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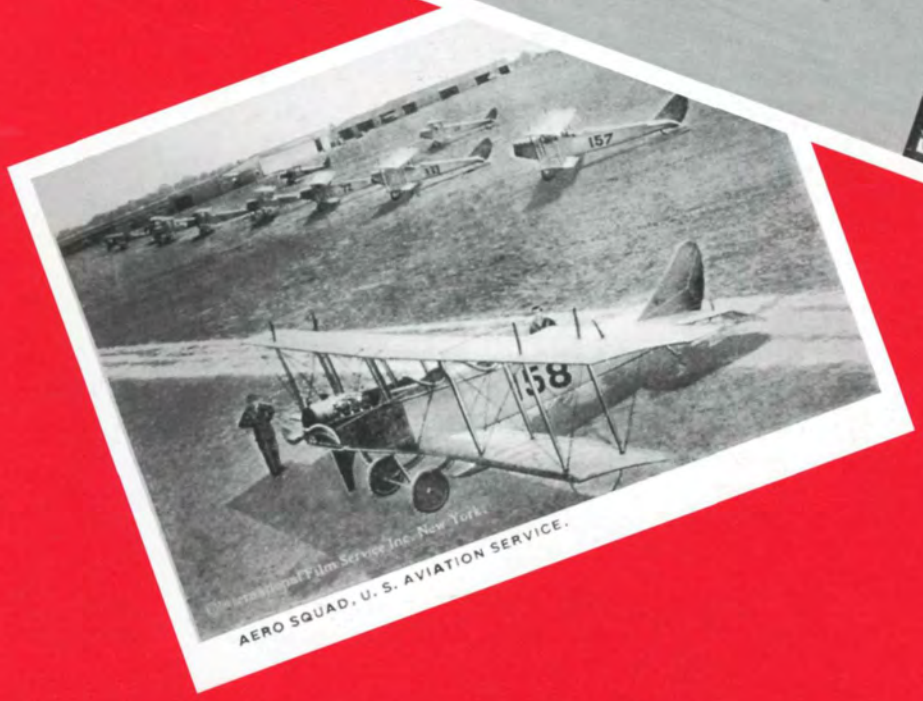
American Aviation

The Early Years



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Information for parks, federal agencies, Indian tribes, states, local governments, and the private sector that promotes and maintains high standards for preserving and managing cultural resources

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Cover: top postcard, the first airplane, 1903, courtesy Wilkie Picture & Puzzle Co., Dayton, Ohio; bottom postcard, Curtiss JN-4s (Jennies), Army Air Service, c. 1918, courtesy Curt Teich Postcard Archives/Lake County (IL) Museum.

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Jody Cook and Ann Deines

Cultural Resources, People, and Places of Aviation's Early Years

The centennial of flight on December 17, 2003, is not far over the horizon, and it is worthy of wide recognition. The Wright brothers' airplane was an extraordinary invention, ranking near the top of every roll of the 20th century's greatest achievements and milestones of the millennium. This thematic issue of *CRM* is only one effort by the National Park Service (NPS) to commemorate the 100th anniversary of the Wright brothers' achievement. It also explores other contributions to American aviation before and after the first flight, primarily those associated with the first decades of U.S. aviation. A second thematic issue planned for publication in 2003 will focus on aviation properties and related cultural resource management issues from later decades.

The first hangar, 1903. Courtesy Graycraft Card Co., Danville, Virginia, and S.W. Worthington.

Wilbur and Orville Wright, Kitty Hawk, and Cape Canaveral are familiar historic names and places in American aviation, but many more are also noteworthy. These thematic issues will focus on historic resources, places, people, and events with stories to tell that are not as familiar as those of 1903. Two articles by Tom Crouch, Senior Curator of Aeronautics at the National Air and Space Museum of the Smithsonian Institution and noted authority on the Wright brothers and the history of aviation, are a special component of this *CRM*. Crouch's article, "Flight in America, 1784–1919," provides an engaging historic context to introduce the theme of American aviation.

We first met at the 1997 annual meeting of NPS historians and soon discovered a mutual interest in American aviation history and cultural resources. This led to development of a session by NPS historians for the 1998 National Aerospace Conference—The Meaning of Flight in the 20th Century—at Wright State University in Dayton, Ohio. Discussions at the NPS historians meeting in 1998 inspired the idea for thematic *CRM*s in conjunction with the centennial of flight.

Many thanks to Dwight Pitcaithley, NPS Chief Historian, for his ongoing efforts to convene all historians in the National Park Service, those in regional/support offices as well as national parks. Our appreciation also goes to the authors contributing to this issue and to our supervisors, Cecil N. McKithan (Chief, National Register Programs Division, Southeast Regional Office) and Lawrence Blake (Superintendent, Dayton Aviation Heritage National Historical Park), for supporting our partnership that produced this *CRM*.

