The base was first conceived in 1939 when the Army Air Corps commenced an extensive expansion program. High on the Air Corps list was the construction of adequate bombing and gunnery ranges. By 1940 a site was located at Wendover, and work began in November of that year. Initially the Air Corps desired some three million acres of land of which 90 percent was public domain. However, because of grazing commitments to local ranchers and farmers, only one and a half million acres were allocated. On April 6, 1942, the first training unit arrived and found the area ideal for bombing and gunnery practice due to the terrain of the region and lack of large population centers. Twenty-one heavy bomb groups trained in Wendover including the 306th BG (first to daylight bomb Nazi Germany), the famed 100th BG (known as the bloody 100th due to aircraft losses) and the Flying Tigers 308th Bomb Group which served in China, Burma and India. Additionally, members of three bomb groups trained in Wendover won the Medal of Honor. The base also served as the test and training site for the atomic bomb and the 509th Composite Group under the command of Colonel Paul W. Tibbets, Jr. It was Colonel Tibbits, flying his B-29, "Enola Gay," who dropped the atomic bomb on Hiroshima in August 1945.

The 509th Group was organized December 17, 1944, and trained at Wendover until May 1945, when they left for Tinian Island in the Marianas. During the group's stay at Wendover, the base became a maximum-security area with signs stating, "What you see here, What you do here, What you hear here, Stays here." Information about the group's mission was so restricted that even members of the 509th did not know the purpose of this training, although Colonel Tibbets was briefed on the Manhattan Project (the code name the U.S. government used for its plan to build an atomic bomb) in September 1944 and given authority to add modifications necessary to make the B-29 capable of delivering the atomic bomb. The crew of the Enola Gay proved that an atomic bomb could be used under combat conditions.

During the final days of World War II and for a short time in the late 1940s and early 1950s, Wendover played a role in the U.S. guided missile program. The first flight of an unmanned U.S. Air Force vehicle to break the sound barrier occurred over the Wendover bombing range. The American "JB-2," a version of the German V-1 rocket, was also extensively tested at Wendover.

Wendover Air Force Base was closed by the Air Force in 1963. The buildings that remain are typical of military buildings constructed during World War II. The frame buildings were neglected after the base's closing, and fell into disrepair until the Historic Wendover Air Field Museum restored them for the benefit of the public.

Wendover Air Force Base is located half a mile south of the town of Wendover, Utah, along the Nevada border. The Wendover Airfield Museum preserves the restored hangars and other buildings, and displays maintenance and training equipment. The operations center, fueling service and museum are open from 8:00am to 6:00pm daily. A self-guided driving tour is available and guided tours can be arranged by calling in advance. Visit the museum's website at www.wendoverairbase.com *for more information.*

Eglin Field Historic District

Eglin Air Force Base in Fort Walton Beach, Florida, has made major contributions to the defense of the United States in the development of tactical strategies, testing of weaponry and missile research. Development of the military base began in 1933 when U.S. Army Air Corps officials from Maxwell, Alabama, initiated a search for a site suitable for a bombing and gunnery range. In 1935 the War Department acquired by lease 137 acres of land near Valparaiso on which to build an airport. Eglin eventually grew to be the largest Air Force base in the Western Hemisphere, and played an important role in World War II. It covers 724 square miles of land and 86,500 square miles of the Gulf of Mexico. There are more than 3,000 buildings on the base, of which 164 were built during World War II. The Eglin Field Historic District contains 20 buildings representative of that era. These buildings are distinguished by the structural clay tile used in their wall construction. The administrative buildings and residences are rectangular in form, capped by shallow-pitched roofs and lack ornamentation. Common plans for wartime buildings, the urgency of wartime, local environmental conditions, and the availability of construction materials, dictated the design of Eglin's buildings. Some of the family housing quarters in the district display architectural characteristics related to the Minimal Traditional style, which reflects the transition from the earlier pre-War Tudor and Colonial Revival styles and the post-war Ranch style.

During World War II, Eglin Field served as the nation's principle station for air warfare experimentation. Accelerated aircraft and armament tests began in September 1941, three months before Pearl Harbor. In May 1941, the Army Air Corps designated Eglin as the Air Corps Proving Ground, removing it from the jurisdiction of the Southeast Air Corps Training Command and placing the base immediately under the control of the Chief of Air Corps. It was at Eglin Field that Lt. Col. James "Jimmy" Doolittle's B-25 crews from the 89th Reconnaissance Squadron and 17th Bombardment Group practiced short-field take-offs in preparation for the carrier-based raid on Tokyo on April 18, 1942. Although the damage the bombs inflicted was relatively small, the psychological effect on the Japanese was significant and America's resolve was strengthened. The primary purpose of the Proving Ground was to provide a station for tactical tests of aircraft armament and accessory equipment and of aviation tactics and techniques. Also, it was here, that final tests of the B-17, the workhorse of the allied air effort against Nazi Germany, were completed and evaluations of the B-29, which was to be employed against the Japanese isles, were initiated. Charles Lindbergh accompanied a flight from Eglin Field January 21, 1944, in an experimental XB-29, which had arrived at the base for tests. The crew of the flight included 1st Lt. F.A. Lewis and Lt. Col. Paul Tibbets, who flew the *Enola Gay*, which dropped the first atomic weapon on Hiroshima, Japan, and Charles Sweeney, who flew in

the B-29 that dropped the second atomic weapon upon Nagasaki. By late 1944, development of a U.S. version of the German V-1 missile had begun at the proving grounds. During the war, it became apparent to military planners that America needed armaments and materials that could function in all climates and under all circumstances. To meet this need, the United States designed and constructed the McKinley Climatic Laboratory at Eglin.

Eglin Field Historic District is roughly bounded by Barranca, Choctawhatchee, Fourth and "F" aves. on the Eglin Air Force Base in Fort Walton Beach, Florida. It is an active base and generally not accessible to the public. However, group tours (20 to 40 people) are available for high-school age and older, depending on AAC mission demands and security levels. Each group must provide its own bus transportation and will be accompanied by an Eglin escort. Contact the Eglin Community Relations department a minimum of three months prior to the desired tour date at 850-882-2817 (or try ext. 2836 or 2879).

McKinley Climatic Laboratory

America's involvement in a global conflict in World War II meant that aircraft would be subjected to a variety of climates, ranging from arctic conditions in Alaska and hot deserts in the Middle East to tropical rain forests in the Far East. In the winter of 1942 to 1943, the otherwise efficient German Air Force could not get its aircraft in the air during sub-zero weather. This grounding of the entire German Air Force, coupled with the difficulties the Cold Weather Test Detachment was experiencing at Ladd Field, Alaska, made it clear to the United States that cold weather-testing was indeed necessary, and a reliable means of testing must be found. The cold weather-testing program was officially assigned to the Army Air Force Proving Ground Command (AAFPGC) at Eglin Field, Florida, on 9 September 1943. Lt. Colonel Ashley C. McKinley reasoned that testing under controlled conditions would yield far superior test results and would be up to 10 times more economical that testing at Ladd Field, which had been expensive and produced only meager results. He further suggested that all U.S. aircraft and equipment be operable at -65 degrees Fahrenheit, and that a refrigerated hangar be constructed to produce such an environmental extreme under controlled conditions. The solution was to construct a refrigerated hangar at Eglin Field. This project called for a hangar type building of sufficient size to house a Main Chamber for aircraft as large as a B-29, several separate cold rooms, armament test chambers, shops and offices. The plans for the project were approved in 1944. Despite the high priority of its construction, the Climatic Laboratory's planned completion date of March 1945 was repeatedly delayed by a combination of technological challenges, wartime material shortages, and post-war strikes by sub-contractors. By May 1947, the first tests were conducted under a simulated arctic environment. Aircraft tested included a Fairchild Packet, a Boeing B-29, a Lockheed P-80, a North American P-51, a Lockheed P-38, and a Sikorsky R5D helicopter. During the tests, temperatures as low as -70 degrees Fahrenheit were reached. The first attempts at the recreation of Arctic conditions on a large scale were successful. With the completion of the Eglin Climatic Hangar, the newly born U.S. Air Force acquired its largest and most important test facility. As Col. McKinley played a key role in its design and construction, the Climatic Hangar was renamed in his honor following his death in 1970.

Within 50 years, more than 300 different aircraft and 2000 other equipment items were tested for the Department of Defense, private industry, and a number of allied governments. On the purely

technical side, its merits and achievements were record setting. Cold weather testing was for the first time, put on a permanent, scientific basis. Early Air Force tests proved so successful that the Climatic Hangar became a facility utilized by all Department of Defense agencies. Several renovations to the Climatic Hangar were later needed in 1968 with the design and construction of the C-5A aircraft. The Salt Test Chamber and Sun, Wind, Rain & Dust chamber were added in 1973 to 1975. Recently, renovations have concentrated on the removal of ozone-depleting coolants.

The Climatic Laboratory consists of six chambers, four in the main building, Building 440, and two detached chambers in Buildings 430 and 448. The Main Chamber is the largest known insulated aircraft hangar, having a total enclosed volume of approximately 3, 282,500 cubic feet. The size of the chamber, 252 feet wide by 201 feet deep by 70 feet high in the center and 35 feet high at the sides, permits testing of the world's largest aircraft and very large pieces of equipment. An area was added to the main chamber in 1968 to specifically allow the C-5a Galaxy to be tested. This appendent area is approximately 60 feet by 85 feet with a ceiling height of 75 feet. With this appendent area included, usable floor space is approximately 55,000 square feet. The floors consist of 12 inches of reinforced concrete laid in blocks 12-1/2 feet square. The sidewalls have reinforced concrete and tile construction from the floor to a height of 28 feet. Above the concrete and tile, the entire building is made of steel. The entrance into the hangar, known as the Main Doors, encompasses the entire front side of the hangar. Self-supporting and self-propelled, the large door is built in two sections, each weighing 200 tons.

The McKinley Climatic Laboratory is located in Building 440 on Eglin Air Force Base. It is an active base and generally not accessible to the public. However, group tours (20 to 40 people) are available for high-school age and older, depending on AAC mission demands and security levels. Each group must provide its own bus transportation and will be accompanied by an Eglin escort. Contact the Eglin Community Relations department a minimum of three months prior to the desired tour date at 850-882-2817 (or try ext. 2836 or 2879).

Ladd Field

Ladd Field was established in 1940 originally as a Cold Weather Test Station at the insistence of Maj. Gen. H.H. Arnold, Chief of the Army Air Corps. Construction began in the fall of 1938. Named in honor of Maj. Arthur K. Ladd, killed in an aircraft accident in South Carolina in 1935, it was built just east of Fairbanks, Alaska. The first Army Air Corps troops arrived at the field in April 1940. Its World War II facilities were designed to fulfill three missions: cold weather experimental station, air depot for repair and testing of aircraft and the principle base in Alaska for the Air Transport Command. Here, at Alaska's first army airfield, vital lessons were learned in wing-icing, navigation, aircraft maintenance and operation, instruments and controls, radio communication, cold weather-clothing, armament and a wide variety of other investigations for operating aircraft in arctic-like conditions. As the Japanese prepared to invade the Aleutians in 1942, the 11th Air Force established an Air Depot at Ladd Field for the repair, testing and supply of aircraft in the Alaska Theater. Beginning in 1942, Ladd Field also became the center of the "Alsib (Alaska/Siberia) Movement," wherein nearly 8,000 military aircraft from the United States were transferred to Russian aircrews for use on the Russian Front, where the Soviet forces engaged the invading armies of Nazi Germany and its allies. Despite Alaska's harsh winters, this

air-ferry route came to be preferred over the longer Miami-Iraq-Moscow route. Soviet diplomats and missions also traveled through Ladd Field during the enroute to and from the Soviet Union and the United States. A contingent of Soviet pilots landed at Ladd on September 24 to begin five days of training before flying the new airplanes home. The Americans wanted to deliver the airplanes to Siberia, but Joseph Stalin, leader of the Soviet Union, wishing to avoid an appearance of U.S.-Soviet collaboration in the Far East, suggested that the pilots pick up the aircraft in Alaska. The Soviet Union and Japan were not at war until the closing days of World War II, and the Soviets seemed to want to avoid any incidents that might incite the Japanese.

The first Air Corps troops arrived at Ladd Field in September 1940, and soon the first B-17 Flying Fortress arrived for experimental work. Cold weather-testing continued at Ladd Field until the spring of 1942 when concern over a Japanese invasion caused the Alaska Department to request the testing be halted. The 11th Air Force took over the field and established an air depot for aircraft repair, service and supply for the Alaska Theater. Within a few months, however, the commanding General of the Army Air Forces directed the reestablishment of cold weather-testing, which continued well after the conclusion of World War II. The establishment of the Air Depot at Ladd in 1942 resulted in the addition of nearly 1,000 officers and men to the garrison. Depot activities, combined with those of the Air Transport Command, resulted in the extension of the existing runway, construction of a second and the building of additional hangars and housing. The Air Transport Command took over Ladd Field in October 1943. By September 1945, when the Russian mission left Alaska, 7,930 aircraft had been delivered to the Soviets by way of the Alsib movement. On November 1, 1945, the Air Transport Command transferred Ladd Field back to the 11th Air Force. Fifteen years later, on January 1, 1961, the Department of the Air Force transferred Ladd Air Force Base to the Department of the Army. The Department renamed the now historic field Fort Jonathan M. Wainwright, for the heroic World War II commander of American forces of Corregidor in Manila Bay in the Philippines.

Because of the extremely cold winters in Alaska's interior, all buildings for the original garrison were permanent in nature. Officers' quarters are arranged in a horseshoe, centered on an open lawn. The huge, metal-clad Hangar No. 1 was the first to be completed at Ladd, in 1941. East, west and south of the hangar are extensive concrete or earthen aircraft parking areas where, later, airplanes destined for the Soviet Union received final preparation. Beyond them is the first of two parallel runways at Ladd Field. In 1941, this reinforced-concrete runway was 5,000 feet in length. By 1943, gravel extensions had been laid out at each end, giving a total length of over 9,000 feet. Two Kodiak, T-type hangars were erected at the end of the parking area east of Hangar No. 1. In 1943 three Birchwood-type hangars were authorized for the south side of the enlarged field. These nearly identical buildings are extant, and in good condition. For a complete copy of the National Historic Landmark registration form for Ladd Field, click here.

Ladd Field, now known as Fort Wainwright , is a National Historic Landmark, and is located on State Rte. 3, bordering the Tanana River, east of Fairbanks, Alaska. Individual tours of the base can be obtained (no large group tours, however); in this time of heightened security no foreign nationals may accompany these tours. Please call Fort Wainwright's Public Affairs at 907-353-6682 for more information. You can also download (in pdf) the Ladd Field National Historic Landmark nomination.

Tuskegee Airmen National Historic Site

The Tuskegee Institute, established by Booker T. Washington in the 1880s in Tuskegee, Alabama, to educate African Americans, was the center for African American aviation during World War II and home to the Tuskegee Airmen. The few African Americans who learned to fly in the early 1900s were self-taught or trained oversees. In 1939, the U.S government passed the Civilian Pilot Training (CPT) Act, authorizing selected schools, including the Tuskegee Institute, to provide basic training for black pilots in case of a national emergency. The following year, Tuskegee was authorized to teach advanced CPT courses. With the outbreak of World War II the U.S. military chose the Tuskegee Institute to train pilots for the war effort because Tuskegee had the facilities, engineering and technical instructors and a climate well suited for year round flying.

Moton Field at the Tuskegee Institute was built between 1940 and 1942, and named for Robert Russa Moton, second president of Tuskegee Institute. The facility included two aircraft hangars, a control tower, locker building, clubhouse, wooden offices and storage buildings, brick storage buildings, and a vehicle maintenance area. Staff from Maxwell Field, Montgomery, Alabama, provided assistance in selecting and mapping the site. Architect Edward C. Miller and engineer G. L. Washington designed many of the buildings. Archie A. Alexander, an engineer and contractor, oversaw construction of the flight school facilities. Tuskegee Institute laborers and skilled workers helped finish the field so that flight training could start on time. The Army Air Corps assigned officers to oversee the training at Tuskegee's Moton Field. They furnished cadets with textbooks, flying clothes, parachutes and mechanic suits. Tuskegee Institute, the civilian contractor, provided facilities for the aircraft and personnel, including quarters and a mess for the cadets, hangars and maintenance shops, and offices for Air Corps personnel, flight instructors, ground school instructors and mechanics. Tuskegee Institute was one of the very few American institutions to own, develop, and control facilities for military flight instruction.

On July 19, 1941, the first class, which included Capt. Benjamin O. Davis, Jr. began rigorous training in subjects such as meteorology, navigation and instruments. Successful cadets then transferred to the segregated Tuskegee Army Air Field, built five miles away by the Army Air Corps, to complete their pilot training. More than 1,000 pilots were trained at the two fields to form one of the most highly respected U.S. fighter groups of World War II. Under the command of Col. Benjamin O. Davis, Jr. the 332nd fighter group--comprised of the 99th, 100th, 301st and 302nd fighter squadrons--flew successful missions over Sicily, the Mediterranean and North Africa. The fight group was known to bomber crews as the "Red-Tail Angels" after the markings on their aircraft, or the "Black" or "Lonely Eagles," as well as the "Black Bird Men" by the German air force. The Tuskegee Airmen completed 15,000 sorties, in approximately 1,500 missions, destroyed more than 260 enemy aircraft, sank one enemy destroyer and demolished numerous enemy installations. The Tuskegee Airmen were awarded many high honors, including Distinguished Flying Crosses, Legions of Merit, Silver Stars, Purple Hearts, the Croix de Guerre and the Red Star of Yugoslavia. In 1945, the 332nd Fighter Group was awarded a Distinguished Unit Citation for "outstanding performance and extraordinary heroism." Having fought America's enemies abroad, the Tuskegee Airmen returned home to join the struggle for equality. The 477th Bombardment Group staged a peaceful protest for equal rights at Freeman Field, Indiana, in April 1945. The Tuskegee Airmen and the 10,000 African Americans that served as

flight instructors, officers, bombardiers, navigators, radio technicians, mechanics, air traffic controllers, parachute riggers, electrical and communications specialists, laboratory assistants, cooks, musicians, and supply, fire fighting and transportation personnel, paved the way for full racial integration of the United States military. A portion of Moton Field was deeded to the city of Tuskegee for use as a municipal airport which is still in use today, while the remaining portions of the field and many of the associated buildings are currently being restored by the National Park Service. Nearby Tuskegee Army Air Field was closed after the war and is now used by a private hunting club.

The Tuskegee Airmen National Historic Site, administered by the National Park Service, is located at Moton Field in Tuskegee, Alabama. It is open 9:00am to 4:30pm, central time, excluding major holidays. Please call 334-727-6390 or visit the park's website for further information. For further information, visit the Legends of Tuskegee web exhibit produced by the National Park Service's Museum Management Program. The National Park Service also adminsters the nearby Tuskegee Institute National Historic Site, which contains the original buildings of this institute and now forms the historic campus of Tuskegee University.

United States Naval Base, Pearl Harbor

The United States Naval Base at Pearl Harbor in Oahu, Hawaii, is significant historically as a strategic port that helped the United States become a formidable world power. Construction of the base at Pearl Harbor commenced in 1908 and officially opened when the USS *California* sailed into harbor in 1911. By 1916 Pearl Harbor was the headquarters of a naval district and subsequently became the command center for the Pacific Fleet. The naval base contains approximately 300 buildings of historic significance, but among the most notable are Drydock #1, the *Arizona* and *Utah* Memorials, and moorings F6, 7 and 8.

The Pearl Harbor Naval Base is the site of the December 7, 1941 surprise aerial attack by the Japanese upon American Pacific forces, that thrust the United States into World War II. This devastating attack took more than 2,000 lives. The battleship USS *Arizona* was sunk and 1,177 American crewmen were entombed within its confines. Altogether 18 ships were sunk or disabled. Of the eight battleships at Pearl Harbor the *Arizona*, *California* and *West Virginia* were sunk; the *Nevada* was grounded; the *Oklahoma* capcized, and the others were damaged. The remains of the USS *Arizona* today serve as a memorial to the men who lost their lives that fateful day. The shrine which rests atop the ship's superstructure can be accessed by motor launch. Pearl Harbor has continued its role as a United States naval base since 1911.

The United States Naval Base, Pearl Harbor, a National Historic Landmark, is located along Hwy. 73 three miles south of Pearl City on the island of Oahu, Hawaii. Due to heightened security, access to the base is restricted with exception to the USS Arizona Memorial*. A virtual tour is available online.*

USS Arizona *Memorial*

The battle-scarred and submerged remains of the battleship USS *Arizona* located just off the

island of Oahu, Hawaii, are the focal point of a shrine erected by the United States to honor and commemorate all American servicemen killed in the Japanese air attack on the U.S. Naval Base at Pearl Harbor on December 7, 1941. The USS *Arizona*, laid down at the New York Navy Yard and commissioned on October 17, 1916, as a part of the Atlantic Fleet, was sent to join the Pacific Fleet in 1921 where it remained until the end of its career. At 7:55am on December 7, 1941, the Japanese unleashed the first wave of an air attack on the United States. Under the command of Commander Mitsuo Fuchido, the Japanese hit Pearl Harbor, Hickam Air Force Base , Ewa, Wheeler Field and Kaneohe Air Base, catching the Army, Navy and Marine forces off guard.

The second wave, under the command of Lieutenant Commander Shigekazu Shimazaki, struck Bellows Airfield, Kanehoe, Hickam and Pearl Harbor approximately one hour later at 8:50am. Japanese torpedoes, bombs and projectiles slammed into ships, aircraft and men, wreaking a terrible toll. The USS *Arizona* suffered from several hits and around 8:10am the battleship was dealt its deathblow, a 1,760-pound armor-piercing bomb that slammed through its deck and ignited its forward ammunition magazine. The *Arizona* reportedly received eight more bomb hits as it sank. When the attack was over, American losses totaled at least eight battleships, three light cruisers, three destroyers and four auxiliary craft either sunk, capsized or damaged, 188 aircraft lost and 159 damaged, and 2,403 killed or missing and 1,178 wounded. Approximately half of the dead came from the USS *Arizona*, with fewer than 200 of the 1,117 aboard surviving. As a result of this attack, the United States entered World War II and defeated Japan in 1945 following the dropping of two nuclear weapons at Hiroshima and Nagasaki. In 1962 a memorial was constructed and by 1980 visitation had increased so much that legislation was passed that authorized the National Park Service to operate the new USS *Arizona* Memorial.