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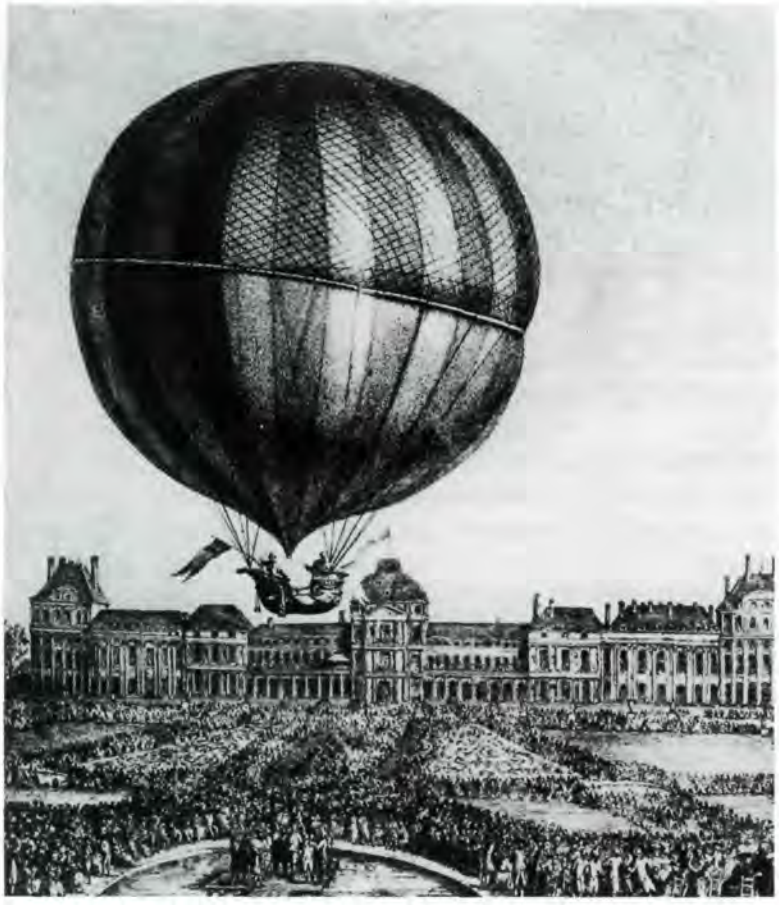
Tom D. Crouch

Flight in America, 1784–1919

June 24, 1784, is an important, if entirely forgotten, day in American history. The announcement that Peter Carnes, a lawyer and tavern keeper from Bladensburg, Maryland, would fly a balloon in Howard Park had attracted "a numerous and respectable Congress of People" to Baltimore that day. The entire city had gone "Balloon Mad," according to one disgruntled clerk. "Every store but our own and a few others were shut."[1]

Joseph Michel and Jacques Etienne Montgolfier had flown the world's first small balloon from the town square of Annonay, in the south of France, on June 4, 1783, barely one year before. The first human beings had flown from Paris only seven months before, on November 21, 1783. Carnes, who had never seen a balloon and who had little more than vague descriptions to go on, had completed work on his hot air craft and sent it aloft on its first tethered flight from Bladensburg on June 14, 1784. That flight, and all of those made early on June 24, were tethered ascents with no one on board. Carnes, who weighed in at 234 pounds, was apparently too heavy for the small balloon to lift.



Jacques Alexandre, Caesar Charles, and M.N. Robert became the first human beings to fly aboard a hydrogen balloon, rising above the rooftops of Paris on December 1, 1783. Letters from Americans living in France carried the earliest news of the invention of the balloon across the Atlantic.

As Carnes was preparing to send the balloon aloft for the last time that afternoon, however, a 13-year-old lad named Edward Warren stepped out of the crowd and volunteered to ascend in the "splendid chariot" dangling beneath the multicolored silk envelope. Baltimore newspapers assured their readers that young Edward behaved "with the steady fortitude of an old voyager." He "soared aloof" to the cheers of the crowd, "which he politely acknowledged by a significant wave of his hat." When Warren returned to the "terrene element" a few minutes later, a collection was taken up so that he might have a reward with a "solid rather than an airy foundation, and of a species which is ever acceptable to the residents of this lower world."[2]

An American had flown from American soil for the first time, and the world would never be quite the same. The winds of change were sweeping across America and Europe. The war that had begun with a few scattered shots fired on the Lexington green had ended just a year before with the signing of the Treaty of Paris in 1783. It seemed only fitting that a new nation which promised unprecedented freedom and opportunity should be born at the very moment when human beings took their first faltering steps toward achieving the freedom of the skies. Only a few months before Edward Warren ascended from Baltimore, Benjamin Franklin had overheard a Parisian suggest that the balloon was a thing of little practical value. Franklin had turned to the fellow and asked: "Of what use is a new born Babe?" If human beings could fly, after all, was there anything they could not achieve?

Peter Carnes and Edward Warren launched America on its love affair with flight. Throughout the 19th century, Americans would thrill at the sight of a colorful balloon, and its even more col-

orful pilot, rising above the local Fourth of July celebration or county fair; listen to tales of the observation balloonists employed by both Blue and Gray during the Civil War; and cluck their tongues at the fate of the latest daredevil to fall victim to an aerial mishap.

Still other Americans, like James Buchanan, of Lexington, Kentucky, abandoned the balloon, a captive of the winds, and became determined to "soar as high as the eagle" on wings that they had designed and built themselves. Buchanan conducted an unsuccessful test of an ornithopter powered by "a Capillary Steam Engine for Navigating the Air," in 1824.[3] He was the first of a long string of aerial dreamers who populated the American landscape during the years prior to 1890. Richard Oglesby Davidson was typical of the breed. He entered the field in 1841 with a proposal for a bird-shaped, human-powered ornithopter, and was still circulating through Confederate Army camps 23 years later, soliciting funds for an aerial weapon guaranteed to bring the Yankees to their knees.[4]

While 19th-century Americans dreamed of flapping wing contraptions with artificial bird beaks, European engineers began the serious business of exploring the fundamental principals of flight technology. The history of the airplane is rooted in several centuries of European research into the forces operating on a body immersed in a fluid stream, culminating in 100 years of active flight experimentation. At the beginning of the 19th century, the Englishman Sir George Cayley (1773–1857) defined the problem of flight, conducted critically important experiments in aerodynamics, designed and built the first successful gliders, and inspired the several generations of enthusiasts who would achieve the ancient dream of winged flight.

The century that followed witnessed the introduction of new engineering instruments like the wind tunnel, important studies in aerodynamics and aircraft stability, and the appearance of practical internal combustion engines, all of which contributed to the development of powered, controlled, heavier-than-air flight. By the time of his death in a glider crash in August 1896, less than half a century after the death of Sir George Cayley, the German pioneer Otto Lilienthal (1848–1896) had completed as many as 2,000 flights in 18 distinct glider designs.

With the death of Lilienthal, however, leadership in aeronautical research passed to the United States, where pioneers like Octave Chanute (1832–1910) and Samuel Pierpont Langley (1834–1906) were setting the stage for the invention of the airplane. On May 6, 1896, Langley, the third Secretary of the Smithsonian Institution, succeeded in launching the first reasonably large, steam-powered model aircraft on flights of up to three-quarters of a mile over the Potomac River. Later that year, Chanute, a prominent American civil engineer and internationally recognized authority on the problems of flight, led a band of experimenters into the sand dunes ringing the southern shore of Lake Michigan, east of Chicago, Illinois, where they flew a series of gliders, including a very advanced biplane that pointed the way to the future of aircraft structures.

Wilbur (1867–1912) and Orville Wright (1871–1948), the proprietors of a bicycle sales, repair, and manufacturing shop in Dayton, Ohio, wrote both to the Smithsonian Institution and to Octave Chanute in 1899 and 1900, respectively, requesting information on aeronautics and announcing their decision to begin their own experiments. The Wrights were superb, self-trained engineers who developed an extraordinarily successful research strategy that enabled them to overcome one set of challenging problems after another, the full extent of which few other experimenters had even suspected. Their ability to visualize machines that had not yet been built, and to imagine the complex interplay of forces on such a device, as well as their capacity to recognize links between apparently unrelated technologies, were among the factors that enabled them to move far beyond their predecessors in the field.

The Wright brothers progressed toward the development of a practical flying machine through an evolutionary chain of seven experimental aircraft: one kite (1899), three gliders (1900, 1901, and 1902), and three powered airplanes (1903, 1904, and 1905). Each of these aircraft was a distillation of the lessons learned and the experience gained with its predecessors. It was not all smooth sailing. Frustration and disappointment were as much a part of the process as the euphoria of discovery. In the fall of 1901, puzzled by the failure of their earliest gliders to match calculated performance, the brothers built their own wind tunnel and designed a pair of brilliantly conceived balances that produced the precise bits of data required to make accurate performance calculations.

Orville and Wilbur Wright. Courtesy Special Collections and Archives, Wright State University.

The Wrights designed and, for the most part, prefabricated their aircraft in Dayton. Initially, however, they had to go elsewhere to fly. From 1900 to 1903, they tested their gliders, and taught themselves to fly at the Kill Devil Hills, a range of low sand dunes some four miles south of the little village of Kitty Hawk on the Outer Banks of North Carolina. Here they found all that they required to conduct their experiments: strong, steady winds, hills that were perfect for gliding, soft sand for landing, and friendly neighbors to assist when required. It was here, where the Wrights had flown for three previous seasons, that they made the first four sustained, powered flights under the control of the pilot between 10:35 a.m. and noon on the morning of December 17, 1903.