The USS Arizona *Memorial, a National Historic Landmark located at Pearl Harbor Naval Base and administered by the National Park Service, is located off State Hwy. 99 (Kamehameha Hwy.) about a 45-minute drive west of Waikiki, Hawaii. The memorial is open daily 7:30am to 5:00pm. Please call 808-422-0561, or visit the park's website for further information.*

The USS Arizona Memorial is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Opana Radar Station

The Opana Radar Site on the Hawaiian Island of Oahu marks the first operational use of radar by the United States in wartime. In December 1939, the U.S. military, experimenting with the advantages of radar, established an Aircraft Warning Service (AWS) that used radar for the defense of American territory. Under the command of Col. Wilfred H. Tetley the AWS established six mobile radar detector sets at Kawaiola, Wainae, Kaawa, Kokohead, Schofield Barracks and Fort Shafter. On Thanksgiving Day in 1941, the same day the Japanese fleet sailed for its Pearl Harbor mission, the radar set from Schofield Barracks was moved to the Opana Radar Site, a location 532 feet above sea level that provided an unobstructed view of the Pacific Ocean. The unit was comprised of four trucks carrying the transmitter, modulator, water cooler, receiver, oscilloscope, operator, generator and antenna.

On December 7, 1941, the Opana Radar Site was manned by Private Joseph L. Lockard and Private George Elliot, who detected approaching aircraft at 7:02am while practicing with the radar equipment. The men reported their findings to the temporary information center at Fort Shafter. The information center staff had gone to breakfast and Lt. Kermit Tyler received the report. Tyler reasoned that the activity was a flight of Army B-17 bombers scheduled to arrive at that morning and advised the radar crew not to worry. Elliot and Lockard continued plotting the incoming planes until 7:40 when contact was lost. Shortly before 8:00am the two men headed to Kawailoa for breakfast and only learned about the attack when they arrived. Elliot and Lockard rushed back to Opana and operated the radar until the attack ended. The missed opportunity to correctly identify the incoming Japanese air attack is one of the great "what might have beens" of military history. Today, a modern Navy telecommunications station occupies the top of the Opana Hill adjacent to the Opana Radar Site.

The Opana Radar Site, a National Historic Landmark, is located off the Kamehameha Hwy. on the Hawaiian Island of Oahu. It is not accessible to the public.

Hickam Field

Hickam Field, adjacent to Pearl Harbor U.S. Naval Base, was established in 1935 as Hawaii's principal army airfield and bomber base. On December 7, 1941, 51 airplanes were on the ground at Hickam, the headquarters of the Hawaii Air Force, and a flight of 12 B-17s was expected to arrive that morning. The first wave of the Japanese attack on Pearl Harbor was primarily targeting battleships and carriers, but the airfields were also to be hit to prevent a counterattack against the Japanese bombers and torpedo planes.

At Hickam Field, Japanese Zero fighters and Val dive-bombers strafed and bombed the fight line and hangars, concentrating on the B-17 bombers. The 12 U.S. B-17s arrived unarmed and low on fuel during the attack. Most succeeded in landing at Hickam where they were attacked on the ground. The second wave of the Japanese attack struck Hickam at 8:40am and by 9:45 the attack was over. Nearly half of the airplanes at Hickam Field had been destroyed or severely damaged. The hangars, the Hawaiian Air Depot, several base facilities--the fire station, the chapel and the guardhouse--had been hit.

The big barracks had been repeatedly strafed and bombed and a portion of the building was on fire. Thirty-five men were killed when a bomb hit the mess hall during breakfast. Hickam's casualties totaled 121 men killed, 274 wounded and 37 missing. Despite the damage inflicted by the Japanese, they ignored the vital repair facilities and gasoline storage tanks at Hickam, Pearl Harbor and elsewhere on Oahu. Hickam Field emerged from the attack stronger than before and played an important role in World War II and since. Today, Hickam is the headquarters of the Pacific Air Force. For a complete copy of the National Historic Landmark registration form for Hickam Field, click here.

Hickam Field, a National Historic Landmark, is a part of Hickam Air Force Base. A virtual tour is available on the website. Guided tours are offered on Wednesdays (mission and security conditions allowing) for groups of 10 or more people when scheduled in advance. Call 808-449-2490 for further information. You can also download (in pdf) the Hickam Field National Historic

Landmark nomination.

Wheeler Field

Established in 1922 as an Army airfield, Wheeler Field was the principal Army Air Corps field in Hawaii during the 1920s and early 1930s. Several "firsts" in flight history occurred at Wheeler--a 1927 nonstop flight from Oakland, California, to Wheeler and in 1935 Amelia Earhart took off from Wheeler on the first solo flight between Hawaii and California. By December 1941, Wheeler contained the headquarters of the 14th Pursuit Wing and the 15th and 18th Pursuit Groups and approximately 90 aircraft.

During the first wave of the Japanese attack on Pearl Harbor on December 7, 1941, 25 dive-bombers dropped approximately 35 bombs on the hangars at Wheeler Field. The Japanese airplanes returned to strafe the fight line, turning it into a river of fire. Four fighters from the 46th Pursuit Squadron were able to take to the air and attack the Japanese over southeastern Oahu. The second Japanese wave arrived and strafed the field, but caused little more damage before the attack ended at 9:45am. Eighty-three aircraft had been destroyed, 38 enlisted men were killed and 59 men were wounded. Wheeler Field quickly recovered and played an important role in World War II. The Seventh Air Service Command was established at Wheeler in 1944 to provide service and support for the B-29 bombers in the Marianas which began massive raids against Japan that fall. Placed in care-taking status in 1949, Wheeler Field was reactivated during the Korean War and houses Army helicopters today.

Wheeler Field, a National Historic Landmark, is adjacent to Schofield Barracks in central Oahu. It is located on the Wheeler Army Airfield, an active base and due to heightened security concerns, it is not accessible to the public.

World War II Facilities at Midway

The World War II Facilities at Midway are recognized for the historic role they played in a crucial World War II battle in the Pacific Theater of operations. Midway is a coral atoll six miles in diameter with three islands--Sand, Eastern and Spit. The atoll's name is said to come from its location, midway between San Francisco and Tokyo. Geographically, it is a part of the Hawaiian chain of islands, located 1,140 nautical miles from Oahu; politically, it has never been a part of the state of Hawaii. The United States took formal possession of the unoccupied islands in 1867. The U.S. Navy assumed jurisdiction over Midway in 1903, and remained custodian of the atoll until 1996. The Commercial Pacific Cable Company established a communications station on Sand Island. The cable establishment gained company in 1935 when Pan American Airways' Clippers arrived at Midway and established weekly commercial flights across the Pacific. Pan Am built a small hotel and flight facilities on Sand Island. Because of this commercial enterprise, the U.S. Congress authorized the U.S. Army Corps of Engineers to dredge an entrance channel between the islands, a harbor and seaplane runways in the lagoon as a civil works project in 1938. Later, the U.S. Navy contributed funds and the dredging increased in scope in preparation for a naval air station. In 1939 the Navy established a partnership with several construction firms, which formed Contractors Pacific Naval Air Base for the construction of facilities for two

patrol airplane squadrons on Sand Island. The civilian employees also began construction of land runways on Eastern Island. A U.S. Marine detachment assigned to Midway arrived in September 1940. They belonged to the 3rd Defense Battalion and promptly began constructing defenses. In September 1941, the 6th Marine Defense Battalion replaced the 3rd Defense Battalion.

The first Japanese attack on Midway occurred on December 7, 1941, when destroyers successfully shelled naval installations. Then, flush with victory after victory in the Pacific and southeast Asia, Japan prepared in the spring of 1942 to capture the Midway Islands, establish a toehold in the Aleutians, and draw out what was left of the U.S. Pacific Fleet and decisively defeat it. Centered on four aircraft carriers, the Japanese fleet of 162 warships and auxiliaries approached Midway in the first days of June. Due to the breaking of most of Japan's JN 25 Naval codes, Admiral Chester W. Nimitz, Commander in Chief of the Pacific Fleet, learned that Japan was planning a massive raid on Midway in the spring of 1942. Admiral Nimitz ordered his forces, centered on three carriers, to sea to intercept the Japanese. Meanwhile, the Marines, Navy and Army personnel on Midway worked furiously to strengthen their defenses. On June 3, Midway's aircraft spotted a part of the Japanese invasion fleet approaching. Before dawn, on June 4, the Japanese launched 108 aircraft, which attacked both Sand and Eastern islands, inflicting considerable damage. U.S. airplanes took to the air from Midway to counter the attack but the Marine fighters suffered greatly. Earlier, strike aircraft consisting of Army Air Corps bombers, Marine scout bombers and Navy torpedo planes departed Midway to attack the Japanese carriers. These Midway-based attacks were unsuccessful but added to the Japanese confusion and aided in the outcome of the battle. The Japanese, unaware that the American carrier aircraft were fast approaching, decided to launch a second attack upon Midway. The American carrier dive bombers struck while the Japanese were still rearming and the strike force aircraft were still on the carrier’s decks. At the end of the Battle of Midway, all four Japanese carriers, which were involved in the attack on Pearl Harbor, had been sunk, while the United States lost the carrier *Yorktown.* The Japanese lost 256 of their finest aircraft, and more than 200 of their most experienced pilots and several thousand sailors perished. The Japanese Navy never fully recovered and its expansion into the Pacific had been stopped. American naval power in the Pacific was restored. The American victory at Midway was the turning point of the Pacific campaign of World War II.

In 1942, the Seventh Air Force sent the 73rd Fighter Squadron to Midway to relieve the badly battered Marine fighter squadron, VMF 221. After the Battle of Midway, the Seventh Air Force bombers staged through Midway on raids to Japanese-held Wake Island. By the middle of 1943, Midway's population had reached 5,000 and the atoll had a critical submarine base and a new air base on Sand Island. In 1945, air operations on Eastern Island were closed, except as an emergency landing field. Pan Am, which had returned to Midway after the war, closed its operations there in 1947, the same year the Civil Aeronautics Authority (CAA) took over Midway's airport operations remaining on Sand Island until 1950. In 1957, a major $40 million building program got underway on Sand Island when Midway became home of the Pacific Airborne Early Warning portion of the DEW line, a network of radar picket ships to give a distant early warning of aircraft or missile attack on North America. Many of the quarters built at that time have since been removed. On October 31, 1996, through a presidential executive order, the jurisdiction and control of the atoll was transferred to the Fish and Wildlife Service of the U.S. Department of the Interior as part of the National Wildlife Refuge system. The World War

II Facilities at Midway consist of ammunition magazines, a concrete pillbox, gun emplacements for 3-inch batteries, which were manned by U.S. Marines, and two emplacements for the 3-inch naval battery, all on Sand Island. Other properties associated with the defense of Midway, but not listed in the National Register, include seaplane ramps/hangar on Sand Island and the Eastern Island runways.

The World War II Facilities at Midway,a National Historic Landmark, are located on Sand and Eastern Islands of the Midway Atoll. Midway Atoll is managed as a national wildlife refuge and open to the public. Midway's rich historical heritage was recently commemorated by the designation of a National Memorial to those who fought in the Battle of Midway. For more information, visit the National Wildlife Refuge's website.

The World War II Facilities at Midway are the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Radar Station B-71

The Klamath River Radar Station B-71 in is a rare survivor of a World War II early-warning radar station, the first step toward the more sophisticated and pioneering early-warning radar defense network. Rather than using camouflage materials, the buildings of Radar Station B-71 were constructed to resemble farm buildings to disguise their true purpose. The station consists of three buildings: a power building disguised as a farmhouse, an operations building disguised as a barn and a functional wood frame two-stall privy or outhouse, now a partially collapsed ruin. The two major buildings were constructed for the Army by a private contractor specifically for the early warning aircraft station, and consist of block walls roughly two feet thick covered with wood-framed gable roofs with wood shingle finish.

As a result of the attack on Pearl Harbor and in the Aleutian Islands, the necessity of guarding American coastlands became more urgent on the Pacific Coast than on the Atlantic. The threat was further demonstrated when a Japanese submarine shelled an oil refinery north of Santa Barbara, California, on February 23, 1942. Another Japanese submarine shelled Esteven Point in British Columbia, Canada, on June 20, 1942, and again at Fort Stevens, Washington, on July 21, 1942. On September 9, 1942, a Japanese submarine-launched aircraft dropped incendiary bombs on Oregon forests roughly 40 miles north of the Klamath River. The radar station south of the Klamath River, in what is now Redwood National Park, was built in late 1942 and early 1943 as the northernmost California station in a network of 72 proposed stations, 65 of which were actually built, stretching from the Canadian border into Mexico. The Klamath station was designated by memorandum dated November 6, 1942, from the Office of the Commanding General, IV Fighter Command, as Station B-71, named "Trinidad." It was also referred to as the "Klamath River" station.

The station was manned by members of the Army Air Corps quartered in barracks near the town of Klamath. One day's operation of the station required a crew of about 35 men to cover the 24 hours in shifts. The station reported by direct telephone to an Aircraft Warning Service Filter Office in Berkeley, California. As the threat of Japanese attack waned towards the end of World

War II, the coastal early radar stations began to be phased out. But with the need for early-warning radar decreasing, the need for air-sea rescue radar increased, and effective July 1, 1944, the Klamath station was converted to emergency rescue service, with the SCR-271 radar replaced with the RC-150 IFF equipment. Station B-71 was thus one of only 22 radar stations on the Pacific Coast, which remained operational until the end of World War II. Station B-71 was abandoned and reverted to private ownership after the war, until the National Park Service acquired it with the creation of Redwood National Park.

Located in Redwood National Park in Northern California, Radar Station B-71 is located on Coastal Dr., just south of the mouth of Klamath River. From the south, take Newton B. Drury Scenic Pkwy. to Coastal Dr. (trailers and motor homes not permitted). A trail leads to the station from the road, although the buildings are not open. The park headquarters is located at Second and K sts. in Crescent City. Visit the park's website or call 707-464-6101 ext. 5064 for further information.

Dutch Harbor Naval Operating Base and Fort Mears, U.S. Army

Dutch Harbor Naval Operating Base and Fort Mears are located on Amaknak Island in Unalaska Bay, in the Aleutian Islands Chain, 800 miles west of Anchorage, Alaska. In early June 1942, Japanese aircraft attacked Unalaska in a fierce two-day bombardment that resulted in 43 American deaths. At the time of the Japanese attack on Pearl Harbor these two bases were the only U.S. defenses in the Aleutians, and they continued as important coastal defenses throughout the war.

In 1912, the U.S. Navy installed a radio station at Dutch Harbor. In the Washington Naval Treaty of 1912, the United States agreed not to fortify the Aleutians. Even when Japan withdrew from the treaty in 1934, the United States took no steps to fortify the Aleutians. Not until 1938 did a Navy board urge the construction of naval, air and submarine bases at Dutch Harbor and Kodiak and an air base at Sitka. At Dutch Harbor, construction began in July 1940 on both army and naval installations, the army mission being defense of the naval air station. When the first army troops arrived at Dutch Harbor in May 1941, they found a new Marine Barracks and Dutch Harbor's "landmark," a large brick residence at the naval radio station. Construction proceeded on both bases and soon the tiny island was crowded with new buildings. The naval air station was commissioned on September 1, 1941. The army base was formally named Fort Mears on September 10, in honor of Col. Frederick Mears, a member of the original Alaskan Engineering Commission, which built the Alaska Railroad, and chief engineer of the Panama Railroad. When Japan attacked Pearl Harbor, the naval air station at Dutch Harbor and the adjacent army post, Fort Mears, were the only defenses the United States possessed in the entire Aleutian Chain. With the entrance of the United States into World War II, the civilian contractor gave way to the Navy, which continued construction. Naval facilities expanded, new missions were added, and the Dutch Harbor Naval Operating Base was commissioned January 1, 1943 to include the air station, submarine base, ship repair facility, and facilities for provisioning the fleet. Eventually 5,680 Navy and 10,000 Army personnel were stationed at the location.

In May 1942, Imperial Guard Headquarters in Tokyo ordered an attack on the Midway Islands, with the dual mission to occupy those islands and destroy the remnants of the U.S. Pacific Fleet. An attack on the Aleutians was planned to divert American attention from Midway. Having broken Japanese codes, the United States was alert to the forthcoming attacks and Fort Mears was notified that the Japanese would attack sometime between June 1 and June 10. Steaming toward Unalaska at that time was Rear Admiral Kakuji Kakuta's Second Carrier Striking Force, consisting of aircraft carriers *Ryujo* and *Junyo* (which had 40 fighters and 42 bombers), heavy cruisers *Takao* and *Maya*, and three destroyers. On June 3, 14 bombs fell on Fort Mears, destroying five buildings, killing 25 soldiers and wounding 25 more. A second strike caused no damage, but a third damaged the radio station and killed one soldier and one sailor. One Japanese Zero airplane did not return to the *Ryujo*, making a forced landing on Akutan, which provided the Americans with their first opportunity to study this excellent airplane. On June 4, a force of nine Japanese fighters, 11 dive-bombers and six level bombers struck Dutch Harbor. Among other targets, bombs destroyed four new steel fuel tanks and 22,000 barrels of oil--a month's supply for Dutch Harbor. During the two days of air attacks 43 Americans lost their lives. Eight American P-40s from Umnak shot down four Japanese airplanes over the west end of Unalaska, loosing 2 of their own in the process. American air losses during the two-day battle amounted to five army aircraft and six naval Catalinas, while the Japanese reported a loss of 11 airplanes. The Japanese carriers withdrew to the west, to a point off Kiska to screen their forces who were landing there.

Amaknak Island is about five and a half miles long and varies in width from a few hundred yards to about one mile. In the north Mount Ballyhoo and Ulakta Head rise dramatically from the sea; Ulakta Head still contains World War II coastal defenses and some coast artillery quarters. To the south of Mount Ballyhoo lies the site of former Dutch Harbor Naval Operating Base on relatively low but rolling terrain. Most of the World War II era constructions remain, although many are fast deteriorating and some are already ruins. Principle features include: the short (4,385-foot) Navy runway which serves the commercial airport today, airplane revetments (barricade against explosives) along the north side of the runway, magazines, aerology-operations building which later became an airline terminal, double hangar, bombproof power plant, two wharves, brick apartment house, a large number of occupied cottages (former naval quarters), torpedo storehouse and two hillside tunnels. South of the naval base is the original site of Fort Mears which was taken over by the Navy in 1944. Several of the Army barracks remain, but are in poor condition. Several concrete pillboxes and, on the hillsides, personnel trenches complete the landscape, although a former submarine base dock exists in "downtown" Amaknak, and Hill 400, at the south end of Amaknak, still contains reinforced defense structures and the hilltop holds gun emplacements and the ruins of a few quonset huts and frame buildings.

Dutch Harbor Naval Operating Base and Fort Mears, U.S. Army, recognized as a National Historic Landmark, lies on Amaknak Island in the Aleutians Island Chain, 800 miles west of Anchorage, the nearest large urban center. It can be reached by air through commercial and charter flights from Anchorage. The Aleutian World War II National Historic Area, also located on Amaknak Island, interprets the history of the Aleut or Unangan people and the Aleutian Islands in the defense of the United States in World War II. It is open year round, although the best time to visit is May through October. Visit the park's website for more information or call 907-581-1276.

Southwestern Proving Ground Airport Historic District

The Southwestern Proving Ground (SWPG) Airport Historic District in Hope, Arkansas, was utilized during World War II as an airfield for bombers and a testing ground for artillery shells and air bombs. The proving ground was in operation from 1941 to 1945 and was a major employer of Hempstead, Howard, Nevada, Clark and Lafayette counties. The construction of the Southwestern Proving Ground was part of the U.S. Government's National Defense Program which provided factories for the manufacture of munitions, airplanes and tanks in preparation for an eventual war. The news of construction on a proving ground in Hope became official in June of 1941. The Real Estate Department of the War Department was in charge of acquiring land by filing condemnation proceedings against the tract and then taking possession of those sections they required to begin immediate work. After the initial evacuation order the War Department decided they needed more room for an airport so they added more acres. In the end 404 families were relocated by a deadline of July 24th. Callahan Construction Company was awarded the job of erecting the proving ground by the War Department and the hiring of 4,000 construction workers began July 15th. Senator Spencer and the project director, W.K. Mellyor, agreed upon a guarantee of preferential treatment of local citizens in considerations for jobs.

When the airport was completed it had the third longest runway in the United States. Opening day festivities were postponed because of the bombing of Pearl Harbor on December 7th, 1941. Testing began in January 1942 and Hempstead County residents were finally allowed within the gates of the proving ground in April. Troops explored the capabilities of LaBolenge chronographs and solenoid chronographs (two different instruments that record time intervals) for accuracy and reliability. 105-mm shells that had fired prematurely in battle were determined by research at SWPG to have faulty rotating bands, thus saving the lives of American troops. B-25s were sent from the airport in Hope to the Gulf of Mexico to observe the testing of bombs for tumbling and proper ballistics after being fired. After World War II the city of Hope received the Southwestern Proving Ground Airport, which became Hope Municipal Airport in 1947.

The Southwestern Proving Ground Airport Historic District is composed of six buildings and five structures, which include the hangar, night landing plant, heating plant, storage building, garage, bomb assembly building, high explosives magazine and concrete runways and hangar apron. The magazine and bomb assembly building are located on adjacent land under private ownership. The remaining five buildings are located on 750 acres owned by Hope Municipal Airport. The hangar is located to the west of U.S. Highway 278 and is surrounded by a concrete apron on all sides. The building is constructed of brick in a restrained Art Deco style on a continuous concrete foundation with a barrel vaulted roof and four corner towers. The interior of the hangar covers a total of 25,000 square feet. The night landing plant is adjacent to the hangar and is about 40 feet from its southeastern corner. The plant is a very simple one-story rectangular brick edifice with a flat roof. The steam heating plant is located east of the hangar, across Airport Road. During the operation of SWPG this building generated steam heat to warm the buildings in the entire complex. The plant is currently empty but the city hopes to install a small museum dedicated to the history of the Proving Ground in the building at a future date. The storage building to the south of the steam heating plant is a rectangular vernacular building with a gable roof. The bomb assembly building is southwest of the hangar and is located on private property within a chain link fence. Bombs were assembled in this building and hauled by truck to Lake

Charles, Louisiana, for testing. The high explosives building is located on private property and is south of the bomb assembly building, outside of the fenced in area.

Southwestern Proving Ground Airport Historic District is located along Airport Rd. at the Hope Municipal Airport in Hope, Arkansas. Only the areas west of U.S. Hwy. 278 are accessible to the public.

Fairmont Army Airfield

Fairmont Army Airfield is one of 12 airfields in the state of Nebraska and numerous facilities throughout the Midwest constructed prior to and during World War II as part of an extensive construction program undertaken by the U.S. military. September 16, 1942, marked the beginning of construction at Fairmont Army Airfield, and it was promptly completed by the latter part of November of that same year. Originally opened as a satellite base for the Topeka, Kansas, Army Airfield, it was converted to an individual facility in 1943. The airfield was utilized as a heavy bombardment training facility during WWII as bombardment groups were trained in the Consolidated Vultee B-24 Liberator and eventually in the more technologically advanced B-29.