The brothers had succeeded, but a great deal of work remained to be done. Over the next two years they continued their work in a cow pasture near Dayton. By the fall of 1905, they had achieved their goal of a practical flying machine capable of remaining in the air for extended periods of time and operating under the full control of the pilot. The air age had begun. Unwilling to unveil their technology without the protection of a patent and a contract for the sale of airplanes, the Wrights did not make public flights until 1908.

By that time, the Wrights were no longer alone in the air. As early as 1906, Alberto Santos Dumont, a wealthy Brazilian living in Paris, France, had succeeded in making the first successful public flight in Europe. His machine, and those that would follow over the next two years, were far more primitive than the Wright aircraft, and were equipped with dangerous and unsatisfactory control systems. Still, the first public flight in Europe of one kilometer, and the first circular flight by a European aircraft were flown while the Wright brothers remained on the ground, attempting to protect and sell their invention.

Other Americans were taking to the air, as well. Glenn Hammond Curtiss, a veteran of the Aerial Experiment Association organized by Samuel Langley's old friend Alexander Graham Bell, won the Scientific American Trophy for a straight-line flight of one kilometer on July 4, 1908.

By the spring of 1908, the Wrights had received their patents and had signed contracts for the sale of airplanes to the U.S. Army and a French syndicate. They rebuilt their old 1905 machine with controls that could be operated

from the new upright seats and returned to Kitty Hawk to polish their flying skills and accustom themselves to the new controls. Then Wilbur was off to France, where he flew in public for the first time near Le Mans on August 8. The Europeans, many of whom had doubted the Wright claims, were astounded with the ease at which Wilbur maneuvered his machine through the air. The skeptics were silenced as this quintessential American quickly became the most celebrated figure in Europe.

Orville made his first public flights to demonstrate the airplane to officials of the U.S. Army at Fort Myer, Virginia, in September. After a series of performances quite as spectacular as those his brother was providing for spectators in Europe, Orville suffered a crash on September 17. The result of a cracked propeller, the accident severely injured Orville, and took the life of his passenger, Lieutenant Thomas Selfridge, who was also a veteran of the Aerial Experiment Association.

While recovering from his injuries, Orville and Katharine, the youngest of the Wright children, joined Wilbur in France. Kings, prime ministers, and the social elite of Europe came to watch the flying and to meet the Wrights, who were emerging as the first great international heroes of the new century. They were welcomed back to America in triumph and heaped with honors and awards.

The Wright Company was founded in 1910 with Wilbur as president, Orville as a vice-president, and a board of directors that included some of the most distinguished names in American business and finance. Corporate headquarters were in New York, but the heart of the operation, the factory and the flying field, were located in Dayton. Huffman Prairie Flying Field, where the Wrights had flown in 1904 and 1905, became an internationally famous location once again when the already historic field became the home of the Wright School of Aviation. The fledgling pilots who earned their wings here included Marjorie Stinson, who soloed at age 20; pioneer naval aviator John Rodgers; Calbraith P. Rodgers, the first man to fly from coast to coast; and Lieutenant Henry Harley "Hap" Arnold, the future commanding general of the U.S. Army Air Forces in World War II.

American aeronautical hegemony was short-lived, however. With war looming on the horizon, European leaders invested heavily in the new technology. Government officials and wealthy private citizens encouraged the development of aviation by sponsoring speed, altitude, and distance competitions, purchasing aircraft in considerable numbers, establishing aerial units in their armed forces, creating aeronautical laboratories, and funding research and development efforts. The United States, the birthplace of aviation, did not invest in aeronautics, and fell woefully behind Europe. By 1913, the U.S. Army could boast a grand total of six active pilots, while the entire U.S. aeronautical industry employed fewer than 170 employees—most of whom worked for Glenn Hammond Curtiss.

A motorcycle builder from Hammondsport, New York, Curtiss was the most successful of the handful of American aircraft builders who entered the field during the decade following the invention of the airplane, winning the first James Gordon Bennett trophy at the great air meet at Reims, France, in 1909, with a speed of just over 47 miles per hour. Curtiss was also the principal target of the lawsuits brought by The Wright Company in an attempt to halt infringement on the Wright patents. The Wrights won every decision handed down by the courts over the seven-year life of the basic suit, but Curtiss was always able to find an argument that would keep the

One of the few manufacturers of airplanes during WWI was The Dayton-Wright Airplane Company in Dayton, Ohio, that manufactured De Havilland-4s. Courtesy NCR Archives at Montgomery County Historical Society.

long and complex legal proceedings alive until finally brought to a halt by the creation of a U.S. patent pool in 1917.

Exhausted by business responsibilities and the patent suits in Europe and America, Wilbur Wright died of typhoid fever in 1912. Orville Wright sold his interest in The Wright Company in 1915. In spite of his legal problems, Glenn Curtiss had established himself as the only U.S. manufacturer operating at a European level, a major supplier of training aircraft to the U.S. government and flying boats to Allied navies. That fact alone is convincing proof that the Wright patent suits were not a major factor explaining the retarded growth of aviation in America prior to World War I, as is sometimes claimed. As noted, heavy European investment in aviation offers reason enough.

Americans flew into combat in World War I aboard aircraft that had been almost entirely designed, and for the most part manufactured, in Europe. By the Armistice, however, U.S. industry was producing the Liberty engines that would power American aircraft for the next decade, including the Fokker T-2 that made the first non-stop coast-to-coast flight in 1923, and the Douglas World Cruisers that completed the first aerial voyage around the globe the following year. Moreover, the advanced American designs that would have seen combat had the war continued into 1919 were available for record flights, such as the first aerial crossing of the Atlantic by the giant U.S. Navy flying boat, NC-4. From the legendary barnstormers to the earliest airmail operators, the pioneers of American commercial aviation began business with war surplus equipment.

The legacy of the American experience in World War I also included congressional investigations that underscored the problems of a limited market and high research and development costs faced by American airframe and engine manufacturers. Recognizing the growing importance of the airplane to national defense, domestic commerce, and international prestige, federal officials took a series of steps to strengthen, support, and regulate the aviation industry between 1915 and 1940.

The first and one of the most important of those steps came in 1915, when the Congress created the National Advisory Committee for Aeronautics (NACA). From the outset, the NACA conducted programs that amply demonstrated the value of basic research in flight technology. Technical reports issued by the agency introduced U.S. aircraft designers to a host of improvements including revolutionary airfoils, improved propellers, engines, and instruments, and various streamlining techniques. NACA engineers experimented with wing flaps and other high-lift devices and explored innovative construction techniques and new materials that helped to set the stage for a new generation of aircraft designs that would emerge in the 1930s.

In the 1920s, a number of developments set the stage for a genuine revolution in which airplanes flying faster, higher, and farther than the pioneers had dreamed possible would absolutely shape the subsequent history of the American Century. Flight technology would redefine the way in which we fight our wars; open the distant corners of the globe to commerce; drive technological change in critical areas ranging from materials research to electronics and computers; and enormously expand our vision of the possible.

Given the historic importance of aerospace technology, the identification, preservation, and interpretation of historic sites, documents, and objects relating to the history of flight should be of concern to all of us who seek to better understand the foundations of the world in which we live. The approach of the centennial of powered, controlled, heavier-than-air flight in 2003 offers a special opportunity to focus on this aspect of our heritage. It is an opportunity that we should not allow to pass us by.

Notes

1 Letterbook, Johannot Johnson and Company, MS. 497–8, Manuscript Division, Maryland Historical Society, Baltimore, MD.

2 *Maryland Journal and Baltimore Advertiser,* June 15–25, 1784.

3 Tom D. Crouch, "The History of American Aviation, 1822–1905," *Aviation Quarterly* 1:2 (1976): 10.

4 Crouch, "The History of American Aviation," 11 and Jeremiah Milbank, *The First Century of Flight in America* (Princeton: Princeton University Press, 1943), 168–169.

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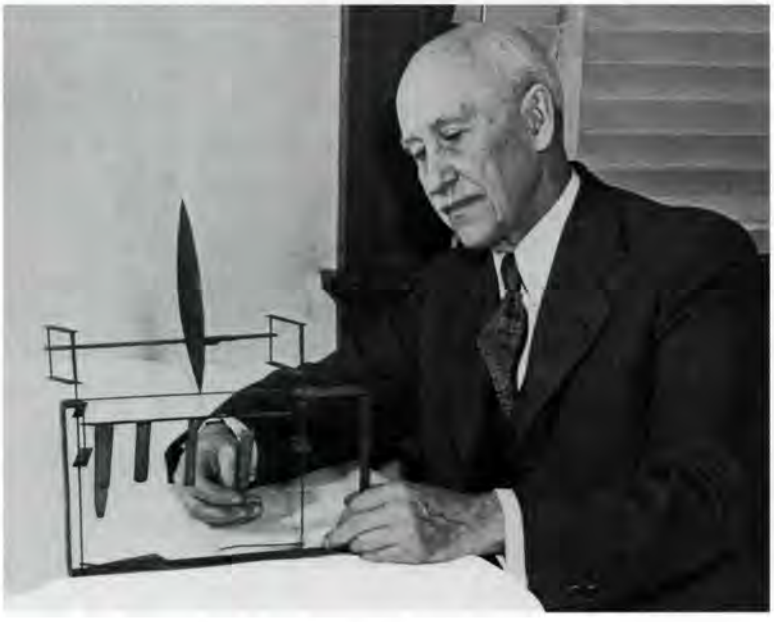
Darrell Collins and Ann Deines

Counting Down to the Centennial of Flight

Over 100 years ago, two visionary young men embarked on an adventure that would blaze a trail to the stars. In 2003 the world will celebrate the centennial of the Wright brothers' first free, controlled, and sustained flights in a power-driven, heavier-than-air machine that occurred at Kitty Hawk, North Carolina, but the brothers' compelling story actually began in Dayton, Ohio, in 1899. In the spring of that year Wilbur and Orville Wright resolved to actively pursue the possibility of human flight.