Fairmont was an "advanced training" facility where men would arrive to be tested in the aircraft that they were assigned to fly, in addition to practicing formation flight and long distance navigation, two fundamental aspects of strategic bombing tactics. Overall, seven bombardment groups were trained at Fairmont throughout the course of the war: the 485th, 451st, 504th, 15th, 98th, 467th and 489th. Lieutenant Colonel Paul Tibbits, commander of the *Enola Gay*, selected certain men from the 504th group to form part of the 509th Composite Group, the team that would commandeer the atomic bomb missions over Japan in 1945. However, it is not certain whether any of the pilots selected at Fairmont indeed flew the atomic bomb mission.

During the war, the Fairmont Army Airfield encompassed approximately 2,000 acres of converted farm land and consisted of 275 support buildings and structures, with the capacity to accommodate 3,700 military personnel. Presently there are three mostly extant runways which extend nearly 7,000 feet in length, alongside their related taxiways and aprons. There are six surviving buildings which include a small oil storage building, a small pump house and four large bomber aircraft hangars. There is also a water tower surrounded by a 20-acre area containing numerous ruins and foundations. Fairmont Army Airfield still retains several WWII era structures and sites whereas the other remaining airfields in the state have lost the majority of their primary structures and buildings associated with Nebraska's WWII legacy.

The Fairmont Army Airfield currently operates as the Fairmont State Airfield, in Fairmont, Nebraska. The airport is open to the public during regular business hours. For more information please contact the General Manager at 402-268-4521.

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Lewiston Satellite Airfield Historic District

The Lewistown Satellite Airfield was constructed in Lewiston, Montana, during World War II as one of four training facilities for B-17 Flying Fortress crew members and included a storage site for the top secret Norden Bombsight. The Norden Bombsight, a synchronous stabilized bomb-aiming device, was considered fundamental in America's precision bombing doctrine. The extant bombsight storage shelter which housed the bombsight is one of a few known buildings of this type remaining in the United States. With construction complete by 1942, Lewistown was built as a satellite field for Great Falls Air Base. Squadrons were trained in the navigation of the B-17 in addition to receiving gunnery and bombing practice. Once their training was complete, the men were sent to the European front. The airfield was in operation during a 12-month period between 1942 and 1943 and thereafter deactivated.

The historic district retains all original buildings within its boundaries, with the exception of a

guard house previously located southeast of the bombsight storage building. The Norden Bombsight was stored in a small one-story building constructed of poured concrete. Divided into two vaults, the Norden device was only accessible through bank vault doors. Other extant buildings include a hangar, the operations building, an armament building and an underground storage vault. The field was declared surplus in 1944 and has served the local community as a municipal airport ever since.

The Lewistown Satellite Airfield Historic District, located on U.S. 87 approximately one mile southwest of Lewistown, Montana, currently operates as the Lewistown/Fergus Municipal Airport. The airport is open to the public during regular business hours. Contact the General Manager at 406-538-3264 for further information.

Attu Battlefield and U.S. Army and Navy Airfields on Attu

Attu Island is the site of the only World War II land battle in North America. The island was subsequently used as a launching site for American bombing missions to Japan's home islands. Many American combat aircraft were lost during the Aleutian Campaign, both to enemy action and to fierce weather conditions. Today, evidence of the desperate battle is found on its eastern end: thousands of shell and bomb craters in the tundra, Japanese trenches, foxholes and gun encampments, American ammunition magazines and dumps, and spent cartridges, shrapnel and shells are located at the scenes of heavy fighting.

Attu is at the western end of the Aleutian Chain, 1,500 air miles southwest of Anchorage, 500 miles east of the Russian mainland, and 750 miles east of the Kurile Islands. Located between the cold Bering Sea and the warm Japanese current of the North Pacific, Attu's volcanic mountains and tundra valleys are subjected to year-round storms and dense fog that make it one of the most forbidding regions in the world. The island has no trees and the lower levels are covered with spongy tundra and a variety of plants. The principle water features of eastern Attu are Holtz Bay, Chichagof Harbor and Massacre Bay. The Aleut village of Attu stood at the head of Chichagof Harbor. It was destroyed during the battle and no trace remains. Archeological sites of earlier Aleut settlements are also found there. The Japanese forces landed at Holtz Bay in June 1942, constructed defense positions there, and established headquarters eventually at Attu village.

The Japanese occupation of Attu, coordinated with the June 1942 attack on Midway, marked the peak of Japan's military expansion in the Pacific. The occupation of this remote part of the North American continent created great alarm among Americans, however briefly, that it was the beginning of an invasion of the United States through Alaska. The American recapture of the island was a morale boost for the nation. In May 1943, U.S. forces landed on the north and south coasts: at Red Beach and Austin Cove on the north, and Massacre Bay on the south, bitter fighting occurring until the two forces joined in Jarmin Pass. The Americans next captured the rugged hill country known as Fishhook Ridge, then began a drive through Clevesy Pass toward Chicagof Harbor. The battle ended when the Japanese made a last fanatical charge on the night of May 29 against the pass, which ended in their annihilation--only 29 of 1,000 survived. The next morning, May 30, Japan announced the loss of Attu. Of the American strength of 15,000, 550 were dead and 1,500 wounded, and another 1,200 Americans were casualties to Attu's

climate. At the Coast Guard station on Massacre Bay is a memorial dedicated to the American naval, air, and ground forces that recaptured Attu.

American army engineers and naval Seabees quickly constructed airfields, roads and camps over the eastern end of the island, of which vivid evidence remains today on the slow-to-heal tundra. Besides the runways and ammunition magazines, a remarkable feature that still exists is a 3,133-foot-long, bombproof storage tunnel cut through a ridge near Clevesy Pass. Near Clevesy Pass, on Engineer Hill (the last goal of the Japanese) are trenches, foxholes, tent pegs, barbed wire, coal pits and other relics of the war. After the reconquest, the 11th Air Force made its first attack on Japan's home islands with eight B-25 bombers on July 10, 1943. Other attacks followed. The Navy constructed both land runways and a seaplane base for patrol bombers and flying boats west of Massacre Bay and at adjacent Casco Cove. For the duration of the war, naval aircraft made their lonely patrols over the North Pacific. As at Alexai Field, the Navy's two land runaways were first covered with steel mats. By 1944, however, asphalt had been laid and the Navy made the runways available to Army planes as well as its own, and the 11th Air Force established maintenance facilities there. For a complete copy of the National Historic Landmark registration form for the Attu Battlefield and U.S. Army and Navy Airfields on Attu, click here.

The Attu Battlefield and U.S. Army and Navy Airfields on Attu, a designated National Historic Landmark. Because of its isolated location, the harsh weather, and a lack of transportation, few visitors come to Attu's battlefield. The entire island is part of the Aleutian Islands National Wildlife Refuge , which is administered by the U.S. Fish and Wildlife Service, U.S. Department of the Interior. Military clearance is required to visit Attu Island. You can also download (in pdf) the Attu Battlefield and U.S. Army and Navy Airfields on Attu National Historic Landmark nomination.

Truk Lagoon Underwater Fleet, Truk Atoll

Truk Lagoon served as an important and formidable Japanese advance naval base during World War II, and today contains the remains of numerous sea vessels from this period. A devastating U.S. Navy carrier strike on Truk Lagoon in 1944 demonstrated American aerial superiority in the Pacific Theater. From July 1942 to February 1944, Japan's Combined Fleet operated out of Truk, extending its power into the Southeast and Southern Pacific. In August 1942, Japanese Admiral Isoroku Yamamoto, Commander in Chief of the Combined Fleet (First, Second and Third Fleets and the Sixth Submarine Fleet) arrived in Truk, maintaining his headquarters on board the giant battleship, *Yamato*. When Admiral Yamamoto's airplane was shot down near Rabaul on April 18, 1943, by American aircraft in an ambush attack, he was replaced by Admiral Mineichi Koga, whose flagship at Truk was the *Musashi*.

The threat of an American attack in early February 1944 caused the Combined Fleet to withdraw from Truk on February 10, never to return. The U.S. Navy's carrier strike on February 17 and 18, 1944, coordinated with an assault on Enewetak Atoll in the Marshall Islands, seriously impaired Truk's air force, destroyed virtually all Japanese shipping in the lagoon, and heavily damaged land installations. Truk was now virtually defenseless and the United States decided an invasion was unnecessary. The successful attack allowed plans to be made to bypass Truk and to strike at Japan's inner defenses in the Marianas. Within the lagoon are the submerged remains of

freighters, tankers, supply vessels, the *Fumitsuki*, a Japanese destroyer and the *1-169*, a large Japanese submarine. Today, the "underwater fleet" at Truk, resting amidst an infinite variety of marine life and containing the honored remains of Japanese warriors, is one of the world's underwater treasures.

The Truk Lagoon Underwater Fleet, Truk Atoll, has been designated a National Historic Landmark. At least 35 sunken sea vessels lie between Dublon and Fefan islands, and east and south of Dublon Island, around Eten, and south to Uman. For tour information please visit the website of the Federated States of Micronesia Visitors Board.

Orote Field

Orote Field played a significant role in the World War II battles between the Japanese and Americans on Guam. However, a pioneering effort in military aviation in the western Pacific began even earlier when a U.S. Marine Squadron arrived in Guam on March 17, 1921, including 10 pilots and 90 enlisted men. The Marine unit constructed an air station near the water at Sumay village, including a hangar for their amphibious aircraft. In 1926, a new administration office was constructed which housed the squadron offices, sick bay, dental office, aerological office and guardhouse. In early 1927, the squadron was sent to China to protect American lives during the Chinese civil war, and became stationed at Olongapo, in the Philippines, which they used as a base to patrol the Chinese coast. Only a handful of men remained here until September 23, 1928, when Patrol Squadron 3-M, consisting of 85 enlisted men and 4 to 6 officers, was assigned to Guam. But shortly thereafter, the naval air station was closed on February 24, 1931, as a cost-saving measure.

When the Japanese attacked Guam on December 8, 1941, they did not bomb the abandoned naval air station. Guam was captured and occupied by the Japanese from December 13, 1941, to July 9, 1944. During that time, the Japanese military government constructed Orote Field, a land-based airfield, using Korean and Guamian labor. On February 23, 1944, American carrier based airplanes attacked the field, and other American raids soon followed. During the Battle of the Philippine Sea the field was used by the Japanese carrier-based airplanes to refuel and rearm. The Japanese airplanes based at Orote Field were also used to attack the American fleet. As of June 1, 1944, Japanese air strength on Guam consisted of 100 Zeros and 10 Gekkos (night fighters) at Airfield #1 and 60 Ginga (bombers) at Airfield #2. It is not clear from the source material, which of these two airfields was Orote Field. However, American raids on June 19, 1944 destroyed the landing fields, the aircraft on the ground and such aircraft that managed to take off. American pilots reported extremely intense antiaircraft fire around Orote Field. Fifteen Japanese airplanes crashed while attempting to land on Orote Field on June 19, 1944. On June 20, 1944, numerous actions occurred in the immediate vicinity of Orote Field between American carrier airplanes and Japanese aircraft seeking refuge at Orote Field after flying from their carriers, or Japanese airplanes needing to refuel and rearm to attack American carriers. Numerous dogfights took place in the air above Orote Field and numerous strikes by American airplanes destroyed Japanese facilities and airplanes on the ground. This was significant because it denied the Japanese the use of a crucial airfield in the battle.

The Japanese assigned the defense of Orote Peninsula to the 54th Independent Guard Unit under

command of Air Group Commander Asaichi Tamai. After the invasion on July 21, 1944, the 1st Provincial Marine Brigade under command of Lt. General Lemuel C. Shepherd fought its way through the village of Agat to the base of Orote Peninsula. Here the Japanese had constructed an elaborate interlocking system of pillboxes, strongpoints and trenches. Regiments of the 1st Provisional Marine Brigade, the 4th and 22nd, fought their way through the area. Shortly before midnight on July 26, 1944, the Japanese trapped on the peninsula staged a suicide attack and were completely wiped out. The advancing Marines still met heavy Japanese resistance in the vicinity of the airfield, where the Japanese fought from caves and coconut bunkers. The peninsula was declared secure on July 29, 1944. It is estimated that the Japanese lost more than 3,000 men defending Orote Peninsula.

Orote Field was used by Marine air power for close combat support missions during the liberation of Guam. This was accomplished by Marine Air Group (MAG)-21 flying Corsairs from Orote Field. By mid-November 1944, MAG-21, now commanded by Colonel Edward B. Carney, was an oversized group, having 12 squadrons based at Orote Field, 529 officers, 3,778 enlisted men and 204 aircraft. MAG-21 was shifted to Agana airfield in 1945, as air operations at Orote Field had always been hampered by adverse crosswinds. The field was next used as a Navy casualty unit for the repair of damaged aircraft. Orote Field was finally closed to all but emergency landings in 1946. Today, the cross-runway is used for C-130 touch-and-go flight training, and for helio-ops by Navy Seals. Much of the time the airfield is off-limits.

Orote Air Field is located on Orote Peninsula on the island of Guam. The major runway runs from NW to SE and the secondary runway crosses the first and runs in a NE to SW direction. Limited tours of the airfield are available. Contact Jennings Bunn, Navy Regional Cultural Resources Manager at 671-339-8194, or n455@guam.navy.mil for further information.

Tinian Landing Beaches, Ushi Point and North Fields, Tinian Islands

The Tinian Landing Beaches, Ushi Point Field, and North Fields, Tinian Island are recognized for the role they played in World War II. The capture of Tinian, one of the Marianas Islands, in the summer of 1944 from Imperial Japan by U.S Marines provided American forces with a valuable airstrip from which to mount raids on Japan; ultimately, the islands served as the base from which the atomic bomb attacks on Hiroshima and Nagasaki were staged.

By selecting almost impossibly small landing beaches during their assault on Tinian, the Marines confused Japanese commanders and established a beachhead at little cost in lives. Despite the narrow beaches (a total of 180 yards in width), two Marine divisions succeeded brilliantly in a difficult amphibious operation. Lt. Gen. Holland M. Smith, USMC, called this "the perfect amphibious operation in the Pacific War." In the first night of the battle, at 2am on July 25, the Japanese employed their usual tactic of attempting to destroy the enemy on the beach. It was a fatal effort for it cost them up to 2,000 lives, including some of their best infantry troops. Future battles would see the Japanese defenses arranged in depth, inflicting heavier casualties on the Americans.

The U.S. Marines' assault on Tinian was considered to be Phase III of Operation FORAGER which began with the capture of Saipan (Phase I) and the battle for the liberation of Guam (Phase II) which was raging even as the Marines approached Tinian. Under the overall command of Admiral Chester W. Nimitz at Pearl Harbor, Admiral Raymond K. Turner, as commander of the Joint Expeditionary Force, was responsible for both the Northern Attack Force (Task Force 52, Saipan and Tinian) and the Southern Attack Force (Task Force 53, Guam). He had relinquished direct control of the Northern Attack Force by the time of the Tinian invasion to rear Admiral Harry W. Hill. The Japanese forces made their last stand on a plateau at the southern and southeastern end of Tinian. After naval and aerial bombardment and fierce fighting by the Fourth Division of U.S. Marines, the Japanese military presence ended on Tinian with 5,500 dead and 404 taken prisoner. The Second Marine and Fourth Marine Divisions had a total loss of 355 killed, 1,550 wounded and 27 missing in action. More than 13,000 civilians, mostly Japanese, were interned on Tinian until the end of the war.

Tinian's topography provided the U.S. Army Air Force with a superb platform for constructing two long-range B-29 bomber airfields, including North Field, the largest airfield in the Pacific and perhaps in the world during World War II. From Tinian's six runways, as well as from bases on Saipan and Guam, armadas of B-29s raided and destroyed Japanese cities and towns in the homeland, shipping in Japanese waters, petroleum supplies, and industrial plants. On May 19, 1945, a new, secretive organization began arriving at North Field, the 1,767-man 509th Composite Group headed by Col. Paul W. Tibbets, Jr. Finally, on August 6, the *Enola Gay* left runway 1 at North Field and dropped an atomic bomb on the city of Hiroshima, Japan, which in a matter of seconds destroyed 62,000 buildings and killed or mortally wounded 80,000 people. On August 9, Maj. Charles W. Sweeney, flying from Tinian in the B-29 *Bock's Car*, dropped a second atomic bomb in Nagasaki, bad weather having prevented his attacking the primary target, Kokura. Before the pilot was able to return to North Field, Tinian, President Harry S. Truman announced Japan's unconditional surrender, which ended World War II.

Today the historic Tinian Landing Beaches White 1 and 2 remain, as does the Japanese pillbox at Beach White 2, the Japanese service apron, air administration building, air operations building and two air raid shelters of former Ushi Point Field. North Field contains four B-29 runways, taxiways and two service aprons.

The Tinian Landing Beaches, Ushi Point, and North Fields, Tinian Island is a National Historic Landmark. Tinian is one of the four major islands in the Mariana chain, and is 45 minutes by airplane from Guam. There are no tours but the runway can be seen anytime, as can the Tinian Landing Beaches and Ushi Point Field, except during periods of military training. From San Jose or the airport, take Broadway, which will pass through forest before opening up onto North Field. A plaque marks the location on North Field where the atomic bombs were loaded for their flights to Hiroshima and Nagasaki. The Taxiway at the northwest corner of the northernmost runway is where the atomic bomb pits are located. Japanese bunkers are visible near White Beach 1. An online brochure offers a self-guide tour or find more information at Visit Tinian.

Second--Generation Norden Bombsite Vault

The Second-Generation Norden Bombsight Vault at the former McCook Army Air Base near

McCook, Nebraska, is an example of the structures used by the military to help ensure the secrecy of this advanced technology device during World War II. The military quickly decided that strategic bombing would play an important role in the war. The Norden Bombsight was crucial in conducting that high-altitude precision strategic bombing by the U.S. Army Air Force and an essential factor in defining air war strategy. The sight was a highly accurate precision instrument developed by Carl L. Norden, a civilian consultant, and Captain Frederick I. Entwhistle, assistant research chief of the U.S. Navy's Bureau of Ordnance. In 1932 the U.S. Army Air Corps ordered its own Norden bombsight.

Charles D. Bright described the sight in his *Historical Dictionary of the U.S. Air Force:* "Precision bombing required meticulous control; to accomplish this, the Norden incorporated a gyrostabilized automatic pilot. The mechanism was modified in 1941 by the Minneapolis Honeywell Company and designated the Army C-1 autopilot. This modification enabled a bomber to be flown on a straight, level course, giving the bombardier a steady platform on which to operate the bombsight during the bombing run. Also known as the "Blue Ox" the Norden could quickly calculate and correct directional changes due to wind drift. Flying at a preset altitude, it could rapidly compute the correct bomb release angle for a constant speed of closure to the aiming point. Under optimal conditions on an undisturbed run, the accuracy of the device was excellent. However, any last second changes in the altitude of the bomber, such as those encountered during battle, could markedly influence the accuracy of the sight."

Because of the importance and sensitive nature of the technology, the Norden Bombsight was a closely guarded secret that required a secure area for its storage when not in use for training. Originally, Norden Bombsights were stored in a wooden building that contained five or six concrete vaults, as well as an area to test and repair the sights. After the Norden Bombsight was reclassified from secret to restricted (probably in 1943), second-generation bombsight vaults came into use. The second-generation vault stood in the open and was used solely for storage purposes. The second-generation Norden Bombsight vault at the former McCook Army Air Field is a small rectangular structure, one-story in height, 11 feet wide and 13 feet deep. It has a very slightly sloping shed-roof and one door on the main façade. The walls are 8 inches thick and the roof is also of reinforced concrete with a tar membrane. An L-shaped wing that measures five feet 10 inches by six feet eight inches is located on the southeast façade, and also has a shed-roof and a door on the main façade. Its function is unknown, though it may have housed electrical equipment. Surrounding the bombsight vault is a combination two-strand barbed wire and six-by-six woven-wire fence, supported by wooden posts. Divided into 10-foot sections, the fence extends 50 feet on each side except in the front where a 10-foot gap provides an entryway.

Nebraska, like most states, became the site of a number of military installations during World War II. There were ordnance depots and plants, and prisoner-of-war camps, but most numerous were airfields. Nebraska eventually became home to 12 air bases. Activated on April 1, 1943, the McCook Army Air Base was originally designated as a satellite field, but later became an independent facility and under the command of the 2nd Air Force, provided training for B-17, B-24 and B-29 crews. Eight different bomb groups representing the 8th, 15th and 20th Air Forces trained at the base. A total of 15,000 servicemen and 500 civilians were stationed at the field during the war. The McCook Base was deactivated on December 31, 1945, and is now in private ownership.

The Second-Generation Norden Bombsight Vault, part of the Significant Relic Components of U.S. Army Air Fields in Nebraska Multiple Property Submission, is located on the access road that runs parallel to the northeast-southeast runway, and is set in about the middle of the row of hangars at the former McCook Army Air Field, near McCook, Nebraska. Off U.S. Rte. 83, turn left going north just before School No. 41 and continue until the abandoned McCook State Airport. It is not open to the public.

U.S. Naval Air Station Dirigible Hangar B

The U.S. Naval Air Station Dirigible Hangar B is associated with important post-World War II military patrols of America's West coast. Plans for building an airport at Tillamook, Oregon, took shape during the summer of 1941 and by September the placement of the airport south of the town had been decided. When the United States entered World War II after the Japanese attack on Pearl Harbor in December 1941, the Navy launched its full non-rigid airship program, which resulted in a series of hangars built in 10 different locations throughout the United States. These hangars mark a significant period of aviation history when airships were an important part of the U.S. anti-submarine defense. All, including the Lighter-than-Airship Hangars in Tustin, California, were built using the same plans and construction began during the early years of World War II. The Tillamook valley was a naturally protected site between San Francisco and the Straits of San Juan de Fuca which made it an ideal base for patrol of this coastal region. Work began on the "Lighter-than-Air" station immediately with the clearing of 2000 acres of dairy farm land four miles south of the city of Tillamook and six miles inland. This area at the southern end of Tillamook Bay was composed of old gravel bars, filled-in riverbeds and sedimentation. It required over two million cubic yards of gravel for grading. The Administration Buildings went up first and were soon followed by barracks, mess halls and roads. Railroad connections to Tillamook and the airport were finished along with the gatehouse and fence by September 1942.

The two hangars built at Tillamook were designed for the "K" style blimps. Hangar "A" was built at a cost of $2,405,395.00 and Hangar "B" for $3, 110.048.00. They both have an egg-shaped roof shell. Stiffened with a series of 51 transverse arch ribs, each building is 1050 feet long, 296 feet wide and 175 feet high. The dimensions of the hangars were so huge that there was no precedent for the manner of their construction. Hangar "B" was started in October 1942 and finally finished on August 15, 1943. Hangar "A" was started on July 26, 1943 and finished except for the final roofing on August 27, 1943, in just 27 working days--avoiding the costly delays and bad weather that affected the construction of Hangar "B." By reason of dimensional magnitude and the volume of lumber used, they are among the largest buildings in the world framed of timber. Two interior catwalks run the length of each hangar, one at each side at a height of 137 feet above the ground. Stairways at each end of the hangar lead from the ground to the catwalks and thence to the roof. A middle stairway leads only to the catwalks. A monitor runs the full length of the ridge of the building. At each end of the hangars there are two pillars which have pockets to house the six huge doors when they are open (three in each pillar). Today, only Hangar "B" remains as Hangar "A" was destroyed by fire in 1992.

Eight "K" series airships (blimps) were housed at the Tillamook Naval Air Station. The "K" series blimps carried a crew numbering eight to 10 and were used for extended flight operations

in the coastal patrols. The ships were 215.7 feet long, 79 feet high and 62.5 feet wide. They were armed with four depth chargers and two 50-caliber machine guns, mounted in the extreme forward upper section of the car. The techniques for air-sea rescue were developed at Tillamook Naval Air Station. Squadrons of FM-2's used the Naval Air Station Tillamook (NAST) as a refueling and rearming facility. In 1948 the Navy decided to close the Station at which time the County negotiated a lease with the Navy and a Commission was appointed to operate the Airport. In 1963, that Commission formally aquired the hangars and after the loss of Hangar A, the remaining hangar was established as a museum in 1994.

The deactivated U.S. Naval Air Station Dirigible Hangar B at Tillamook Bay is located at the southerly end of an estuarine valley in Oregon formed by the meeting of the Wilson and Trask rivers with the Pacific Ocean. The Hangar today serves as the Tillamook Air Museum. The museum is open daily from 10:00am to 5:00pm; closed Thanksgiving and Christmas Day. There is a fee. Please call 503-842-1130 for further information or visit www.tillamookair.com

Lighter-than-Air Ship Hangars

The Lighter-than-Airship Hangars in Tustin, California, are two of a series of hangars that were built in 10 different locations throughout the United States. These hangars mark a significant period of aviation history, when airships were an important part of the U.S. anti-submarine defense. Each hangar was capable of sheltering an entire squadron of six airships. All were built using the same plans and construction began during the early years of World War II. These airship hangars are among the largest wood-supported structures in the world, rivaled only by the other hangars built from the same plans such as the U.S. Naval Air Station Dirigible Hangar B. The hangars stand 189 feet high to the top of the wind indicator, and 178 feet to the top of the roof, and have long been considered landmarks in Orange County. The hangars are 1088 feet long and 297 feet wide, covering a total ground area of 298,188 square feet.

The hangars were completed in 1943 when the air station was Santa Ana Naval Lighter-than-Air Base. The hangars were constructed in three main sections; two identical supporting structures of concrete located at each end of the hangar with a massive center section covered by a wood-framed, 484,932 square-foot arched roof. The end sections consists of two pillars, six huge doors and a brace connecting the two pillars at the top. The pillars are used as "pockets" to house the hangar doors (three in each pillar). The brace is also used as a guide for opening and closing the doors. Fifty-one individual wooden braces support the roof. Following World War II, the base was decommissioned. During the period 1949-1951 the hangars were used as a museum for aircraft and a storage area. In 1951 the base was recommissioned and the hangars were used to house helicopter squadrons during the development of the vertical assault, a new military strategy to utilize the quickness and flexibility of helicopters in attacks. The base has recently been decommissioned again. Plans are currently being developed to adaptively reuse the hangars.

The Lighter-than-Airship Hangars are located on Valencia and Redhill aves., in Tustin, California. They are currently not open to the public but can be seen from these avenues.

Hangar No. 1 United States Naval Air Station Wildwood

Hangar No. 1 is a two-and-a-half story, two-bay, wood building constructed during World War II at the Naval Air Station Wildwood, New Jersey; now the Cape May County Airport and Industrial Park. With the outbreak of World War II, the Civil Aeronautics Administration constructed the runways at the present-day airport in 1939. In April 1942, five months after the attack on Pearl Harbor, agreements were finalized to expand the airport. Construction of Hangar No. 1 began in October 1942, as part of a project to support the initial group of 108 officers, 1,200 men and 72 airplanes. Hangar No. 1 is the only remaining intact structure from the original World War II construction campaign. Activity peaked in October of 1944, with 16,994 takeoffs and landings, at a time when the station accommodated as many as 200 airplanes. Hangar No. 1 is important for its role in training Navy fighter and dive-bombing pilots during World War II to fight in the Pacific theater. Considered to have been an "exclusive domain" for dive-bombing training during World War II, United States Naval Air Station Wildwood was used nearly exclusively for dive-bombing squadrons from mid-1943 to January 1945. After that time, fighter bomber and dive-bomber squadrons used the facility equally.

Air crews were trained in combat tactics in naval aircraft such as the "Dauntless," "Helldiver" and "Corsair." With the field lighting system at an affiliated outlying field in Delaware, dive-bomber squadrons stationed at Wildwood had the opportunity for night flying practice, particularly night field carrier landing practice which simulated their future duties in the Pacific. Practice dive-bomber targets were constructed in the nearby Delaware Bay and on the Atlantic Ocean coast. After training was completed, pilots would meet up with their air groups at the designated carrier and proceed to the Pacific. The hangar is the "Standard Wood Hangar" designed by the Department of the Navy. The architect, Albert Kahn, a consultant to the military services during World War I, produced many of the designs for naval installations, especially those for air hangars, and it is possible that he designed the Standard Wood Hangar. The siting, heating system design and interior details were designed by Sherman Sleeper Associates Architects and Engineers of Camden, New Jersey. It is estimated that 20-30 hangars of this type were constructed during World War II. The massive building measures 290 feet long by 219 feet wide by 51 feet high, creating 2,558,000 cubic feet. It is constructed of bolted wood Pratt trusses in 10-foot panels at the roof level, bolted cross-braced vertical supports at the north and south interior elevations and bolted center supports, which form the division between the two bays. The structure contains two 120'L x 200'W bays for airplane storage and maintenance and rows of offices and workrooms that form the north and south elevations. Twelve full-height telescoping doors form the east and west elevations of the hangar; these doors retract into door pockets at each corner of the hangar.

After the war the air station became the property of the War Assets Administration in 1946, and station operations reverted to Cape May County. Subsequent airplane-related businesses have occupied the hangar and minimally altered the structure with interior partition walls and removal of windows for energy conservation. Today Hangar No.1 United States Naval Air Station Wildwood is the heart of the Naval Air Station Wildwood Aviation Museum and houses the TBM-3E Avenger, the U.S. Navy's leading torpedo bomber in World War II.

Hangar No. 1 United States Naval Air Station Wildwood is the heart of the Naval Air Station Wildwood Aviation Museum located at 500 Forrestal Rd., at the Cape May County Airport in Rio Grande, New Jersey. The museum is open during the spring and summer daily from 9:00am

to 5:00pm, and in the fall and winter it is open 8:00am to 4:00pm weekdays, and 8:00am to 3:00pm weekends. For more information, visit the museum's website or call 609-886-8787.

Building 1301, Dover Air Force Base

Building 1301, Dover Air Force Base is a single- story, World War II era aircraft hanger and support facility located in Dover, Delaware. Built in 1944 as an experimental station, it is one of the few remaining buildings that have survived from the early years of the Dover Air Force Base (AFB). Building 1301 was constructed during World War II when Dover AFB was used to test and develop rocket-equipped fighters for use in warfare. The facilities constructed for the 4146th Base Unit at Dover consisted of this experimental station (hangar, power plant and shop) as well as an administrative building, barracks area, ammunition magazine and a range area.

Building 1301 consists of three connected sections--hanger, heating plant and shop. The hangar is visible from much of the Air Base, it is much larger than the other two sections, measuring 155 feet wide and 160 feet deep. The curved roof with no internal columns provides a clear height of 42 feet. The hangar was constructed with seven-inch thick, reinforced concrete slab. Aside from the bulk of the hangar, one of the principle architectural features of the building is the set of main hangar doors at each end. The doors consist of a wooden superstructure and a set of sliding doors that provide a clear opening of 28 feet when open and form a solid surface when closed. The interior of the hangar is a vast open space. Attached to the north side of the hangar is the power plant, which was designed as part of the hangar complex. It is a two-story, gable-front cinder-block building. North of the power plant is the shop, connected to the hangar by a long, narrow corridor that forms part of the east wall of the power plant. The shop is a rectangular, wood-frame, single-story, gable-roofed building.

History does not record the individual who first conceived of the idea of using aircraft as a rocket launcher but experiments were being conducted in the United States during the early part of World War II. The first efforts to place rockets on aircraft were tried by the Army Ordnance Department. They used an experimental four-and-a-half-inch rocket that was attached to the wing of a P-40 aircraft at Wright Field in Ohio. The aircraft was flown to Aberdeen Proving Ground in Maryland for test firing. Modifications to the rocket and launcher were needed and testing continued into 1943. The Army Air Force realized that rockets could be a very significant weapon in the air war. By early 1944, the Army Air Force was ready to create a special unit for the continued development of air-launched rockets. The Ordnance Department asked the Army Air Force Commanding General to create the unit at Dover Air Force Base on January 25, 1944. The rocket program at Dover progressed quickly and in July 1944, a civilian engineer, Roy Healy, was sent to Burma to supervise the installation of rocket launchers on the fighting planes to be used against the Japanese in South-East Asia. He provided training and assisted in the field modification of the mounts on the P-51A airplane so that the aircraft could carry both bombs and rocket launchers.

The 4146th also practiced with rockets later used against the Germans with great success. The work in air-launched rockets conducted by the 4146th Base Unit was the beginning of a new type of air combat experience for American pilots and for combat pilots around the world. Inexpensive and efficient rockets made it easier for smaller combat aircraft such as the early jets

of the Korean Conflict to move against ground targets that would not have been accessible to traditional bombers. Also, the use of air-launched rockets in aerial combat meant that aircraft could stand off from each other during the engagement and fire at each other using electronic means to lock onto the target instead of using close visual sightings.

Building 1301, Dover Air Force Base is located at 1301 Heritage Rd. in Dover, Delaware, and is now the Air Mobility Command Museum. The entrance to the museum is located south of Dover Air Force Base off DE Rte. 9, one half mile from its intersection U.S. Rte. 113. It is open Tuesday-Saturday, 9:00am to 4:00pm. Please call 302-677-5938 or visit the museum's website for further information.

Douglas DC-3 Airplane, N34

The Douglas DC-3, N-34, is a monoplane aircraft built as a TC-47B in 1945 for the U.S. Navy by the Douglas Aircraft Company in Oklahoma City, Oklahoma. It has seen continuous use since then, first as a Navy airplane and later as a transport airplane associated with the Federal Aviation Administration's safety inspection program. The Douglas DC-3, N-34 is representative of an aircraft type that revolutionized the commercial airline industry and made a significant contribution to the evolution of military aviation during World War II. First designed and built in the mid-1930s, the first DC-3 flew on December 17, 1935, exactly 32 years after the Wright brothers made the first powered airplane flight. More than10,000 DC-3s were manufactured but only 410 are still registered in the United States, making this airplane a rare survivor of a once common aircraft type. Registered in at least 159 separate countries, the DC-3s were utilized in a vast array of duties from luxury transcontinental passenger transports to crop spraying. General features of Douglas DC-3s include all metal fuselage and cantilevered low wing, all metal vertical and horizontal stabilizer, two reciprocating radial engines, fabric covered control surfaces (ailerons, rudder and elevators) and two main landing gear consisting of wheels and tail wheel. The all-aluminum metal low wing was built in three sections with the stub-wing center section integrated into the lower fuselage; it supports the engines, nacelles and landing gear on each side of the fuselage.

Completed in 1945 near the end of World War II, the Navy used the Douglas DC-3, N-34 at various worldwide locations as a transport airplane. Among the assignments were London, Rome, Naples, Paris, Algiers, Frankfort, Brussels, Oslo, Stockholm, Dublin, Cairo, Kuwait and Baghdad. Later converted to a R4D-6, it was assigned to the U.S. Navy Utility Transport Squadron Four (VRU-Four) from February 26, 1947 until March 1949 when it was detached from the squadron and returned to the U.S. On April 8, 1947, N-34 nosed over in the mud while being taxied out of the only parking area available in London, and both engines had to be changed. While not officially assigned to the Berlin Airlift (1948-1949), it is highly probable that N-34 flew into Berlin in support of Operation VITTLES, as most airplanes in the area during that time were pressed into support of the airlift operation. Sometime prior to 1956 the airplane was put into storage by the Navy.

The Navy loaned the airplane, along with four other DC-3s, to the Civil Aviation Administration (CAA), later the Federal Aviation Administration (FAA). The initial FAA assignment as a flight inspection airplane was to the Southwest Region in Fort Worth, Texas, and later to various other

FAA regions. This airplane was operational and photographed with its first CAA livery paint scheme on the ramp at Oakland in August 1958.

In 1981, N-34 was withdrawn from flight inspection and assigned to the training program in Oklahoma City, but was declared excess to FAA needs on January 1, 1983. During the early stages of disposing of the DC-3s beginning in the 1970s (as new jets were taking over their functions), initial efforts by FAA employees to preserve one for its historic value finally cumulated in this last FAA DC-3, N-34, being reinstated by the FAA Administrator in 1985. Since its 1983 retirement and 1985 restoration, N-34 has been used in the FAA's aviation educational programs to promote aviation and the FAA's heritage. The airplane retains the same equipment, furnishings and arrangement that were originally installed in 1957 and is currently being restored so that it can participate in the First Flight Centennial at Kitty Hawk.

The Douglas DC-3, N-34, in operational condition, is housed at Hangar 10, Federal Aviation Administration, Mike Monroney Aeronautical Center Oklahoma City, Oklahoma, when not in use.

B-17G "Flying Fortress" No. 44-83690

B-17G Flying Fortress No. 44-83690 in Peru, Indiana, is a rare intact example of the important World War II heavy bombers manufactured by the Douglas Aircraft Company in Long Beach, California. Douglas was one of two companies other than Boeing designated to manufacture B-17s during World War II. General features on the B-17 include its mid-wing monoplane design, aluminum-clad exterior, four radial engines, massive wing structure and heavy armament. Although many U.S. airmen and craft contributed to the Allied victory in World War II, the B-17 has become especially symbolic of the self-reliance, daring and sacrifice of American airmen during the war. American confidence in the B-17 became the cornerstone for the Air Corps doctrine of strategic "daylight" bombing in German-occupied Europe.

While the B-17s were used in the Pacific, by 1944 the B-29 had replaced the B-17 for use in the Pacific Theater. B-17s were initially intended as a fast, land-based bomber, which could patrol at sea and intercept naval vessels. B-17Cs were the first of the series to see action. Twenty were flight delivered to the Royal Air Force on the Lend-Lease agreement in 1940. The British pressed them into bombing well-protected sites, but the B-17Cs proved to be undergunned and performed poorly in this task, so Boeing engineers redesigned the tail assembly and improved firepower. The improved version was the B-17E. The E model was the most advanced type of B-17 when the U.S. entered World War II. They were the first American-manned B-17s to see action in the European Theater. B-17Fs had increased armament including guns that fired through the nose window or nose check area, and a single gun that could be fired upward from a dorsal window aft of the top turret. The final improvement on the B-17 was the G series, introduced in July 1943. Firepower was boosted, with a twin-gunned, power operated chin turret added to counter head-on attacks by the German Luftwaffe. Angled cheek gun ports on the nose area also introduced increased firepower. Waist gunner windows were staggered to allow greater freedom of movement for the gunners. The tail turret was now power operated.

The G series could hold a crew of 10, including pilot, co-pilot, bombardier, radio operator,

navigator, dorsal turret gunner, two waist gunners, ball turret gunner and tail gunner. Typical for B-17Gs are the four 1,380-horsepower Wright GR1820-97 Cyclone air-cooled, nine-cylinder radial engines equipped with exhaust driven turbochargers. The radial engines of 44-83690 are still intact, but would likely require a complete overhaul to be functional. The wingspan is 103 feet, 9 inches--longer than the typical B-17Gs span of 74 feet, 4 inches in length. General features include the raised cockpit section and Plexiglas nose cone. Characteristic of all B-17s, starting with the E series, is the massive dorsal fin, which gracefully sweeps to merge with the fuselage. All B-17s have retractable tail-wheel landing gear. The empty weight of the airplane is 32,720 pounds. Fully armed and loaded, B-17s weigh 65,600 pounds. Payloads of 4,000-5,000 pounds were typical but up to 17,6000 pounds could be carried for less than maximum range. The maximum speed was 300 miles per hour at 30,000 feet.

No.44-83690 is a representative G-series B-17. It was delivered for use on May 9, 1945 and assigned to Patterson Air Force Base in Ohio, 4100 Base Unit, where it was put into storage. On November 14, 1945, it was assigned to 4168 Base Unit (Air Material Command), South Plains Field, Texas. In June of 1947, it was transferred to 4141 Base Unit, Air Material Command, Pyote Field, Texas. This B-17G is also an example of an experimental aircraft that participated in nuclear and radio-guided unmanned aircraft testing shortly after World War II. In February 1951, it flew to Kwajalein (Marshall Islands) in the South Pacific to participate in Operation Greenhouse. From 1956 until 1959 it was assigned to the 3235th Drone Squadron, Missile Test Center, Patrick Air Force Base in Florida. The test center evaluated Nike, Talos, Genie, Bomarc and Sidewinder missiles by destroying B-17s. In some cases, intentional partial hits were used to evaluate results. One of the last active military B-17s, 44-83690 was removed from the official Air Force inventory in August 1960. Its last flight was to Grissom Air Force Base (then known as Bunker Hill) for permanent display in 1961. The Heritage Museum Foundation, now the Grissom Air Museum, was established in 1981 as part of the Air Force Museum Program and maintains the airplane. The museum, which is open to the public without having to enter the base itself, displays aircraft which have been used by the 305th Group throughout its history.

The B-17G "Flying Fortress" No. 44-83690 is located at the Grissom Air Museum, 6500 Hoosier Blvd., at Grissom Air Force Base, off of U.S. 31, in Peru, Indiana. The museum is open from 10:00am to 4:00pm Tuesday-Saturday, closed January and holidays. Outdoor exhibits are open from 7:00am to dusk daily. Admission is free. Contact 765-688-2654 for more information, or visit www.cyberair.com/museums/usa/in/gam.html.

Atka B-24D Liberator

The Atka B-24D Liberator bomber, located at its crash site in Atka Island, Alaska, played a highly significant role in World War II. In the Aleutian Campaign against the Imperial Japanese forces from 1942 to 1943--the only battles fought in North America during the war--it was a superb weapon. This aircraft flew in at least 18 combat missions before finally succumbing to bad weather rather than enemy action. Manufactured in 1941, it was the 19th of only 20 B-24Ds produced and is now only one of two B-24Ds known to exist in the world. Designed and built by Consolidated Aircraft, the original appearance of Serial #40-2367 was that of a four-engine bomber with twin tail fins. It weighed approximately 36,000 pounds, had a wingspan of 110 feet and was 67 feet long. It carried a crew of 9 men and was primarily used for bombing. This B-

24D airplane came to Alaska in March 1942 and served exclusively in the Aleutian Campaign, but had been taken from combat duty and was being used as a weather observation plane. Had it crashed during combat, the usual pattern of explosion, fire or total loss at sea, would have destroyed it. However, on December 9, 1942 it was crash-landed in Atka, Alaska, in an emergency landing which saved several lives. The tail broke off in the characteristic B-24 manner, but the tail section is intact, minus the vertical tail fins, which are in the vicinity of the aircraft. A brief passage from the 11th Air Force History, 1941-1945, gives the following account:

On 9 December (1942) Colonel Hart and Brigadier General William E. Lynd of General Buckner's staff, took off from Adak in a B-24 piloted by Captain John Andres. The two officers wished to accompany the weather plane to make personal observations from Kiska and Attu. The plane reached Attu, circled over Holtz Bay, and then returned to Adak. Arriving back at Adak at 1600, the pilot found his base socked in by weather. He notified the tower that he planned to fly to the far end of Atka Island and attempt a crash landing. Atka, too, was closed in, and the plane was crash-landed . . . There was only one casualty. General Lynd sustained a fractured collarbone and the crew members and Colonel Hart spent an uncomfortable night on the beach while the personnel of Eleventh Air Force Headquarters spent an uncomfortable night wondering what had happened to them. The next day, they were signed by a Navy PBY which landed and put a rubber boat ashore. The men had adequate food and were able to gather enough driftwood to build a fire, a difficult problem in the treeless Aleutians. The castaways were picked up on 11 December by the Navy seaplane tender USS Gillis, *chilly and tired but otherwise unharmed.*

The B-24 was the heavy bomber mainstay, built in larger numbers and in more versions than any other U.S. aircraft during World War II. It served in every theater of the war and was used by all branches of the U.S. Armed Forces, as well as the Air Arms of the British, French, Chinese, Dutch, Australian and Indian Allies. The prototype aircraft was built and first flown on December 29, 1939, after which 18,187 were manufactured. One of the most illustrious chapters in the Liberator's story is its service in the Aleutian Campaign from March 1942 through the end of the war. B-24s flew in the initial patrols and search missions and are best remembered for valiant duties performed during the Kiska and Attu bombing campaign in the summer and fall of 1942 and the re-invasion of 1943. During this time, hazardous long-range missions were flown from Umnak Island in the Aleutians to bomb Japanese installations at Kiska and Attu islands. The concentration of Japanese antiaircraft batteries at Kiska was one of the largest and deadliest in the Pacific.

The Atka B-24D Liberator is located on Atka Island, Alaska.

U.S. Army Aircraft P-51D-25NA 44-73287

Now located in Springfield, Illinois, U.S. Army Aircraft P-51D-25NA 44-73287, Federal Aviation Administration (FAA) registration number NL951M, is an example of the 8,202 P-51 D Mustang U.S. Army Air Force (USAAF) fighter aircraft manufactured by North American Aviation, Inc., between 1942 and 1945. In its role as a long-range bomber escort in the European Theater of Operations during World War II, the P-51D design exhibited its greatest influence and

is credited by many as the airplane that shifted the European airwar in favor of the allied forces. The date of manufacture for this particular aircraft was June 7, 1944. The finished version was delivered to the U.S. Army on March 7, 1945. This P-51D is important in military history through its association with and use by the USAFF, USAF and various U.S. Air National Guard units during and after World War II. P-51Ds were used by these organizations for a variety of missions, including interception of enemy aircraft, long-range bomber escort, armament support for land and sea forces, photographic reconnaissance and flight training. This aircraft exhibits the aerodynamic, power plant armament and other engineering subsystem designs that allowed the P-51D to perform at levels surpassing other single-engine, propeller driven fighter aircraft during World War II. Of the 8,202 P-51Ds manufactured by North American Aviation, Inc., this airplane is one of only 166 remaining in the United States at the end of the 20th century, only 104 of which were operational. The wingspan of 44-73287 is 37.03 feet and has a wing area of 236 square feet. The plane's two-section, semimonocoque fuselage is constructed entirely of aluminum alloy and is 32 feet and 2 5/8 inches in length.