As we draw closer to 2003, hundredth anniversaries of noteworthy steps Wilbur and Orville took in their quest for flight will occur. These events were essential to the Wright brothers' invention of the airplane, for the Wrights' successful flights in 1903 were the culmination of their earlier work. As the brothers' invention is celebrated in 2003, the entirety of their achievements and these other milestones should be remembered.

May 30, 1899. In his first documented step in the pursuit of human flight, Wilbur Wright wrote the Smithsonian Institution requesting all the available information on early attempts to solve the problem of flight. The Smithsonian Institution sent pamphlets and a list of published works on the subject. And so, the Wright brothers' homework began in the summer of 1899. From the resources they reviewed, the Wright brothers detected that previous experimenters failed to give the issue of controlling flying machines serious consideration.

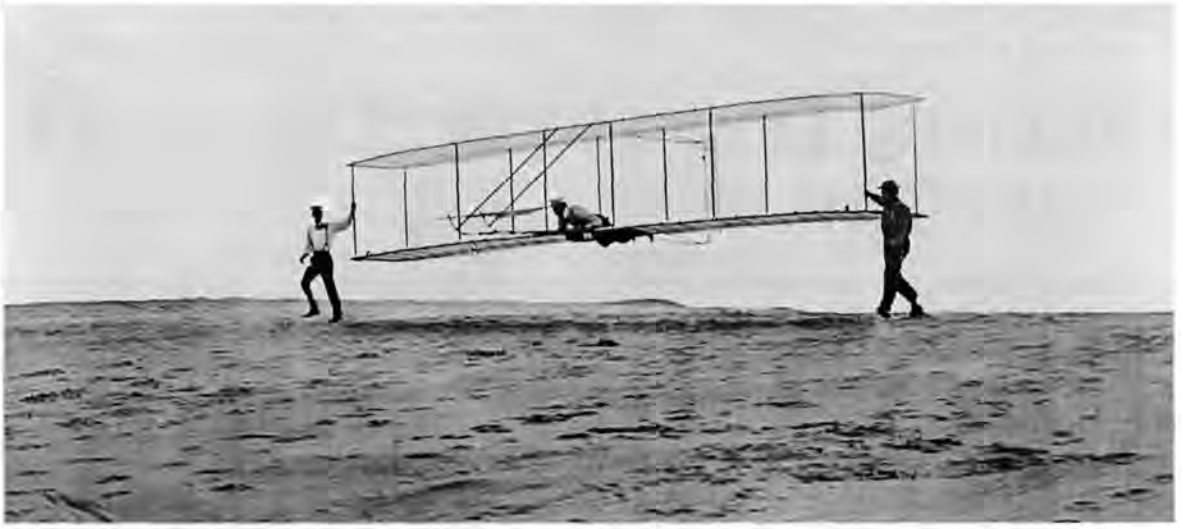


Orville Wright with one of the two balances used in the 1901 wind tunnel tests, 1946. Courtesy Carillon Historical Park.

July 1899. Convinced that the concept for controlling a flying machine could be gleaned from how birds used their wings in flight, Wilbur found a solution as he was twisting a rectangular inner-tube box one day at the bicycle shop. Wilbur found the answer in the twisting motion—creating a helical twist instead of treating each wingtip independently. Wilbur constructed a kite using this concept and test flew it in a field near his Dayton home. The kite test was a success, and Wilbur called his theory of control wing-warping.

May 13, 1900. After reading Octave Chanute's book, *Progress in Flying Machines*, the Wrights learned much about early aviation research. Wilbur wrote to Chanute and the opening paragraph in his letter was a clue to his determination to solve the problem of flight: "For some years I have been afflicted with the belief that flight is possible to man. My disease has increased in severity and I feel that it will cost me an increased amount of money if not my life."[1] This was the beginning of a correspondence that continued for the next 10 years. Chanute served as a sounding board for the Wright brothers and offered them advice throughout their research and experiments. The relationship between the three would only end when Chanute died in 1910.

September 6–October 23, 1900. The brothers' next step was to construct and fly a full-sized glider to test their theories, such as wing-warping, and their understanding of aerodynamics. Weather conditions around their hometown were not always suitable, so they studied National



Launching the 1902 glider in Kitty Hawk, North Carolina. Photo courtesy Carillon Historical Park.

Weather Bureau records and chose Kitty Hawk, North Carolina. Here on the lonely sand dunes of Kitty Hawk, the autumn winds blew steadily and long stretches of deep soft sand provided a cushion for hard landings. Much to the wonder of the local residents, these two young men spent the windy fall days of 1900 flying their glider like a kite, learning its ways, and finally, gliding aboard the craft lying prone on the lower wing.

July 7–August 22, 1901. Anxious to begin tests with a larger glider, the Wrights again left Dayton for the Outer Banks of North Carolina. They set up camp near the largest of the Kill Devil Hills. Wilbur made several hundred glides during the 1901 experiments. Using the slopes of Kill Devil Hill and West Hill, he sailed along in winds up to 27 miles per hour, breaking all records for distance in gliding, but the brothers were far from satisfied. They had learned a great deal about control, though their glider was still too feeble while lifting itself off the ground and staying aloft for longer flights. On their way home from Kitty Hawk, Wilbur declared his belief to Orville that not within a thousand years would man ever fly!

October–December 1901. The Wright brothers conducted wind tunnel experiments and determined there was an error in John Smeaton's coefficient used in the calculations for the commonly accepted lift data. Wilbur and Orville conducted meticulous experiments in a wind tunnel they constructed to measure lift and lift-to-drag ratios using balances they made from hacksaw blades.[2] The brothers used their data to calculate revised lift and drag coefficients. This led to the correction of the universally accepted data that they had used to construct their previous gliders.

August 25–October 28, 1902. With renewed faith in the air pressure tables compiled from their wind tunnel experiments, the brothers returned to Kitty Hawk with a new glider. In this glider the Wright brothers made nearly 1,000 flights. By the end of the 1902 season of experiments, the Wrights had solved two of the major problems of flight: how to properly design wings and control surfaces and how to control a flying machine about its three axes (roll, pitch, and yaw). Most of the battle was now won. The only major problems remaining were incorporating an engine and propellers.

November 1902. After returning home to Dayton, the brothers immediately began searching for an engine manufacturer. The brothers, in characteristic fashion, undertook the project themselves when they could not locate anyone to make an engine to their specifications. Their mechanic, Charlie Taylor, built the engine in the Wright brothers' bicycle shop using the available machinery and tools. In December 1902, the brothers began addressing the construction of propellers. Their research uncovered no theoretical basis for the development of ship propellers that they could apply to airplane propellers, and once again they started at the beginning. After discussions and research, Wilbur and Orville determined a propeller was a rotary wing whose design should be based upon their formulas for lift and drag. The Wright brothers incorporated the engine and propellers made in their bicycle shop into their next machine to attempt free, controlled, and sustained flight in a power-driven, heavier-than-air machine.

March 23, 1903. The brothers filed their first patent application based on their 1902 glider and with no mention of a power plant. After the

U. S. Patent Office rejected the Wrights' patent application twice, the brothers hired patent lawyer Henry Toulmin, who persuaded the brothers to include in their patent application the brothers' three-axis system of control, including wing-warping. The U.S. Patent Office finally granted Patent No. 821,393 on May 22, 1906, to Wilbur and Orville for a flying machine.

September 25–December 17, 1903. When the Wrights arrived at their Kill Devil Hills camp, they first repaired the old living quarters. They also occasionally took their 1902 glider out for flights, and after a few trials both brothers glided for more than a minute and set new world records. After months of delays the 1903 Wright Flyer was ready for flight. Shortly after 10:00 a.m. on the morning of December 17, 1903, the Wright Flyer was moved to a spot on level ground upon the arrival of men from the nearby U.S. Life Saving Station. Orville took the pilot's position; engine and propellers were started. At 10:35 a.m., the machine moved slowly forward under its own power and lifted into the air. The flight covered 120 feet and lasted only 12 seconds. They completed three more flights that day, with the last flight by Wilbur covering 852 feet in 59 seconds.

Wilbur and Orville Wright had solved a mystery that had baffled mankind for centuries. The age of flight had come at last, but only after more than four years of work, four trips to Kitty Hawk, and extensive experiments and research. The Wright brothers' entire inventive process should be commemorated and celebrated as we near the centennial of flight in 2003. The Wright brothers were not just two Daytonians who operated a bicycle shop and happened to fly one day, but dedicated researchers and engineers who focused on a question and followed scientific methods to find the solution.

Notes

1 W. Wright to O. Chanute, May 13, 1900 in Marvin W. McFarland, ed. *The Papers of Wilbur and Orville Wright* (Salem, NH: Ayer Company, Publishers, Inc.,1953) 1:15.

2 The balances are in the collections of The Franklin Institute, Philadelphia, Pennsylvania.

Darrell Collins is the historian at Wright Brothers National Memorial.