At the end of World War I, air power pioneers in the U.S. and Europe placed a great deal of emphasis on the potential of strategic bombardment based on Italian air war theorist Giulio Douhet's principle of taking long-range bombers and hitting the enemy's war-making potential behind its own lines. It was during the open stages of World War II that the power and influence of modern fighter planes under the control of well-trained pilots became very apparent as the world observed the German Air Force (Luftwaffe) destroy the air forces of Poland, Denmark, Norway, Holland, Belgium and France in late 1939 and early 1940. As the war intensified, so did the German and American fighter design effort. Air-to-air superiority was the dominant concern of both nations, but support roles such as bomber escort, night interception, and strafing/bombing surfaced as the primary secondary functions. The United States put the twin-engine, twin-fuselage Lockheed P-38 Lightning, the Republic P-47 Thunderbolt and the North American Aviation P-51 Mustang in the air to meet these needs. The P-51 Mustangs were initially developed for use by Great Britain against the Germans. The Germans countered the Mustangs with upgraded versions of the Me 109s/110s and the newly introduced Focke Wulf 190. When USAAF strategic bombers deployed to England in 1942, it was thought that the heavily armed B-17s and B-24s could fend off the German fighters during daylight precision bombing. Although the Luftwaffe fighters found it more difficult to close on the USAAF bomber formations, they simply changed their tactics and began attacking the bombers head on. The solution to this dilemma was to produce a fighter to escort the bombers all the way to their target and defend against enemy interdiction.

This need for long-range escorts had not escaped the attention of Commander of the USAAF General Henry H. (Hap) Arnold. In early 1942, Arnold ascertained from previous British air operations that an escort fighter was needed to defend the American bombers if the daylight bombing doctrine was to be successful. The ranges of the fighters, primarily the P-40, P-47 and the P-38, were just not sufficient to accomplish the task. By the fall of 1943, it was apparent the answer to the long-range escort problem was the P-51B/C. When Lieutenant General James H. Doolittle took command of the 8th Air Force in January of 1944, fighter-escort doctrine emphasizing offensive tactics was implemented, allowing the escorts to engage the enemy fighters as they were preparing to attack the bomber streams. Luftwaffe Fighter Chief Adolf Galland stated that, "The day that the USAAF fighters took the offensive was the day that

Germany lost the air war." While the P-51 Mustangs also took part in the Pacific War, they were never the dominant airplane. Some were used in the Korean War, but afterwards they were used by Latin American nations, National Guard Units or eventually scraped.

This P-51D entered the European war during the last month of fighting, assigned to the USAAF's 8th Air Force Fighter Command. On July 18th 1945, the aircraft was shipped back to the U.S. and assigned to the 4108th Base Unit at Newark Field, New Jersey, in September. After eventually ending up at Kirtland Air Force Base, New Mexico, it was returned to active duty during the Korean War. Its activated New Mexico unit was redesignated the 188th Fighter/Interceptor squadron, which was transferred to Long Beach, California, in May 1951. After transfers to Yuma Air Force Base and Standiford Field in Louisville, Kentucky, it was flown to the Sacramento Air Material Area, McClellan Air Force Base, California, for reclamation. In June of 1957 it was grounded as excess. On December 11, 1957, it was dropped from the USAF inventory and sold to its first civil owner. The man who saved this P-51D from the scrapper's cutting torch was Willaim Kelbaugh of Chino, California, who eventually sold it to William Sherman Cooper of Merced, California, in 1964, who flew the airplane in the sport of Unlimited Air racing. Through a succession of owners, the airplane eventually was owned by Mike George of Springfield, Illinois, who returned the airplane to its original condition and received the EAA's 1993 Preservation, 1995 Best Mustang and 1995 Silver Wrench Awards at Oshkosh and was named the 1995 Warbird Reserve Grand Champion at the EAA's Sun and Fun Air Show in Lakeland, Florida.

U.S. Army Aircraft P-51D-25NA 44-73287 is housed at the Air Combat Museum, Capital Airport in Springfield, Illinois. Take the first entrance off J. David Jones Pkwy. to Capital Airport. For more information call 217-522-2181 or visit www.aeroknow.com/acm.htm

TBM-3E "Avenger" Torpedo Bomber Warplane

The TBM-3E Avenger, now located at Hangar No. 1 U.S. Naval Air Station Wildwood, New Jersey, is a rare extant example of the U.S. Navy's leading torpedo bomber. Throughout World War II, Avengers flew with the U.S. Navy, the U.S. Marines and the Royal Navies of the Allies in every theater of the conflict, successfully carrying out reconnaissance, bombing raids and anti-submarine patrols and contributing significantly to the eventual Allied victory. The Avenger participated in every major air-sea battle of World War II between June 1942 and August 1945, and played a significant role in search-and-destroy missions hunting German submarines, proving its worth in both night and daytime assignments. The most famous American to fly an Avenger was George H.W. Bush, later 41st President of the United States, who joined the Navy in 1942 and became the youngest naval aviator ever, at the age of 20, in June 1943.

This Avenger is a rare survivor of a type of warplane that was produced in great numbers in World War II, but of which few have survived. Of the 9,839 that were manufactured by Grumman Aircraft and General Motors, it is estimated that only 75 to 100 remain. The TBM-3E was the last Avenger model put into production during the war. It was built in 1945 in Eastern Aircraft's Trenton-Ternstedt plant outside of Trenton, New Jersey. The single-engine bomber is over 40 feet long and stands 16 feet, 5 inches high. With its wings fully extended in flying position, the airplane measures 54 feet 2 inches wide. The body and wings are made of

aluminum, and the parts of the airplane that control its movement--rudder, ailerons, horizontal stabilizer and vertical stabilizer--consist of an aluminum frame covered with fabric. The engine is a Wright Cyclone engine, R-2600. It is not known if this TBM-3E Avenger was equipped with radar, since there is no evidence on the body that it was. Not found on this Avenger, but built as part of the standard body was a gunner's turret, and bomb bay doors, both of which have been removed previously. The airplane was acquired by the U.S. Navy on April 6, 1945, and was delivered in May 1945 to VT-26 (a torpedo squadron) base in San Diego, California. This Avenger remained with VT-18 for the rest of its World War II military career, but never saw action.

This TBM-3E illustrates the massive military manufacturing effort that New Jersey made during World War II. It is one of 7,546 Avengers built at General Motors' Eastern Aircraft Trenton-Ternstedt plant. Formerly used to manufacture and assemble General Motor's automobiles, the plant was converted in 1942 to assemble TBM Avengers and built them from 1942 until the end of hostilities in 1945. In recognition of its great effort to produce war materials, the Trenton-Ternstedt plant was awarded the "E for Excellence Award" for superior war production on January 2, 1945.

The use of aerial torpedoes began several years before the start of World War I, when U.S. Navy Admiral Bradley Fisk (1854-1942) patented the first one in 1912. The British Naval Air Service was the first to use torpedoes from airplanes in World War I, although American development of aircraft carriers was concurrent with those in Europe, and as they developed, so did a new breed of aircraft--the torpedo bomber. The U.S. Navy's first torpedo aircraft were twin-engine converted Martin TM-1s, modified Army bombers, but in the 1930s, Douglas Aircraft Company introduced the first TBD Devastator which became the Navy's leading torpedo bomber. In early November 1939, the U.S. Navy approached a number of aircraft manufacturers to design and build a replacement torpedo bomber for the aging Douglas TBD-1 Devastator and Grumman Aircraft Company received the contract. The Grumman Avenger, or Torpedo Bomber F (TBF), with F being the Navy's designated letter for the Grumman factory, was replaced by General Motors Avenger TBM, with M being the Navy's designated letter for the General Motors factory. General Motors converted automobile plants into airplane manufacturing facilities during World War II, and agreed to produce combat airplanes quickly and in quantity. On January 21, 1942, Eastern Aircraft was born, comprised of General Motors plants in Linden, Trenton and Bloomfield (all in new Jersey), Baltimore (Maryland) and Tarrytown (New York). Plants were emptied of their automobile equipment and converted into airplane manufacturing. As the war went on, streamlined manufacturing and sub-contracting increased the output of planes. By the end of the war, the Avenger had become one of the three most numerous carrier aircraft of all time. The total production of 9,839 Avengers was exceeded only by 12,570 Corsairs (a naval attack fighter) and 12,275 Hellcats (another fighter used for anti-submarine work, to provide air cover for invasion forces, and to provide close air support for ground troops).

This TBM-3E Avenger remained with the Navy until 1950, when it was transferred to the Canadian Armed Forces. In 1960, the bomber was decommissioned, and the rest of its active career was spent as a Canadian aerial tanker for firefighting and agricultural spraying. In 2001, Naval Air Station Wildwood Aviation Museum acquired the TBM-3E Avenger from Canadian Aerial Firefighting where it was known as Tanker 312 registered as CF-Mud. An anonymous

private donation of $66,000 allowed Naval Air Station Wildwood Aviation Museum to purchase the TBM-3E. Shortly afterwards, the Museum received a $60,000 New Jersey special legislative grant to restore its Avenger.

The TBM-3E "Avenger" Torpedo Bomber Warplane is now at the Naval Air Station Wildwood Aviation Museum located at 500 Forrestal Rd., at the Cape May County Airport in Rio Grande, New Jersey. The museum is open during the spring and summer daily from 9:00am to 5:00pm, and in the fall and winter it is open 8:00am to 4:00pm weekdays, and 8:00am to 3:00pm weekends. For more information, visit the museum's website or call 609-886-8787.

USS Lexington

Located in Corpus Christi, Texas, the aircraft carrier USS *Lexington* (CV-16) participated in almost every major World War II naval campaign in the Pacific from 1943 to 1945. The ship was a highly decorated warship, receiving numerous citations acknowledging her exemplary service. As an Essex-class carrier, *Lexington* is also important for illustrating the development of aircraft carrier design, the refinement of multi-carrier operations, and the integration of aviation as a primary strike weapon in naval strategy. As early as 1910, the U.S. Navy, recognizing the potential value that flight would have in naval operations, appointed non-flyer Captain Washington Irving Chambers to keep informed of developments in aviation. Chambers worked closely with Glenn Curtiss, aircraft manufacturer Eugene Fly (an associate of Curtiss) and Lieutenant T.G. Ellyson, the first naval aviator (trained in aviation by Curtiss at no cost to the government) to demonstrate the advantages of aviation to the Navy. Although naval aviation was utilized during World War I, aircraft assigned to warships generally provided only reconnaissance support for the fleet.

The possibility of using planes as a naval strike weapon did not begin until the 1920s when aircraft capable of performing heavy bombardment against land or sea targets were built. Naval vessels capable of carrying several squadrons of such aircraft were developed concurrently. Thus the first eight carriers constructed by the U.S. Navy varied in size, speed, protection and aircraft complement in order to provide the greatest number of carriers capable of launching the greatest number of air strikes, yet still comply with treaty-imposed tonnage restrictions. *Essex* (CV-9), the ninth U.S. carrier authorized, was a product of these earlier designs. A total of 26 Essex-class carriers were ordered by the U.S. Navy between February 1940 and June 1943 and 24 were completed. This was the largest class of carriers ever built by the United States and over half, including *Lexington* (CV-16), served as part of the Pacific Fleet during World War II.

Prior to World War II, the Navy had no practical battle experience for its carriers. It was in the Pacific Theater that aircraft carrier operations were developed and refined. Serving as mobile air bases, carriers could maneuver aircraft around the open waters and scattered island chains of the Pacific. By employing a combination of scouting, fighter or bomber aircraft to control the enemy's air power, groups of carriers, screened by surface ships, could open the way for island invasions, cover and support amphibious operations, and help to hold the conquered areas. Thus carriers became an integral compound of nearly every campaign throughout the Pacific War. With aircraft that extended the fleet's firepower beyond the range of large caliber battleship guns, the carrier's status was elevated from reconnaissance platform to that of major surface combatant.

World War II and the carrier campaigns of the Pacific firmly established the role of aviation within naval operations and the aircraft carrier replaced the battleship as the Navy's primary strike weapon. With postwar advances in nuclear arms and jet propulsion, the Essex carriers were upgraded to facilitate these new weapons and aircraft. Thus with modifications, *Lexington* continued to serve through the Cold War where air power played an increasingly important role in the major wars and limited engagements of the period.

USS *Lexington* (CV-16) was launched in 1942 as a welded, steel hull, Essex-class aircraft carrier with an overall length of 872 feet and a length along the waterline of 820 feet. *Lexington* had hangar deck capacity for 103 aircraft. *Lexington's* first air group (AG-16), consisted of 89 aircraft that included 32 F6f-3 Hellcat fighters, 35 SBD-5 Dauntless dive-bombers and 18 TBF-1 Avenger torpedo bombers. On November 26, 1991 *Lexington* was decommissioned. After making the successful bid to preserve, display and interpret *Lexington*, the city of Corpus Christi, Texas prepared a new life for the carrier as a museum ship.

The USS Lexington, *a National Historic Landmark, is now the USS* Lexington *Museum on the Bay, located in Corpus Christi Bay at 2914 N. Shoreline Blvd., just off Hwy. 181, in Corpus Christi, Texas. The museum is open daily, 9:00am to 5:00pm; from Memorial Day-Labor Day is it open until 6:00pm; closed Christmas Day. There is a fee; please call 361-888-4873 or visit the museum's web site at http://www.usslexington.com/general.shtml. for further information.*

USS Yorktown

Located in Mount Pleasant, South Carolina, the USS *Yorktown* (CV-10), the second Essex class carrier built by the United States, was commissioned on April 15, 1943. As early as 1910, the U.S. Navy recognized the potential value that flight would have in naval operations. Although naval aviation was utilized during World War I, aircraft assigned to warships generally provided only reconnaissance support for the fleet. The possibility of using airplanes as a naval strike weapon did not begin until the 1920s when aircraft capable of performing heavy bombardment against land or sea targets were built. Naval vessels capable of carrying several squadrons of such aircraft were developed concurrently. Thus the first eight carriers constructed by the U.S. Navy varied in size, speed, protection and aircraft complement in order to provide the greatest number of carriers capable of launching the greatest number of air strikes, yet still comply with treaty-imposed tonnage restrictions. *Essex* (CV-9), the ninth U.S. carrier authorized, was a product of these earlier designs.

A total of 26 Esssex-class carriers were ordered by the U.S. Navy between February 1940 and June 1943 and 24 were completed. This was the largest class of carriers ever built by the United States and over half, including USS *Yorktown* (CV-10), served as part of the Pacific Fleet during World War II. World War II and the carrier campaigns of the Pacific firmly established the role of aviation within naval operations and the aircraft carrier replaced the battleship as the Navy's primary strike weapon. Serving as mobile air bases, carriers could maneuver aircraft around the open waters and scattered island chains of the Pacific. By employing a combination of scouting, fighter or bomber aircraft to control the enemy's air power, groups of carriers, screened by surface ships, could open the way for island invasions, cover and support amphibious operations, and help to hold the conquered areas. Thus carriers became an integral compound of nearly every

campaign throughout the Pacific War. With aircraft that extended the fleet's firepower beyond the range of large caliber battleship guns, the carrier's status was elevated from reconnaissance platform to that of major surface combatant.

Named for the CV-5 aircraft carrier that was sunk during the Battle of Midway, the new USS *Yorktown* had a distinguished war record, receiving 11 battle stars and a Presidential Unit Citation for its World War II services. During World War II, the USS *Yorktown* fought against the Japanese for more than two years, inflicting heavy damage on the Japanese at Truk and the Marianas, helping sink the largest battleship ever built, the Imperial Japanese Navy's *Yamato* and supporting American ground troops in the Philippines, at Iwo Jima and at Okinawa. The USS *Yorktown* was converted for jet use in 1955 with the addition of a new angled flight deck, hurricane bow and flight deck. It then served as an anti-submarine carrier in Vietnam. In 1968 the Essex class carrier was used to recover the crew of Apollo 8, the first manned mission to orbit the moon. Before being decommissioned in 1970, the USS *Yorktown* had a notable career in the service of the United States. For a complete copy of the National Historic Landmark registration form for the USS *Yorktown*, click here.

The USS Yorktown *aircraft carrier, a National Historic Landmark, can be seen at Patriots Point Naval and Maritime Museum in Mount Pleasant, South Carolina, across the harbor from historic downtown Charleston. The museum is open daily from 9:00am to 7:30pm during the summer and from 9:00am to 6:30pm during the winter. Please call 1-800-248-3508, or visit the museum's website for further information. You can also download (in pdf) the USS* Yorktown *National Historic Landmark nomination.*

USS Intrepid

Located in Manhattan, New York, the USS *Intrepid*, the third Essex class carrier built by the United States, was laid down at the Newport News Shipbuilding and Drydock Company of Virginia and commissioned on August 16, 1943. As early as 1910, the U.S. Navy recognized the potential value that flight would have in naval operations. Although naval aviation was utilized during World War I, aircraft assigned to warships generally provided only reconnaissance support for the fleet. The possibility of using airplanes as a naval strike weapon did not begin until the 1920s when aircraft capable of performing heavy bombardment against land or sea targets were built. Naval vessels capable of carrying several squadrons of such aircraft were developed concurrently. Thus the first eight carriers constructed by the U.S. Navy varied in size, speed, protection and aircraft complement in order to provide the greatest number of carriers capable of launching the greatest number of air strikes, yet still comply with treaty-imposed tonnage restrictions. *Essex* (CV-9), the ninth U.S. carrier authorized, was a product of these earlier designs. A total of 26 Essex-class carriers were ordered by the U.S. Navy between February 1940 and June 1943 and 24 were completed. This was the largest class of carriers ever built by the United States and over half, including USS *Intrepid* (CV-11), served as part of the Pacific Fleet during World War II.

World War II and the carrier campaigns of the Pacific firmly established the role of aviation within naval operations and the aircraft carrier replaced the battleship as the Navy's primary strike weapon. Serving as mobile air bases, carriers could maneuver aircraft around the open

waters and scattered island chains of the Pacific. By employing a combination of scouting, fighter or bomber aircraft to control the enemy's air power, groups of carriers, screened by surface ships, could open the way for island invasions, cover and support amphibious operations, and help to hold the conquered areas. Thus carriers became an integral compound of nearly every campaign throughout the Pacific War. With aircraft that extended the fleet's firepower beyond the range of large caliber battleship guns, the carrier's status was elevated from reconnaissance platform to that of major surface combatant.

In two years of fighting against the Japanese the USS *Intrepid* was hit by enemy action on five occasions and took part in the largest naval battle in history, the Battle of Leyte Gulf in 1944. The USS *Intrepid* helped sink both of Japan's super-battleships, *Yamato* and *Musashi*. Five battle stars were awarded to the USS *Intrepid* for its World War II service. The USS *Intrepid* was extensively modernized by the Navy in 1954, converting it to a modern attack carrier capable of handling jets. All heavy guns were removed, the centerline elevator was removed and a new heavy-duty starboard side elevator was installed. The USS *Intrepid* is now operated as a memorial and museum ship.

The USS Intrepid, *a National Historic Landmark, can be viewed at the Intrepid Sea-Air-Space Museum in Manhattan, New York. In the spring and summer the museum is open from 10:00am to 5:00pm Monday-Friday; 10:00pm to 7:00pm Saturday and Sunday. During the fall and winter the museum is open from 10:00am to 5:00pm Tuesday-Sunday. Please call 212-245-0072, or visit the museum's website for further information.*

USS Hornet

Located in Alameda, California, the USS *Hornet* (CV-12) was part of a wartime buildup of U.S. carrier forces in a war that demonstrated the vital role of naval aviation. As early as 1910, the U.S. Navy recognized the potential value that flight would have in naval operations. Although naval aviation was utilized during World War I, aircraft assigned to warships generally provided only reconnaissance support for the fleet. The possibility of using airplanes as a naval strike weapon did not begin until the 1920s when aircraft capable of performing heavy bombardment against land or sea targets were built. Naval vessels capable of carrying several squadrons of such aircraft were developed concurrently. Thus the first eight carriers constructed by the U.S. Navy varied in size, speed, protection and aircraft complement in order to provide the greatest number of carriers capable of launching the greatest number of air strikes, yet still comply with treaty-imposed tonnage restrictions. *Essex* (CV-9), the ninth U.S. carrier authorized, was a product of these earlier designs. A total of 26 Esssex-class carriers were ordered by the U.S. Navy between February 1940 and June 1943 and 24 were completed. This was the largest class of carriers ever built by the United States and over half, including USS *Hornet* (CV-12), served as part of the Pacific Fleet during World War II.

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Launched just 10 months after its predecessor, the USS *Hornet* (CV-8), was lost in battle, the new *Hornet* had a distinguished World War II career that included the invasion of Saipan and the Battle of the Philippine Sea, the amphibious landing on Palau, the Philippines, Iwo Jima and Okinawa and strikes against the Japanese home islands. The USS *Hornet* and its air groups were credited with shooting down 688 planes, destroying another 742 aircraft on the ground, sinking a carrier, cruiser, 42 cargo ships and 10 destroyers and assisting in the sinking of the Japanese battleship *Yamato*. The *Hornet* received seven battle stars and the Presidential Unit citation during World War II. The USS *Hornet* was reactivated for the Korean conflict and its last combat deployment was as an antisubmarine warfare carrier in the Vietnam conflict.

The USS *Hornet's* exceptional career was capped with the recovery of the Apollo 11 and Apollo 12 astronauts at the end of these missions. Navy divers aided the Apollo 11 crew, astronauts Neil A. Armstrong, Edwin E. Aldrin, Jr. and Michael Collins, back to the *Hornet* after the capsule hit the water. The Apollo crew, wearing containment suits because of the possibility of introducing alien bacteria, stepped from the helicopter, waved and entered quarantine. President Richard M. Nixon welcomed the astronauts back to earth aboard the carrier . "*Hornet* plus three" then steamed for home. The Navy announced the impending retirement of the USS *Hornet* on January 15, 1970, and the carrier was decommissioned on June 30.

The USS Hornet, *a National Historic Landmark, can be seen at the USS* Hornet *Museum in Alameda, California. At Atlantic Avenue, turn left through the gate and into Alameda Point (formerly Naval Air Station Alameda). Turn left on Ferry Point and proceed along the water towards the cluster of large ships. Parking is available across the street from the USS* Hornet. *The museum is open from 10:00am to 5:00pm Wednesday-Monday; limited access on Tuesdays due to ship maintenance. Please call 510-521-8448, or visit the museum's website for further information and for directions from Oakland, San Jose, and San Francisco.*

United States Air Force Academy, Cadet Area

Born in the first decade of the Cold War, the United States Air Force Academy provided the new military service with a trained and educated officer corps at a time when national policy placed unprecedented emphasis on air power. Its campus, set in magnificent natural surroundings at the foot of the Rampart Range in Colorado, ranks among the finest examples of modern movement architecture commissioned by Federal agencies during the post-World War II era.

The United States reorganized its military under the National Security Act of 1947, establishing the Air Force as an independent service equal to the Army and Navy. In 1954, the Federal Government authorized the creation of the United States Air Force Academy (USAFA) to serve as the primary undergraduate educational institution of that new service, it continues to serve as an important military educational institution today. It joined the other two major U.S. academies-

-the United States Military Academy at West Point, New York, and the United States Naval Academy at Annapolis, Maryland--as the nation's undergraduate military schools.

Following World War II, the United States entered into a 45-year confrontation with the Soviet Union known as the Cold War. Although it was the newest service, the Air Force emerged as the nation's primary military arm, resulting in a major expansion of its ranks. The new service required an influx of officers, leading to the establishment of the USAFA. In the face of technological advances, including a burgeoning nuclear arsenal, the new service academy educated those officers for the increasingly complex demands of military leadership. In addition, it helped to define the Air Force's identity as distinct from the Army and Navy.

Built between 1958 and 1968, the campus was designed by Skidmore, Owings and Merrill (SOM), and broke from the traditions of West Point and Annapolis with its architectural vocabulary to become "the first U.S. national shrine to be designed in the modern style," according to *Architectural Forum* magazine. Its buildings stirred a national debate in Congress, professional journals and the popular media during the early years of the Cold War. In a survey of federally-built architecture, Lois Craig declared, "Perhaps no architectural debate over government buildings in the 1950s equaled the discussion about the design of the new U.S. Air Force Academy." The responses encapsulate many of the significant issues debated about architecture in the postwar era.

In particular, the Cadet Chapel is an exceptional example of postwar modern movement architecture. In the 1950s, while the United States engaged in the Cold War, American civil religion stood in contrast with "godless Communism." Historian Sydney Ahlstrom remarked of the decade, "There seemed to be a consensus that personal religious faith was an essential element in proper patriotic commitment." President Dwight Eisenhower summarized the non-sectarian attitude, stating, "Our government makes no sense unless it is founded on a deeply felt religious faith--and I don't care what it is." The Academy carefully embraced three major beliefs with distinct worship spaces in the chapel for Catholics, Protestants, and Jews, expanding in recent years to include Muslim, Buddhist and other faiths.

The United States Air Force Academy, a National Historic Landmark, is located 14 miles north of downtown Colorado Springs, Colorado. It is currently open to visitors, who must enter through the North Gate, accessible from Exit 156B on I-25. The Visitors Center is open from 9:00am to 5:00pm daily. The Cadet Chapel is open from 9:00am to 5:00pm, Monday-Saturday with periodic closings for chapel events. For more information, call the Visitor's Center at 333-2025, visit the Academy's website or e-mail pa.comrel@usafa.af.mil.

The United States Air Force Academy is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Goddard Rocket Launching Site

On March 16, 1926, Dr. Robert H. Goddard launched the world's first liquid-propelled rocket here in Auburn, Massachusetts, setting the course for future developments in rocketry. He

launched the rocket from his outdoor laboratory, an open field on the Asa Ward Farm at Auburn, Massachusetts. Since his childhood, Goddard had been fascinated with the thought that a rocket could be constructed that could reach the moon or even Mars. In 1914 Goddard received two U.S. patents that still remain fundamental documents in the field of rocketry--one for the design of the nozzle combustion chamber that allows the introduction of liqid fuel into the chamber and the other for the design of a multistage rocket for high altitude flight. In the following three years, Goddard received 70 patents for rockets and rocket apparatuses. He worked with the U.S. Army Signal Corps during World War I before returning to Auburn and his experiments with liquid propulsion. On November 1, 1923, Goddard static tested a rocket engine fueled with liquid oxygen and gasoline supplied by pumps on the rocket and by December 1925, this engine was operated independently of the testing frame.

The practical culmination of Goddard's work came on March 16, 1926 when he launched the world's first successful liquid-fueled rocket. The slim 10-foot cylinder reached an altitude of 41 feet, flew for two-and-a-half seconds and fell to the ground 184 feet from the launching frame. Goddard's final launch from Auburn, on July 17, 1929 was also a historic first. The 11-foot rocket carried an aneroid barometer, thermometer and a camera triggered when the parachute opened. All three instruments operated successfully and were recovered. The roaring rocket was heard throughout the town and some observers, thinking it was an airplane in flames, called for ambulances. The wire services quickly reported that Dr. Goddard's moon rocket had exploded violently. Despite the negative publicity, this event caught the attention of Charles A. Lindbergh, who was instrumental in obtaining substantial support from the Guggenheim Foundation for Goddard's research. Another grant from the Smithsonian Institution enabled Goddard to move his laboratory to Roswell, New Mexico, where on December 30, 1930, a rocket achieved an altitude of 2,000 feet and a speed of 500 miles per hour. A little over four years later, Goddard sent up the first rocket equipped with a gyroscope, which rose to 4,800 feet and traveled a horizontal distance of 13,000 feet. However, it was not until the appearance of the German V-2 missile in 1943 that the significance of Goddard's research was fully recognized and his work seriously studied by American scientists.

The Goddard Rocket Launching Site, a National Historic Landmark, is located at 20 Upland St. in Auburn, Massachusetts. The Asa Ward Farm was converted to the Pakachoag Golf Course in the early 1930s. The Goddard Rocket Launching Site is commemorated with two markers that are accessible to visitors during regular operating hours of the golf course. Call 508-755-3291 for further information.

White Sands V-2 Launching Site

The White Sands V-2 Launching Site, or Launch Complex 33, was developed specifically to accommodate V-2 rocket tests at the White Sands Missile Range in New Mexico. The launch complex has two important structures: the old Army Blockhouse and the launching crane, also known as the Gantry Crane. The Army Blockhouse was completed in late September 1945 and was primarily used as an observation point and laboratory in the pioneer development of the V-2 rocket in the United States. The Gantry Crane, a steel tower 75 feet tall and 25 feet wide, was constructed in November 1946 to launch the V-2 and Viking rockets. The German V-2 Rocket-Vergeltungswaffen-2, or "weapon of retaliation"--the most advanced rocket of its type, was

developed to support the German war effort and by 1945 hundreds of these rockets were launched against Allied targets in England and on the continent of Europe. The American government in Operation Paperclip captured more than 100 V-2 rockets and numerous German scientists and engineers associated with the V-2 development program, including Dr. Werner Von Braun. The Army brought Dr. Von Braun and the captured V-2s to the newly opened White Sands Missile Range.

By March 1946 the first captured V-2 was static test fired at White Sands and in April 1946 the first V-2 was launched. From 1946 to 1951 the Army generated an increasing expertise in rocket technology and launched 67 V-2s from White Sands, establishing high altitude and velocity records that reached to the very edge of space. From these experiments emerged the first generation of American built rockets such as the Corporal, Redstone, Nike, Aerobee and Atlas. At the conclusion of the testing program for the V-2, the Army transferred its rocket team under Dr. Von Braun to the Redstone Arsenal in Huntsville, Alabama, to continue work on basic research and prototype development of new rockets. Launch Complex 33 at the White Sands Missile Test Range tested and launched the very first generation of technologically sophisticated rockets that enabled Americans to probe to the very edge of space.

On the White Sands Missile Range the world's first nuclear device (code name "Trinity") was detonated on July 16, 1945. The Los Alamos Project of the Manhattan Engineer District of the War Department began in 1943 with its purpose the development and final manufacture of a nuclear instrument of war. The Trinity Site, within the White Sands Missile Range, is a National Historic Landmark.

White Sands V-2 Launching Site, a National Historic Landmark, is located at the White Sands Missile Range in New Mexico. The missile range is closed due to security concerns; interested parties who want to see the Launch Complex 33 should call the public affairs number at 505-678-1134 well in advance -- a guided tour is possible. The White Sands Missile Range Museum offers many exhibits tracing the history of missile and space flight testing. It is located between Las Cruces and Alamogordo, New Mexico, off US-70, US-82. The museum is open weekdays from 8:00am to 4:00pm and weekends from 10:00am to 3:00pm; closed major holidays. The Missile Park in front of the museum is open daily, dawn to dusk. For more information call 505-678-8824 or visit the museum's website. Visitors may alse be interested in the nearby White Sands National Monument.

US Naval Ordnance Test Facilities, Topsail Island MPS

At the end of World War II the Navy established the US Naval Ordnance Test Facilities at Topsail Island, North Carolina, for Operation Bumblebee, a top-secret, experimental project to develop and test ramjet missiles, which advanced the Nation's jet aircraft and missile programs. So successful were the tests conducted at the Topsail Island site that the ramjet proved its value, opened the way for the advance of supersonic jet aircraft design and brought the United States to the threshold of modern space technology with the Talos, Terrier, Tartar and Sea Sparrow missiles aboard naval vessels. Named after a bumblebee, which although aerodynamically unable to fly, does not know this and flies anyway, this operation lead to the maturing of supersonic aircraft and shipboard missile design in the mid-20th century.

Topsail Island was the third of three widespread test sites established along the Atlantic seaboard in the closing years of World War II, and the first permanent ground for missile testing. The Topsail Island site, placed in operation in March 1947, incorporated rigid structures that were designed and built for specific uses related to the assembly, firing, monitoring and perfecting of experimental ramjet missiles. The buildings associated with this testing, the Assembly Building, Facility Control Tower and Observation Tower No. 2 possess exceptional importance because they are the only aboveground resources remaining at these three sites where the Nation's burgeoning ramjet missile program grew from experimentation to maturity. The Assembly Building is a one-and-a-half-story masonry building and the Control Tower is a three-story reinforced concrete building. Observation Tower #2 is an unaltered example of the seven instrument towers erected on Topsail Island.

The first explanation of the theory behind the ramjet engine was made in 1908 by a French engineer, Rene Lorin, who speculated that exhausts from standard internal combustion engine, if directed into diverging nozzles, produced jets that would propel the vehicle. During World War I, Lorin brought his theories of the ramjets to the attention of the French government, suggesting that it might be used to defeat the Germans. He was not taken seriously at the time, and little attention was given to refining ramjets at the time. The incentive came in World War II with the impact of Germany's V-2 rocket assaults on France and England in 1944. Following the war, the research and development of high-altitude warfare became a vital and competitive affair on an international scale. In the United States, the first test site for ramjet missiles was at Island Beach, New Jersey, managed by the U.S. Navy in association with the John Hopkins University Applied Physics Laboratory and the Kellex Corporation. The second installation was activated at Fort Miles, Delaware, in early 1946. However, by April 1946, a joint report by the Navy and its partners identified Topsail Island as the most suitable location for a permanent test site.

Naval and Marine personnel, numbering 500 men, and led by Lieutenant Commander Tad Stanwick, arrived at the site by mid-1946 to begin installation of the facilities needed for the testing. Research, development and testing of the missile components were handled by the Applied Physics Laboratory at Silver Spring, Maryland, and the two-stage rockets, consisting of a solid booster to launch the missile and a ramjet engine to bring it up to supersonic speed, were made at Cumberland, Maryland.

During the next 18 months, an estimated 200 experimental rockets, each measuring six inches in diameter and between three and 13 feet in length, were fabricated at the Assembly Building, dispatched to the launch site, and fired along a northeasterly angular deflection of 15 degrees to the shoreline for a maximum clear distance of 40 miles. Despite the initial success of the US Naval Ordnance Testing facility at Topsail Island over its 18-month span, its location did not fulfill completely the needs of a permanent base because weather conditions and increased sea traffic interfered with testing, and the facility was abandoned and its equipment moved to other sites.

US Naval Ordnance Test Facilities is located along Hwy. 50 on Topsail Island, North Carolina. Take US Hwy. 17 from Wilmington or Jacksonville, North Carolina, to Hwy. 50 east towards Surf City. From Raleigh, take I-40 to exit 408, then take 210 until it joins Hwy. 17 north. The Assembly Building, at 720 Channel Blvd. is now the Missiles and More Museum, open April-

mid-October from 2:00pm to 4:00pm Monday, Tuesday, Thursday, Friday and Saturday (closed Wednesday and Sunday). From November to March the museum is only open by appointment. Contact the Chamber of Commerce for further information at 1-800-626-2780 or visit http://members.tripod.com/topsailjo/society.html.

Cape Canaveral Air Force Station

Cape Canaveral Air Force Station in Florida has played an important role in the space program and missile testing in the United States. In 1947 Cape Canaveral Air Force Station was selected as the site for a U.S. Missile Testing Range. The first missile, a German V-2 rocket, was launched on July 14, 1950. During the following three years, facilities were constructed for the testing of cruise-type missile weapons including the Matador, Snark and Bomark. Launch Complex 5/6, constructed in 1955 for the Redstone missile testing program and subsequently used for the Jupiter C, Juno I, Juno II and Mercury/Redstone missiles, launched Alan Shepard in *Freedom 7* on May 5, 1961 and Gus Grissom in *Liberty Bell 7* on July 21, 1961. Launch Complex 26 launched *Explorer I*, the first U.S. satellite, on January 31, 1958 and was the site of the launch of primates Ham, Gordo, Able and Baker in tests that paved the way for Alan Shepard's Mercury flight. The Atlas, the nation's first intercontinental ballistic missile (ICBM), utilized Launch Complexes 13 and 14. On December 18, 1958 an entire Atlas vehicle, Project Score, was placed into orbit carrying a tape-recorded message from President Eisenhower that was relayed to the world.

A total of 10 Gemini launches were flown from Complex 19 in 1965 and 1966, marking the beginning of sophisticated manned space flight. Two of the largest and most advanced launch facilities built at Cape Canaveral Air Force Station by the National Aeronautics and Space Administration (NASA) were Launch Complexes 34 and 37. Here, the first of 15 launches of the Saturn space vehicle occurred on October 27, 1961. Launch Complex 34 was also the site of the January 27, 1967, fire that claimed the lives of astronauts Gus Grissom, Edward White and Roger Chaffe.These complexes went on to launch the first series of the three-man Apollo space flights.

However, a gradual decline occurred in most operations at Cape Canaveral Air Force Station, which could no longer house new rocket facilities. Most operations, including the remainder of the Apollo launches, were transferred to nearby John F. Kennedy Space Center. The Cape Canaveral Air Force Station includes discontiguous sites and encompasses six launch pads, a mobile service tower and the original Mission Control Center that was used for all Mercury flights and the first three Gemini flights. For a complete copy of the National Historic Landmark registration form for the Cape Canaveral Air Force Station, click here.

The Cape Canaveral Air Force Station, a National Historic Landmark, is located on Patrick Air Force Base in the Cocoa and Cocoa Beach vicinity on the east coast of Florida. The Air Force Space and Missile Museum is open to the public daily. Please call 321-853-9171, or visit the museum's website for further information. Visitors may alse be interested in the nearby Canaveral National Seashore. You can also download (in pdf) the Cape Canaveral Air Force Station National Historic Landmark nomination.

The Cape Canaveral Air Force Station is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Unitary Plan Wind Tunnel

The Unitary Plan Wind Tunnel located at the Ames Research Center at Moffett Field, Sunnyvale, California, was a research facility used extensively to design and test new generations of aircraft, both commercial and military, as well as National Aeronautics and Space Administration (NASA) space vehicles, including the space shuttle. The Unitary Plan Wind Tunnel was created by the National Advisory Committee for Aeronautics (NACA), parent agency of NASA. Constructed between 1950 and 1955, this complex actually contains three wind tunnels. It represents the continual development of superior aeronautical research facilities after the end of the Second World War. These research facilities formed the foundation from which NASA would launch the American effort to land a man on the moon.

After the construction of the Variable Density Wind Tunnel at Langley in 1921, NACA built an impressive variety of technical research facilities upon which the American aircraft industry was based. These facilities enabled the American aircraft industry to dominate the skies in both commercial and military aviation. By 1945, America's lead in the field of aviation seemed to be evaporating. The technological achievements of the German missiles and jet aircraft indicated a lag in American aeronautical research. In 1949, Congress passed the Unitary Plan Act, under which the Federal government coordinated a national plan of facility construction encompassing NACA, as well as the Air Force, private industry and universities. The Unitary Plan resulted in the construction of a new series of wind tunnel complexes to support the American aircraft industry, including the Ames Unitary Plan Wind Tunnel Complex.

Construction of this facility began in 1950-1951 and continued until 1955. Because no one wind tunnel could meet all the demands for additional research facilities simulating the entire range of aircraft and missile flight, NACA chose to build the Ames tunnel with three separate test sections drawing power from a common centralized power plant. The transonic test section spanned 11 by 11 feet, while the two supersonic sections were smaller: nine by seven feet and eight by seven feet. Giant valves 20 feet in diameter supplied air from one supersonic leg to another. The American West Coast aircraft industry quickly capitalized on the Ames Unitary Plan Wind Tunnel Complex. The famed Boeing fleet of commercial transports and the Douglas DC-8, DC-9 and DC-10 were all tested here, as well as military aircraft such as the F-111 fighter, the C-5A transport and the B-1 bomber. In addition to aircraft, in the 1960s and 1970s almost all NASA manned space vehicles including the Space Shuttle were tested in the Ames Unitary Plan Wind Tunnel complex.

The major element of the tunnel complex is its drive system, consisting of four intercoupled electric motors. The transonic wind tunnel is a closed-return, variable density tunnel with a fixed geometry, ventilated throat, and a single-jack flexible nozzle. Airflow is produced by a three-stage, axial-flow compressor powered by four wound-rotor, variable-speed induction motors. For conventional steady-state tests, models are generally supported on a string. A schlieran system, one that allows regions of varying refraction in a transparent medium caused by pressure or

temperature differences and detectable by photographing the passage of a beam of light, is available for studying flow patterns, either by direct viewing or by photographs. The details of the larger supersonic tunnel are much the same, except that it is equipped with an asymmetric, sliding-block nozzle and the airflow is produced by an 11 stage, axial-flow compressor powered by four variable-speed, wound-rotor, induction motors. The smaller supersonic tunnel is a closed-return, variable-density tunnel equipped with a symmetrical, flexible-wall throat and the sidewalls are positioned by a series of jacks operated by hydraulic motors.

The Unitary Plan Wind Tunnel, a National Historic Landmark, is also featured in the Santa Clara, California, Travel Itinerary. It is located at the Ames Research Center, Moffett Field, Sunnyvale, California. Moffett Field is 35 miles south of San Francisco. From Hwy. 101 use the Moffett Field exit. The Ames Research Visitor Center is open 8:00am to 4:30pm Monday-Friday. Call 650-604-5000 for further information. Admission is free. There are no tours of the wind tunnels.

Neutral Buoyancy Space Simulator

The Neutral Buoyancy Simulator is located in Building 4705 at the Marshall Space Flight Center in Huntsville, Alabama. It was designed by the Army in 1955 to provide a simulated zero-gravity environment in which engineers, designers and astronauts could perform for extended periods of time in simulated environment of outer space. The Neutral Buoyancy Simulator is a facility that is unique within the National Aeronautics and Space Administration (NASA) inventory of training facilities. Due to its capability to support research and testing of operational techniques and materials needed to successfully perform space-manned missions, the Neutral Buoyancy Simulator contributed significantly to the American manned space program. Projects Gemini, Apollo, Skylab and the Space Shuttle have all benefited from the Neutral Buoyancy Simulator. Until the mid-1970s, when an additional facility was constructed at the Johnson Space Flight Center to support the Space Shuttle Program, this facility was the only test facility that allowed astronauts to become familiar with the dynamics of body motion under weightless conditions.

Within the heart of the simulator is a large water tank, 75 feet in diameter and 40 feet deep. The water within the simulator is temperature controlled, continuously recirculated and filtered. There are four observation levels with portholes to view activities within the simulator. An elevator serves all four observation levels and special systems are integrated into the tank for underwater audio and video, pressure-suit environmental control and emergency rescue and treatment. Life support is simultaneously provided by these systems for up to four pressure-suited subjects. Additional systems include date aquisition and recording, underwater lighting, special underwater pneumatic and electrical power operations of motor, valves, controls, and indicators that are required for high fidelity and functional engineering mockups and trainers. Adjacent to the Neutral Buoyancy Simulator is a completely equipped test control area for directing, controlling and monitoring simulation activities in the Neutral Buoyancy Simulator. An annex contains the operating crew dressing and shower area. For a complete copy of the National Historic Landmark registration form for the Neutral Buoyancy Simulator, click here.

The Neutral Buoyancy Simulator, a National Historic Landmark, is located inside the George C. Marshall Space Flight Center in Huntsville, Alabama. It is closed to the public. You can also

download (in pdf) the Neutral Buoyancy National Historic Landmark nomination.

Propulsion and Structual Test Facility

Built in 1957 by the Army Ballistic Missile Agency and transferred to the National Aeronautics and Space Administration (NASA), the Propulsion and Structural Test Facility, in Huntsville, Alabama, became the primary center responsible for the development of large vehicles and rocket propulsion systems. During the 1960s, under the direction of Dr. Werner von Braun, the Saturn family of launch vehicles was developed here. This facility has supported testing of the Army Redstone Rocket, the Saturn S-1B vehicle and the F-1 engine of the Saturn 1-C vehicle employed in the Apollo program. One position of the test stand was later modified to accommodate static testing for the Solid Rocket booster currently used in the Space Shuttle program.

Continually used and modified to meet new demands, the Propulsion and Structural Test Facility has played a part in testing every important rocket developed by the Redstone Arsenal and, later, the Marshall Space Flight Center. Without the Propulsion and Structural Test Facility the Apollo missions and the American Space Program would never have succeeded. Years of testing at this site have literally launched the American Space Program.

The Propulsion and Structural Test Facility, a National Historic Landmark, is located at the George C. Marshall Space Flight Center in Huntsville, Alabama. It is closed to the public. The Propulsion and Structural Test Facility has also been documented by the Historic American Engineering Record.

Redstone Test Stand

The Redstone Test Stand is the oldest static firing facility at the Marshall Space Flight Center, in Huntsville, Alabama. Constructed by the Ordnance Guided Missile Center at Redstone Arsenal and transferred to the National Aeronautics and Space Administration (NASA) in 1960, the Redstone Test Stand was the first test stand in the United States to accommodate the entire launch vehicle for static tests. Prior to this, test stands had accommodated the engine only. The Redstone Test Stand was an important facility in developing the Jupiter C and the Mercury/Redstone vehicles that launched the first American satellite and the first American manned space flight, along with developing the launch procedures vital to manned space flight.

After the USSR opened the space age in October 1957 by orbiting Sputnik I, the Army Redstone Team led by Dr. Werner von Braun was directed to attempt a satellite launch, a feat accomplished on January 31, 1958. The Mercury/Redstone vehicle was tested at the Redstone Test Stand and two of these vehicles eventually carried men into space. As the space program grew and expanded, more sophisticated test sites were required. The Redstone Test Stand was phased out of the active test program in 1961 and all usable equipment was removed.

The Redstone Test Stand, a National Historic Landmark, is located at the George C. Marshall Space Flight Center in Huntsville, Alabama. It is closed to the public. Visit the Redstone

Arsenal's history webpage for more information. The Redstone Test Stand has also been documented by the Historic American Engineering Record.

Space Launch Complex 10

The Space Launch Complex 10 (SLC-10) is part of the Headquarters Air Force Systems Command Western Space and Missile Center (WSMC) at Vandenberg Air Force Base in Lompoc, California. Built in 1958 for the U.S. Air Force's Intermediate Range Ballistic Missile (IRBM) Testing Program, this complex was adapted for space flight purposes. SLC-10 is comprised of a blockhouse and two launch pads (east and west) and was one of two launch pads built by the Douglas Aircraft Company to support combat training launches of the SM-75 Thor IRBM. Vandenberg Air Force Base belongs to Strategic Air Command (SAC).

The SLC-10 blockhouse, with its supporting electrical equipment, is intact. The blockhouse was used to control launches from both the east and west pads. The blockhouse is a self-contained reinforced concrete building capable of withstanding the dangers of catastrophic vehicle failures at lift-off. The missiles launched from the pad were liquid fueled. At SLC-10W, the fuel and liquid oxygen storage tanks, four nitrogen storage tanks, two high pressure storage tanks, and their associated pipes are still intact and in good condition. The launch vehicle erecting-launching mount and the launch shelter (prefabricated building) are still in place and in good condition. SLC-10W is the best surviving example of a launch complex built in the 1950s at the beginning of the American effort to explore space.

The first launch from SLC-10E occurred on June 16, 1959, by the Royal Air Force of the United Kingdom, as the Thor missiles had been developed in England. In order to support the nuclear testing project at Johnston Island, the entire launch complex was dismantled and transported to that remote Pacific atoll between January and March 1962. The desire of Headquarters USAF to proceed with the Burner I/Altair satellite program led to the decision to rebuild the SLC-10W. Construction began in May 1963, using equipment shipped from England where the 60 IRBM sites were being dismantled, and was completed in October 1963. After the pad was used for missile/launcher twist testing in its IRBM configuration from March to April 1964, it was partially torn down for modifications to support space launch operations. The pad was back in commission in October 1964, ready to support the Burner I/Altair series of satellite launches. On January 18, 1965, the first THOR Burner I space booster was launched. Twenty launches, using THOR/Burner IIs, THOR Burner IIAs and Thor/Block 5D-1s were performed at this site between 1968 and July 1980. On July 14, 1980, the last LV-2F THOR Space Booster in existence became the 32nd THOR to lift off from SLC-10W.

Space Launch Complex 10, a National Historic Landmark, is located at Vandenberg Air Force Base 10 miles NW of Lompoc and 17 miles SW of Santa Maria, California. The Vandenberg AFB public tour program recently resumed after it was suspended two years ago due to heightened security levels at this active base. Tours are available the 2nd and 4th Wednesday of each month, security and mission permitting. Tours depart from the visitor's center parking lot at 10:00am, take visitor by bus through the base and include a tour of the Heritage Museum, which provides mock-ups of missile silos, an old missile control station and decommissioned rocket engines. Tour duration is two hours, and participants are encouraged to arrive 30 minutes prior to

departure time. Reservations are required at least two weeks in advance and visitors need two forms of photo identification. No walk-ons are permitted. For reservations and more information call the 30th Space Wing Public Affairs office at 805-606-3595.

Space Flight Operations Facility

The Space Flight Operations Facility (SFOF) is located at the Jet Propulsion Laboratory (JPL) in Pasadena, California. This facility is where spacecraft tracking and scientific data are received and processed from the JPL's Deep Space Network. The JPL from the beginning of its association with the National Aeronautics and Space Administration (NASA) in 1958 has served as the primary NASA center for the unmanned exploration of the planets. The first version of the Space Flight Operations Facility was built in 1958 to support the Explorer 1 satellite. This mission control center was in a single room that housed all the communications, recording and other support necessary for Explorer 1. By 1961, with the coming of Project Ranger to explore the moon, it was obvious that a more elaborate mission control center was necessary. A new SFOF, replacing the Explorer 1 control center, was constructed as the focal point of the Deep Space Network--the hub of the vast communications network through which NASA controls its unmanned spacecraft flying in deep space.

Located in a three-story square building with a standby powerhouse extending from the basement on the west side, the new SFOF was constructed in 1963. All parts of the building, except for portions of the basement and the standby powerhouse, are air-conditioned to precise tolerances. At the heart of the SFOF is the Network Operations Control Center, which provides a centralized point for NASA's Deep Space Network. The Network Operations Control Center has two separate functional elements: Network Operations Control and Network Data Processing. The Network Operations Control Center houses consoles, video displays, projection screens, status and operation displays, closed circuit television communication links and telephones necessary to control and monitor deep space flight operations. The Network Data Processing Center houses the computers and the data storage and processing facilities necessary to support the Network Operations Control Center. Other areas of the building house offices, public viewing areas and additional support facilities for the Network Operations Control Center.

The Mariner, Viking, Pioneer and Voyager projects that have explored the planets and solar environment have all been controlled for at least part of their missions in this facility. The vast harvest of scientific information concerning the planets and the universe gathered by these spacecraft first saw the light of day and were read by technicians working in the SFOF. The SFOF is the symbol of the technology that explored the planets and brought back new discoveries to Earth, and it is the resource most closely associated with the unmanned planetary exploration program of the JPL and NASA. The Space Operations Facility is still an active NASA facility supporting various ongoing NASA projects and its equipment is continually modified and upgraded.

The Space Flight Operations Facility, a National Historic Landmark, is located at Jet Propulsion Laboratory (JPL) at 4800 Oak Grove Dr. in Pasadena, California. Visitors must contact the JPL Public Services Office to make an advance reservation for a free group or individual tour. All tours are two to three hours in duration and commonly include a multi-media

presentation on JPL entitled "Welcome to Outer Space," which provides an overview of the Laboratory's activities and accomplishments. Visitors 18 years of age or older must present valid photo ID. Please call the Public Service Office at 818-354-9314 to make a reservation or visit the JPL website for further information.

John F. Kennedy Space Center MPS

John F. Kennedy Space Center in eastern Florida has historically functioned as the major National Aeronautics and Space Administration (NASA) launch facility for manned and unmanned space missions. Prior to the development of the John F. Kennedy Space Center, space missions originated from Cape Canaveral Air Force Station. However, when President Kennedy initiated the Man-to-the-Moon project, Cape Canaveral Air Force Station was deemed insufficient to house further facilities. In 1961 NASA requested from Congress authority to purchase 125 square miles of property that became John F. Kennedy Space Center. The space program proceeded rapidly, progressing through four major phases: Mercury, Gemini, Apollo and the Space Shuttle. Project Mercury, executed in less than five years, put a manned spacecraft in orbital flight around the earth. Project Gemini was dedicated to long-duration missions. The goal of the Apollo program, the largest and most ambitious of the manned space programs, was landing astronauts on the moon and their safe return to earth. After the first few Apollo missions, all originating at the John F. Kennedy Space Center, Apollo 11 culminated when astronauts Neil A. Armstrong and Col. Edwin E. Aldrin, Jr. touched down on the moon in their lunar module on July 21, 1969 while Lt. Col. Michael Collins, navigator of the Apollo craft, remained in orbit.

The Space Shuttle program was dedicated to creating a reusable shuttle. The first reusable space shuttle lifted off from John F. Kennedy Space Center on April 12, 1981, carrying John Young and Robert Crippen. By 1986, NASA was approaching a goal of 12 to 13 shuttle launches each year. Following the loss of the *Challenger* and its crew on January 28, 1986, the program experienced a 32-month hiatus. Today as the leading space center, John F. Kennedy Space Center launches manned space vehicles, unmanned planetary spacecraft, scientific, meteorological and communications satellites and serves as a launch site for the reusable Space Shuttle. The planning and directing of space vehicle assembly, preflight preparation, spacecraft tests, countdown and launch operations and landing operations are among a few of the responsibilities of John F. Kennedy Space Center. The National Register listings at the John F. Kennedy Space Center include the Operations and Checkout Building, the Missile Crawler Transporter Facilities, the Crawlerway, the Headquarters Building, the Press Site, Clock and Flag Pole, the Vehicle Assembly Building, the Central Instrumentation Facility, the Launch Control Center and Launch Complex 39.

John F. Kennedy Space Center Multiple Property Submission is located on the east coast of Florida approximately midway between Jacksonville and Miami. The Kennedy Space Center Visitor Complex is open every day of the year (except Christmas Day and certain launch days) from 9:00am to 5:30pm. For further information please call 321-449-4444 or visit www.kennedyspacecenter.com

The John F. Kennedy Space Center is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in

the National Register. To learn more, visit the Teaching with Historic Places home page.

Apollo Mission Control Center

The Apollo Mission Control Center, in Building 30 at the Lyndon B. Johnson Manned Space Flight Center in Houston, Texas, consists of a mission operations wing (MOW), operations support wing (OSW) and an interconnecting lobby wing. This facility was used to monitor nine Gemini and all Apollo flights, including the flight of Apollo 11 that first landed men on the moon. The Apollo Mission Control Center, provided critical support to the success of the mission, exercised full mission control of the flight of Apollo 11 from the time of liftoff from Launch Complex 39 at the Kennedy Space Center to the time of splashdown in the Pacific.

The technical management of all areas of vehicle systems of Apollo 11 including flight dynamics, life systems, flight crew activities, recovery support and ground operations were handled at the Apollo Mission Control Center. Through the use of television and the print news media the scene of activity at the Apollo Mission Control during the first manned landing on the moon was made familiar to millions of Americans. When Neil Armstrong reported his "That's one small step for a man, one giant leap for mankind" to Mission Control his words went immediately around the world and into history. After the end of the Apollo Program this facility was used to monitor manned spaceflights for Skylab, Apollo-Soyuz and all recent Space Shuttle flights. For most Americans the Apollo Mission Control Center and Launch Complex 39 at the Kennedy Space Center symbolize achievements of the manned space program. For a complete copy of the National Historic Landmark registration form for the Apollo Mission Control Center, click here.

The Apollo Mission Control Center, a National Historic Landmark, is part of the Lyndon B.Johnson Manned Space Flight Center, located at 1601 NASA Rd. approximately 25 miles south of downtown Houston in the NASA/Clear Lake area. Space Center Houston, the Official Visitor center of NASA's Johnson Space Center, is open from 10:00am to 7:00pm weekdays in June, 9:00am to 7:00pm in July, 10:00am to 5:00pm in August, and on summer weekends from 10:00am to 7:00pm. During the winter it is open weekdays 10:00am to 5:00pm and 10:00am to 6:00pm on weekends. There is a fee for admission. Please call 281-244-2105 or visit the space center's website for more information. You can also download (in pdf) the Apollo Mission Control Center National Historic Landmark nomination.

The Apollo Mission Control Center is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Space Environment Simulation Laboratory

Located at Building 32 at the Lyndon B. Johnson Space Center in Houston, Texas, the Space Environmental Simulation Laboratory (SESL) was part of the manned spacecraft program of the United States. The SESL was designed, built, and used to conduct thermal-vacuum testing for all United States manned spacecraft of the Apollo era. The large size of both chambers in the SESL meant that full scale flight hardware could be tested for a variety of design and development

programs involving such factors as operating temperatures, fluid leak rates, changes in absorptive or emissive properties of thermal coatings and other materials. The testing was absolutely essential to man rate, a higher safety level used for manned aviation operations, flight hardware. The safety of the astronauts and the success of the manned space program depended on information that resulted from these tests in the SESL.

Since it was constructed in 1965, the SESL has tested all Apollo command and service modules, Apollo lunar modules, spacesuits for extra-vehicular activity, the Skylab/Apollo telescope mount system, various Space Shuttle systems, the Apollo/Soyuz docking module and various large scale scientific satellite systems such as the parabolic reflector subsystem of the Applications Technology Satellite. The thermal vacuum testing done at the SESL since 1965 has been a significant factor contributing to the success of both the manned and unmanned space program of the United States.

The SESL Chamber A is the largest of the Johnson Space Center thermal-vacuum test facilities. Its usable test volume and high-fidelity space simulation capabilities are adaptable to thermal-vacuum tests of a wide variety of test articles. The major structural elements of the chamber are the rotatable floor, the 40-foot diameter access floor and the dual manlocks at the floor level and at the 31-foot level. Test articles are normally inserted into the chamber by means of overhead cranes and a dolly and track. The dual manlocks are chambers that provide a means for the test crew to move from ambient air pressure to the thermal-vacuum environment and back. When the inner door is bolted, either of the manlocks can be used as an altitude chamber for independent tests. Chamber B, the smaller man-rated chamber, has the same basic capability as Chamber A and can accommodate a variety of smaller scale tests more economically and with faster responses. Major structural elements of the chamber are the removable top head, the fixed chamber floor, and a dual manlock at the floor level. For a complete copy of the National Historic Landmark registration form for the Space Environmental Simulation Laboratory, click here.

Space Environmental Simulation Laboratory, a National Historic Landmark, at NASA's Lyndon B. Johnson Space Center is located on NASA Rd. 1, approximately 25 miles south of downtown Houston in the NASA/Clear Lake area. Space Center Houston, the Official Visitor center of NASA's Johnson Space Center, is open weekdays from 10:00am to 7:00pm in June, 9:00am to 7:00pm in July, 10:00am to 5:00pm in August, and on summer weekends from 10:00am to 7:00pm. During the winter it is open weekdays 10:00am to 5:00pm and 10:00am to 6:00pm on weekends. There is a fee for admission. Please call 281-244-2105 or visit the space center's website for more information. You can also download (in pdf) the Space Environmental Simulation Laboratory National Historic Landmark nomination.

Rocket Propulsion Test Complex

The Rocket Propulsion Test Complex, or the National Space Technology Laboratories, was established in the early 1960s as the national rocket test range for large rocket propulsion systems. This facility in Mississippi was the primary site for conducting research, development and certification testing on non-flight engines to improve and upgrade basic engine design and acceptable testing of flight engines.

The Saturn V rocket was one of the most reliable rockets ever built for the space program and was crucial to the effort to land a man on the moon. The success of the Saturn V was dependent upon extensive ground testing of the vehicle. Once the Saturn V lifted off the pad there was no turning back for repairs. Its powered flight was brief but critical. The economics of rocketry and the physical safety of the astronauts demanded that the rocket work perfectly. This was the purpose of the Rocket Propulsion Test Facility. No Saturn V was shipped to the Kennedy Space Center until its engines were fully tested and certified. Any problem capable of causing a failure in the vehicle was discovered and corrected before the actual launch. The Rocket Propulsion Test Complex was the critical final step in certifying the Saturn V rocket ready for flight.

The two test areas, A and B, of the Rocket Propulsion Test Complex were both built in 1965. The B Test Complex supported all ground testing for the S-1C stage of the Saturn V rocket. Its test stand is a dual position stand, 407 feet tall and constructed from steel and concrete resting on 1600 steel pilings each 98 feet long. During test firings, the S-IC stage was secured by four huge hold-down arms anchored to a slab of concrete 39 feet thick. The retraining arms clamped onto the rocket tail by means of a drive mechanism geared to move only three inches per minute. In addition to the test stand, the B Test Complex consists of a Test Control Center (TCC) and the required technical facilities (water, electrical, high pressure gas, propellant systems, etc.), as well as the associated ground support equipment necessary to control and fire the captive stage. The TCC houses the equipment and people required to control, observe, supervise and monitor the operation of the test complex. The TCC is also a position from which technical observers can view test firings and which provides a blasterproof location for test stand personnel who have vacated the stand during test firings. The TCC is capable of supporting additional stage and/or engine test stands. The high-pressure Gas System includes a battery of air, nitrogen and helium. The propellant system includes a 300,000-gallon ready storage tank and docking and transfer facilities for the liquid propellant barges.

The A Test Complex performed all ground testing for the S-11 stage of the Saturn V rocket. It consists of two single-position test stands, designated A-1 and A-2, a TCC, observation bunkers, technical systems (such as high-pressure gas systems, water, electrical, etc.), as well as all associated ground service equipment necessary to control and fire engines or stages involved. Each stand is capable of static firing a stage up to 33 feet in diameter and 82 feet long. Using an adapter system or modifying the stand can test stages of greater or smaller diameter and length. These stands were designed for 1,000,000 pounds of thrust although they have a capability up to 1,200,000 pounds. The stand propellant systems include liquid oxygen and liquid hydrogen. The TCC performs the same functions as the B TCC. It is also capable of supporting additional test stands without modifying the physical facilities. The high-pressure gas battery contains air, helium and nitrogen. There is also a separate gas battery for the hydrogen system. The A Test Complex now supports engine testing for the Space Shuttle program.

The Rocket Propulsion Test Complex, a National Historic Landmark, is within NASA's Stennis Space Center, located in the southwest corner of Mississippi about 50 miles northeast of New Orleans, Louisiana, and 30 miles from the Mississippi Gulf Coast. From the north, take Interstate Hwy. 59 South. From New Orleans Interstate 10 North to just over the state line in Mississippi. The visitor center is open Monday-Saturday from 9:00am to 5:00pm and on Sunday from 1:00pm to 5:00pm; closed all major holidays. For more information or to book a group

tour, call 1-800-237-1821 or visit the Stennis Space Center website.

Saturn V Launch Vehicle

On January 25, 1962, the National Aeronautics and Space Administration (NASA) formally assigned the task of developing the Saturn V Launch Vehicle, a three-stage rocket designed for a lunar landing mission, to the Marshall Space Flight Center in Alabama, with launch responsibility committed to the Kennedy Space Center in Florida. Dr. Werner von Braun headed a nationwide team drawn from industry, government and the educational community, which provided the expertise to produce the Saturn V. During a seven year period a total of 13 Saturn V Space Vehicles were launched, including two unmanned test flights, 10 Apollo flights and one flight which carried the Skylab space station to earth's orbit.

On July 16, 1969, a Saturn V lifted off with Neil Armstrong, Edwin Aldrin and Michael Collins aboard, and carried them to their rendezvous with destiny--Man's first expedition to the surface of the moon. Stages of the Saturn V Launch Vehicle are not recovered after a mission; therefore, a Saturn V that has flown a mission will never be available for display purposes. This first Saturn V Launch Vehicle, one of three such vehicles in existence, was the test vehicle at the Marshall Space Flight Center. It is identical to the one that put Man on the moon and has been on display since 1969. The U.S. Space and Rocket Center, home to this Saturn V, has launched the Save the Saturn V Campaign to repair internal and external corrosion to the rocket caused by 30 years of exposure to weather.

The Saturn V Launch Vehicle, a National Historic Landmark, is located at the United States Space and Rocket Center in Huntsville, Alabama, near the Marshall Space Flight Center. The museum is open from 9:00am to 5:00pm year round. Please call 1-800-637-7223, or visit the museum's website at www.spacecamp.com for further information.

Saturn V Dynamic Test Stand

A component of the George C. Marshall Space Flight Center in Huntsville, Alabama, the Saturn V Dynamic Test Stand represents the last step in the testing process before the vehicle was accepted for full flight status. Built in 1964 to conduct mechanical and vibrational tests on the fully assembled Saturn V Space Vehicle, and measuring 360 feet high and 122 feet by 98 feet at the base, this facility performed crucial ground testing to ensure the success of the Saturn V. Once launched, a Saturn V could not be recovered for testing; therefore, major problems capable of causing failure of the vehicle were discovered and corrected at the Saturn V Dynamic Test Stand before the rocket ever reached the launch complex at the Kennedy Space Center . Any flaw in the vehicle could result in the loss of the lives of the astronauts riding in the Apollo Command Module.

Each component of the rocket was tested separately and in partial and full assembly. Then, the rocket was brought to the Saturn V Dynamic Test Stand to test the entire vehicle under dynamic load conditions. Mechanical and vibrational tests were conducted until the Saturn V vehicle was deemed ready for flight. As a result of the tests performed at the Saturn V Dynamic Test Stand

no Saturn V ever failed in flight. After completion of testing for the Saturn V program the Saturn V Dynamic Test Stand was modified for testing the Space Shuttle. At the present time this facility is on a standby basis, but it will be retained for future use in NASA programs because of its unique capabilities to dynamically test large space vehicles.

The Saturn V Dynamic Test Stand, a National Historic Landmark, is located at the George C. Marshall Space Flight Center in Huntsville, Alabama. It is closed to the public.

The Saturn V Dynamic Test Stand is the subject of an online-lesson plan produced by Teaching with Historic Places, a National Register program that offers classroom-ready lesson plans on properties listed in the National Register. To learn more, visit the Teaching with Historic Places home page.

Rendezvous Docking Simulator

The National Aeronautics and Space Administration (NASA) used the Rendezvous Docking Simulator at the Langley Research Center in Hampton, Virginia, to train Gemini and Apollo astronauts in docking procedures they had to master before attempting to land on the moon. NASA engineers decided that the best method of accomplishing President Kennedy's goal of a moon landing by 1969 was through a lunar orbit rendezvous (LOR). The LOR called for a single Saturn V launch of two spacecraft into lunar orbit. One would remain in orbit while the other would descend to the moon and then boost itself back into lunar orbit, rendezvous and dock with the mother ship before returning to earth. To accomplish this task it was essential that Apollo astronauts be trained in all aspects and problems likely to arise in an attempt to dock the Apollo Command and Lunar Excursion Modules in lunar orbit. Failure to dock would result in the failure of the entire mission and the likely loss of the lives of the astronauts. The Rendezvous Docking Simulator gave the astronauts the experience of docking the spacecraft in a safe environment that closely resembled a space environment. Only when the Apollo astronauts had successfully mastered rendezvous and docking skills in the Rendezvous Docking Simulator would NASA give permission for the attempt to land on the moon.

Following the completion of the Apollo program, the Rendezvous Docking Simulator was modified to solve open-and-closed loop pilot control problems, aircraft landing approaches, simulator validation studies and passenger ride quality studies. The name of the facility was changed to the Real-Time Dynamic Simulator. At present, this facility is inactive.

The Rendezvous Docking Simulator, a National Historic Landmark, at Langley Research Center is located at 100 NASA Rd. in Hampton, Virginia. It is closed to the public. Please visit Langley's website for further information.

Lunar Landing Research Facility

The Lunar Landing Research Facility at the Langley Research Center in Hampton, Virginia, permitted the National Aeronautics and Space Administration (NASA) to train the Apollo astronauts to fly in a simulated lunar environment. NASA hoped to accomplish President Kennedy's goal of a moon landing by 1969 through a lunar orbit rendezvous (LOR). The LOR called for a single Saturn V launch of two spacecraft into lunar orbit--one remaining in orbit

while the other descended to the moon. The LOR plan was based on the idea that NASA-trained astronauts could master the techniques of landing the the lunar excursion module (LEM) on the moon's surface and returning to orbit to dock with the mother ship.

The Rendezvous Docking Simulator provided training in docking the spacecraft while the Lunar Landing Research Facility was designed to solve the problem of how to land the men on the surface of the moon. Prior to the creation of this facility there existed no direct parallel between the unique piloting problems of the LEM and normal aircraft operating in Earth's atmosphere. Conditions encountered by the LEM were different due to the moon's lack of an atmosphere and low gravitational force. Experiences gained by the Apollo astronauts at the Lunar Landing Research Facility showed that it was possible to successfully master the necessary skills needed to land the LEM on the moon. Neil Armstrong and Edwin Aldrin trained here for many hours, mastering the complex skills before NASA approved plans for their historic moon landing in July 1969.

The Lunar Landing Research Facility, a National Historic Landmark, at Langley Research Center is located at 100 NASA Rd. in Hampton, Virginia. It is closed to the public. Please visit Langley's website for further information.

Nike Missle Site C47

The Nike defense system was a significant aspect of both civilian life and military planning during the Cold War era in the United States. Nike missiles were radar guided, supersonic antiaircraft missiles. In keeping with the U.S. doctrine of "deterrence," planners hoped that systems like the Nike would make a direct attack on the continental United States so costly as to be futile. Nike Missile Site C-47 near Wheeler, Indiana, is an intact Nike base intended to protect a major potential target, Chicago. Although the Army's first surface-to-air missile defense program began in a 1944 memorandum, it was not until the Soviet Union developed new long range, high altitude bombers capable of reaching the United States, combined with the detonation of their atomic bomb in 1949, that the United States began to respond. President Truman reinforced the long held tenant that the Army was in charge of ground based antiaircraft artillery when he put them in charge of protecting the U.S. mainland from attack.

The Nike systems depended on three functional areas or components: radar systems to obtain, identify and track targets; a launch site with capability to handle multiple rockets; and an administrative section to coordinate and authorize launch. The mission of the Nike within the continental United States was to act as a "last ditch" line of air defense for selected areas. Nike missile sites like C-47 were constructed in defensive rings surrounding major urban and industrial areas. In all, the Army built more than 250 Nike-Hercules missile batteries across the United States during the late 1950s and early 1960s, protecting strategic military and civilian targets--the Chicago defensive area had about 20 bases ringing metropolitan Chicago. The SALT (Strategic Arms Limitation Talks) accords limited the deployment of the Nike-Hercules missiles. With the exception of batteries in Alaska and Florida that stayed active until the late 1970s, by 1975 all Nike-Hercules sites had been deactivated. C-47 closed in 1972.

The Nike Missile Site C-47 near Wheeler, Indiana, was constructed from 1954 to 1956 and

consists of two separate parcels of land located nearly a mile apart. The first parcel of land, 14 acres, was the Launcher Area and is surrounded by two eight-foot-tall cyclone fences, original to the base. A guard shack remains at the main gate. The actual launchers, three independent concrete underground bunkers with blast doors, remain intact. This site has three modules, each with its own magazine, elevator and ventilation system. The Administrative Building, with its flat roof and concrete block construction, served as the day barracks where the launcher area crew would have their meals and relax during 24-hour shifts. The Fallout Shelter, to the east of the main gate, was constructed with solid poured concrete walls and roof system. The shelter has no windows and once had blast doors to protect the occupants from nuclear fallout. The largest building on the launcher site is the Vehicle Maintenance Building.

The second parcel of land was for the Control Area and contains 13 buildings, five radar towers, a wastewater treatment in-ground enclosure, basketball court and a cyclone fence. All the buildings at the Control Area are single-story, slab-floored, concrete walled buildings with flat roofs. The Administration Building housed the day room, supply rooms and a barbershop.

The Nike Missile Site C47 is located near Wheeler, Indiana. The Launcher Area is found on the south side of County Rd. 700 N., approximately one quarter mile west of County Rd. 500 W. The Control Area is located on the north side of County Rd. 600 N., near the town of Wheeler. Nike Missile Site C47 is closed to the public, except the Administrative area, which is a recreational area/store, open 1:00pm to 7:00pm, Monday-Friday and 11:00 to 7:00pm Saturdays and can be contacted at 219-947-7733. Closed December 16-February 28.

Site Summit

Site Summit, near Anchorage, Alaska, is an exceptionally well preserved Cold war-era Nike-Hercules missile installation and an important physical representation of U.S. military strategy during the Cold War. During World War II the U.S. Army recognized that advancements in Germany's aircraft and missile technology had made America's existing conventional artillery obsolete. In response, Army ordnance studies focused on developing a surface-to-air guided missile system that could intercept and destroy attacking airplanes. The Nike and Nike-Hercules missile systems were essential components of the United States' military defense system during the Cold War period. Established in response to the increasing threat of long range Soviet bombers carrying nuclear and conventional weapons, the Nike program provided an important surface-to-air missile system capable of destroying incoming enemy aircraft. More than 250 Nike-Hercules missile batteries were built across the United States during the late 1950s and early 1960s, protecting strategic military and civilian targets.

A total of eight Nike batteries were erected in Alaska. Because of its proximity to the Soviet mainland, Alaska was considered a pivotal location in the United States' first line of defense from anticipated Soviet aggression. Alaska's eight Nike installations were critical to the overall military strategy for the air defense of the country, representing crucial components in the military network of detection, identification, interception, and destruction. Site Summit, located atop Mount Gordo Lyon just outside Anchorage, was situated to protect Fort Richardson Army and Elmendorf Air Force bases as well as the city of Anchorage. Construction of Site Summit necessitated the blasting of approximately 60 feet of mountain peak to provide a level area for

the Battery Control Building. A second ridge was leveled for the launch area. In addition to the massive rockwork, it was necessary to construct one and a half miles of road that rose 2,000 feet. Construction, supervised by the Alaska District of the U.S. Army Corps of Engineers, began in May 1957 and was completed in September 1958. The equipment arrived in February 1959 and in May the missile battery was declared operational. Washington, D.C. architect Leon Chatelain, Jr. in cooperation with Spector and Montgomery Architects, designed the original Nike facilities.

On November 20, 1960, General J.H. "Iron Mike" Michaelis, Commander of the U.S. Army Alaska, told spectators gathered at the first live Nike missile test firing from Site Summit that "live-fire exercises were invaluable training in firing from actual combat sites and at the same time demonstrated to the citizens of Alaska and the Nation the power of this modern weapon." Annual firings from Site Summit continued during the months of November and December for four years until 1963. In July 1964, the Army canceled practice firings from Site Summit because population growth in the flight range area made the firings unsafe.

Typically, 125 soldiers were needed to operate a Nike site. Although not all personnel were required to live on the premises, the site was staffed 24 hours a day, seven days a week. The changing political climate and rapidly developing defense technologies, especially with the development of the intercontinental missiles, made the Nike missile bases obsolete. Nationwide, Nike batteries started phasing out in 1965. The U.S. Army intended to replace the Nike system with the SAM-D, later named the Patriot, a superior antiballistic missile system in the 1970s. "With the exception of batteries in Alaska and Florida that stayed active until the late 1970s, by 1975 all Nike-Hercules sites had been deactivated." [p 177, *To Defend & Deter, The Legacy of the U.S. Cold War Missile Program*, A study sponsored by the Department of Defense, Legacy Resource Management Program, Cold War Project] In May 1979, Site Summit was placed on stand down status and deactivated two months later. The Army continued to guard the site until 1986.

Site Summit is located atop Mount Gordo Lyon 12.5 miles east of downtown Anchorage. It is not accessible to the public.

Minuteman Missle National Historic Site

Minuteman Missile National Historic Site in western South Dakota is one of the Nation's newest national park areas. Established by Congress in 1999, the park consists of a nuclear missile silo and launch control facility. From this seemingly isolated patch of Midwestern prairie U.S. Air Force officers could have launched intercontinental ballistic missiles (ICBMs) at targets in the Soviet Union. With the simple turn of keys, nuclear missiles would have been exchanged with the Soviet Union, making real one of the greatest fears of the 20th century, nuclear war.

The park is not yet open to the public, but when it is, visitors will be guided through the launch control capsule and topside support structures of a Minuteman II launch control facility known as Delta-01. Visitors will be allowed access to an area that, although not secret, was seldom seen by civilians from the time it was completed in 1963. Modified only slightly through its 30 years of continuous service, the site is an excellent example of a Cold War missile system. Operated by crews from nearby Ellsworth Air Force Base, Delta-01 was part of the 44th Missile Wing.

Known as missileers, these young men and women had the ability to launch 150 Minuteman II missiles, a small fraction of the 1,000 ICBMs that were once deployed in the upper Great Plains. Contractors built the sites, finishing three weeks ahead of schedule despite the enormity of the task, labor disputes and South Dakota's challenging weather.

Security was a serious concern in and around each of the silos and launch control facilities. Each "flight" of missiles was controlled and protected by a launch control facility from which security police closely monitored and controlled access to 10 missile silos (Delta 1 and Delta 9 are now protected as part of the park) and the launch control center. This security system included checking visitors' credentials, monitoring radio transmissions and observing microwave detection and seismic sensor systems, as well as armed response teams. The armed response teams patrolling the "flight" were dispatched by launch control facility personnel to any breach of security at the silos. Armored vehicles were used to respond to any security breaches. Known as Peacekeepers, these were usually Dodge pickup trucks with an armored body and a turret mounted M60 machine gun. The Peacekeepers were a common sight on roads surrounding each of the missile sites and Minuteman Missile NHS recently acquired two of these vehicles for display.

In 1991, President George H.W. Bush and Soviet Premier Mikhail Gorbachev signed the Strategic Arms Reduction Treaty (START), placing a limit on the number of ICBMs and outlining a process for the demolition of some existing systems, including the Minuteman II. Long since replaced by the Minuteman III at several other installations, the escalating repair and maintenance costs of the Minuteman II made it a likely choice for deactivation. As the demolition of the 450 sites proceeded, Air Force and National Park Service employees began to work together on preservation of two of the sites.

Minuteman Missile National Historic Site is located on the I-90 travel corridor in western South Dakota. This park is not yet open to the public, but will be administered with Badlands National Park to conserve dollars and share human resources. For more information on the upcoming Minuteman Missile National Historic Site visit that park's website on the National Park Service's Parknet or call 605-433-5552.

Air Force Facility Missile Site 8 (571-7) Military Reservation

Air Force Facility Missile Site 8 (571-7) Military Reservation in Green Valley, Arizona, is the sole remaining Titan II Intercontinental Ballistic Missile (ICBM) complex of the 54 that were "on alert" during the Cold War between 1963 and 1987. The Titan II missiles were contructed to survive a first strike nuclear attack from the Soviet Union and to retaliate. It is the single remaining example of the liquid-fueled ICBM missile launch facilities utilized by the Strategic Air Command. Titan II carried the largest single warhead used in the ICBM program and was capable of destroying targets that Atlas, Titan I and Minuteman I and II could not. Built in response to the "missile gap" panic of the late 1950s and early 1960s, Titan II Missile Site 571-7 provides a unique window into the design, construction and operation of a weapon system built to survive a first-strike nuclear attack and be able to launch its missile if so ordered. The site has retained, or assembled, all of the above and below ground command and control facilities as well as the missile silo itself. Unlike the first generation Atlas or Titan I ICBMs, or the Thor and

Jupiter Intermediate Range Ballistic Missiles (IRBM), Titan II utilized storable liquid propellants. Fully fueled at all times, the Titan II was ready for launch at a moment's notice. From the turn of the launch keys to lift-off took slightly less than one minute. Approximately 35 minutes and 6000 miles later, the Mark VI re-entry vehicle would have detonated on target as either an air or ground burst.

The decision to build an ICBM weapon system originated in the late 1940s but was shelved due to budgetary constraints. After the Korean War, and following the detonation of the first thermonuclear bomb by the Soviet Union in 1953, the U.S. government became convinced of the need for an ICBM weapon system despite the cost. Time was of the essence, and the 1954 summary report of Dr. John von Neumann to the Teapot Committee stressed that the need for a strategic offensive missile system was urgent. Two development tracks were recommended in the Teapot Committee report--the first was the ICBM program. Initially, it took time to load the liquid oxygen onto the missile, open the silo doors and bring the missile to the surface. The Titan I replaced the earlier Atlas missiles as the program developed, and later, with internal guidance systems came the Thor and Jupiter IRBM systems. The Titan II, designed by the Martin Company in 1958, had superior liquid propellants than the Titan I. Instead of taking 15 to 20 minutes to raise, fuel and launch Atlas or Titan I missiles, the Titan II could be launched from the underground silo in less then one minute. The entire Titan II system was on alert by December 31, 1963. In October 1981, President Reagan announced the start of the Strategic Forces Improvement Program, which called for the decision to modernize the land-based ICBM forces by retiring the Titan II system and replacing it with a more advanced system. The Salt I Treaty signed by President Nixon and Premier Brezhnev limited the United States to 1054 ICBMs. With the exception of Titan II Missile Site 571-7, all of the Titan II missile sites were destroyed over a five year period beginning in 1982.

The engineering significance of Site 571-7 re sts primarily in underground features, which were designed to insure that launch control could be maintained and operated under extraordinary circumstances. The Launch Control Center is a three-story, cylindrical concrete and steel structure within which a three-story building is suspended on massive springs. The Blast Lock structure protects the Launch Control Center from damage due to either a nearby nuclear explosion or from a missile propellants explosion. Each blast door weighs three tons and the doors were interlocked in pairs so that at least one door of each pair was closed and locked at all times.

Two nine-and-a half-foot diameter underground cableways connect the missile silo and Launch Control center to the blast lock area. The missile silo was covered by 740-ton silo closure door to protect the missile from nearby blast, radiation or inclement weather. Since the Titan II was designed to be launched from within its silo without first being lifted to the surface, unlike all previous liquid-fueled ICBM and IRBM missiles, the silo design required several unique engineering solutions. Among these problems were the dissipation of the 5000-degree F engine exhaust gasses and the reduction of the tremendous acoustical energy generated by rocket engine operation within an enclosed space. The overall Titan II Missile Site 571-7 was comprised of an approximately 10-acre circular military reservation enclosed by a four-strand barbed wire fence. Within this reservation is the actual missile site--a 3.3 acre parcel surrounded by a 6.5 foot security fence. This site is now the home of the Titan Missile Museum, which opened on May

21, 1986. Nowhere else in the United States is there such a facility open for public inspection and education. Access to this site represents a rare opportunity to educate people about the much-feared prospects of the conduct of nuclear war and the government's efforts to deter it. For a complete copy of the National Historic Landmark registration form for the Air Force Facility Missile Site 8 (571-7) Military Reservation, click here.

Air Force Facility Missile Site 8 (571-7) Military Reservation, a National Historic Landmark, is located at 1580 West Duval Mine Rd., in Green Valley, Arizona. The museum is open daily November l -April 30, except Thanksgiving and Christmas, 9:00am to 5:00pm; from May 1-October 31 it is open Wednesday-Sunday, 9:00am to 5:00pm. There is a charge for admission. Call 520-625-7736 or visit the museum's website for more information. You can also download (in pdf) the Air Force Facility Missile Site 8 National Historic Landmark nomination.

Learn More

By clicking on one of these links, you can go directly to a particular section:

Links to Aviation History, Tourism and Preservation Websites

National Park Service: Aviation Related Historic Sites
The National Park Service administers several aviation related historic sites including: Dayton Aviation Heritage National Historical Park, Wright Brothers National Memorial, Tuskegee Airmen National Historic Site, USS *Arizona* Memorial, Aleutain World War II National Historic Area, Minuteman Missile National Historic Park, Fort Vancouver National Historic Site, Gateway National Recreation Area, Golden Gate National Recreation Area, American Memorial Park, Canaveral National Seashore, Indiana Dunes National Lakeshore, War in the Pacific National Historical Park, and White Sands National Monument

U.S. Air Force Centennial of Flight Office
Established to research, plan and coordinate the U.S. Air Force's active participation in the worldwide celebration. Wright Patterson Air Force Base is one of the largest and most important bases in the U.S. Air Force, and includes the Wright Brother's Huffman Prairie Flying Field and the USAF Museum.

U.S. Centennial of Flight Commission
The Federal commission was established by Congress to assist in commemoration of the centennial of powered flight and the achievements of the Wright brothers. Their website provides a comprehensive collection of outstanding educational essays, multimedia, links to aviation related museums around the county, and the most up-to-date information on celebration activity.

National Aeronautics and Space Administration (NASA)

Congress established NASA in 1958 as a civilian agency to lead "the expansion of human knowledge of phenomena in the atmosphere and space." NASA Headquarters and the nine NASA Field Centers located across the nation are planning education-based activities to celebrate the Centennial. NASA's website offers a variety of educational resources and photographs.

Smithsonian's National Air and Space Museum
:This national museum maintains the largest collection of historic air and spacecraft in the world. It is also a vital center for research into the history, science, and technology of aviation and space flight. In December 2003, the museum will open its 760,000 square foot companion facility at the Washington Dulles International Airport in Northern Virginia.

American Institute of Aeronautics and Astronautics (AIAA)
Officially formed in 1963 AIAA is the world's largest professional organization devoted to advancing engineering and scientific pursuits within aviation, space and defense on behalf of government, industry and academia.

Guidelines for Evaluating and Documenting Historic Aviation Properties
Although written for individuals interested in nominationg avaition related places to the National Register, but this National Register Bulletin contains a wealth of useful historical information.

Teaching with Historic Places: Aviation Lesson Plans
The National Register of Historic Places' Teaching with Historic Places program has developed several classroom-ready lesson plans that focus on America's aviation history.

American Aviation Heritage Theme Study, National Historic Landmarks
To ensure the preservation and protection of our nation's aviation heritage, work is underway on a Theme Study on the history of American aviation to identify the sites, districts, buildings, structures, and landscapes that best illustrate or commemorate key events.

Man In Space, National Park Service History Program
A historical study of the locations and events associated with man's exploration of space.

Legends of Tuskegee, National Park Service Museum Management Program
This web exhibit highlights the achievements of the Booker Taliafero Washington, George Washington Carver and the Tuskegee Airmen and features the collections of the Tuskegee Institute National Historic Site and Tuskegee Airmen National Historic Site located in Tuskegee, Alabama.

Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER)
The HABS/HAER program documents important architectural, engineering and industrial sites throughout the United States and its territories. Their collections, including a number of aviation related sites, are archived at the Library of Congress and available online. You can view these by clicking on the link above and entering the search terms such as "airplane," "hangar," or "air force."

National Trust for Historic Preservation
Learn about the programs of and membership in the oldest national nonprofit preservation organization.

Historic Hotels of America
A feature of the National Trust for Historic Preservation's Heritage Traveler program that provides information on historic hotels and package tours in the vicinity of this itinerary.

National Park Service Office of Tourism
National Parks have been interwoven with tourism from their earliest days. This website highlights the ways in which the National Park Service promotes and supports sustainable, responsible, informed, and managed visitor use through cooperation and coordination with the tourism industry.

Links to Websites of Places Featured in this Itinerary

Dayton Aviation Heritage National Historical Park & Wright Patterson Air Force Base
Wright Brothers National Memorial
Fort Myer Historic District
Pearson Field, Fort Vancouver National Historic Site
Stinson Field, Mission Parkway
***Shenandoah* Crash Site:** www.noblecountyohio.com/shenandoah.html
Charles A. Lindbergh, Sr. House
Torrey Pines Gliderport
Naval Air Station Sunnyvale/Moffett Field Museum
Amelia Earhart Birthplace
Pangborn-Herndon Memorial Site: www.wenatcheevalleymuseum.com
Terminal Building, Old, Hangar and Powerhouse at Key Field: www.meridianairport.com
Building No.105, Boeing Airplane Company
Smith Field
Floyd Bennett Field Historic District
Santa Fe Depot and Reading Room
Idaho Falls Airport Historic District
Administration Building
Newark Metropolitan Airport Buildings
Marine Air Terminal
Washington National Airport Terminal and South Hangar Line
College Park Airport
Naval Air Station, San Diego, Historic District: www.historictours.com/sandiego
Rockwell Field: www.historictours.com/sandiego
Pensacola Naval Air Station Historic District
Kelly Field Historic District: www.kellyusa.com
Hangar 9, Brooks Air Force Base
Crissy Field, Presidio of San Francisco
Randolph Field Historic District
March Field Historic District

Hamilton Army Air Field Discontiguous Historic District
Rogers Dry Lake
Variable Density Tunnel
Full Scale 30- by 60-Foot Tunnel
Eight-Foot High Speed Tunnel
Wendover Air Force Base: www.wendoverairbase.com
Ladd Field
Tuskegee Airmen National Historic Site
United States Naval Base, Pearl Harbor
USS *Arizona* Memorial
Hickam Field
World War II Facilities at Midway
Radar Station B-71
Dutch Harbor Naval Operating Base and Fort Mears, U.S. Army
Attu Battlefield and U.S. Army and Navy Airfields on Attu
Truk Lagoon Underwater Fleet, Truk Atoll
Tinian Landing Beaches, Ushi Point and North Fields, Tinian Islands
Hangar No. 1 U.S. Naval Air Station Wildwood
Building 1301, Dover Air Force Base
Douglas DC-3 Airplane, N34
B-17G "Flying Fortress" No. 44-83690: www.cyberair.com/museums/usa/in/gam.html
U.S. Army Aircraft P-51D-25NA 44-73287: www.aeroknow.com/acm.htm
TBM-3E "Avenger" Torpedo Bomber Warplane
USS Lexington: www.usslexington.com
USS *Yorktown*
USS *Intrepid*
USS *Hornet*
White Sands V-2 Launching Site U.S. **Naval Ordnance Test Facilities, Topsail**:
http://members.tripod.com/topsailjo/society.html
Cape Canaveral Air Force Station
Redstone Test Stand
Space Launch Complex 10
Space Flight Operations Facility
John F. Kennedy Space Center: www.kennedyspacecenter.com
Apollo Mission Control Center
Space Environmental Simulation Laboratory
Rocket Propulsion Test Complex
Saturn V Launch Vehicle
Rendezvous Docking Simulator
Lunar Landing Research Facility
Minuteman Missile National Historic Park
Air Force Facility Missile Site 8 (571-7) Military Reservation

Selected Aviation Bibliography

Recommend Sources

Prepared in 1998, our National Register Bulletin entitled *Guidelines for Evaluating and Documenting Historic Aviation Properties* contains a broad list of avaition resources.

Credits

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