Ann Deines is the historian at Dayton Aviation Heritage National Historical Park.

Marla McEnaney

From Pasture to Runway

Managing the Huffman Prairie Flying Field

In 1998, Wright-Patterson Air Force Base, in conjunction with Dayton Aviation Heritage National Historical Park, undertook a Cultural Landscape Report for Huffman Prairie Flying Field. The flying field, a national historic landmark within Wright-Patterson Air Force Base, is a partnership unit of the national historical park. Dayton Aviation Heritage historical technician Elizabeth Fraterrigo completed a site history, with landscape analysis and evaluation and treatment alternatives currently being determined by this author.

Huffman Prairie Flying Field is the site where Wilbur and Orville Wright mastered the principles of flight. Following their 1903 first flights at Kitty Hawk, North Carolina, the two brothers returned to their Dayton, Ohio, home and from spring 1904 to fall 1905 continued perfecting their flying technique while developing the world's first practical airplane. Their airfield consisted of an 84-acre pasture owned by the Huffman family; the Wrights gained permission to use the property after promising to coax the horses and cows outside the fence during their flights.[1] In keeping with the belief that property rights extended vertically, they remained within the boundary of the field by flying in circles. By October 5, 1905, Wilbur Wright was able to fly for almost 40 minutes, covering a distance of

over 24 miles at an average speed of 38 miles an hour. It was the longest flight recorded at that time—longer than all their 1904 flights combined.

At that point, the Wrights turned from experimentation, and from 1906 to 1908, they concentrated on patenting and marketing their invention. In 1910, they once again returned to the Huffman property to open a flight school. Lieutenant Henry "Hap" Arnold, who later became commanding general of the U.S. Army Air Forces in World War II, was just one of the renowned pilots who trained at the Wright School of Aviation.[2] Even though the school closed in 1916, the property retained its link to aviation; in 1917, it was subsumed into one of the military antecedents of Wright-Patterson Air Force Base. It lies today at the end of the base's flight lines. The air above is often filled with planes ascending and landing, a frequent reminder of Wilbur and Orville Wright's contribution to modern aviation.

An analysis of the historic flying field landscape revealed that the site retained several features from the historic period, though there have been contemporary additions. Many of the additions are commemorative in nature and were added as early as 1941. The location of the Wrights' hangars and the corners of the seven-sided pasture were marked in the early 1990s, the former as part of a national historic landmark dedication ceremony. The 1905 hangar was also reconstructed, and although it is a replica, it provides a sense of scale and represents the frugal nature of the Wrights' operations. The remaining additions, which are more intrusive in nature, accumulated over time as the base expanded. All in all, the flying field has a fairly high level of integrity, as its open meadow character is intact, and significant features such as a tree row and remnants of a locust tree can still be found at the site. The locust tree is significant—at the center of their oval flight path, it was used for navigation. It also figured prominently when Orville Wright solved the final problem of aircraft control while turning his flyer in an attempt to avoid crashing into the tree.

Treatment of the landscape will focus on protecting these features while facilitating interpretive programs for visitors.[3] Because the flying field is a simple site with few clues to its historic importance, there is a strong tendency to view it as a backdrop for more dynamic interpretive activities. It is critical, however, to recognize that it is the resource's subtle character that needs to be protected. The preferred treatment approach is to rehabilitate the landscape in order to allow interpretive exhibits to be developed. Any new facilities must be designed and located to avoid intruding upon views within and out of the historic landscape; NPS and Wright-Patterson Air Force Base cultural resource specialists have determined that the earlier period of 1904 to 1905 will be the primary interpretive focus. During this period, the Wrights' experiments at the flying field were unique, in comparison to the 1910–1916 period, when other flight schools were operating and the events taking place at the site were not extraordinary.

The goal for protecting the site is to maintain the more intangible openness and horizontality of the meadow as well as the extant historic features—the tree row and locust tree. The meadow character extends beyond the historic

Wright Flyer III at Huffman Prairie Flying Field, 1905. Courtesy Special Collections and Archives, Wright State University.

Huffman Prairie Flying Field, showing the reconstructed 1905 hangar and a boundary marker. Photo courtesy Dayton Aviation Heritage National Historical Park.

boundaries on the two sides of the flying field that are surrounded by Huffman Prairie. The prairie, a 109-acre parcel that is an Ohio natural landmark, provides a buffer between the historic landscape and base development. The cultural landscape report suggests expanding the area of managed prairie outside the historic boundaries, creating a no-development zone on all sides of the flying field to protect historic views.

The bumpy, closely shorn texture of the flying field's surface changed with the cessation of grazing. During the historic period the pasture was distinct from the taller surrounding prairie. Re-establishing this historic three-dimensional relationship through grazing or mowing is another goal of the treatment program.

The preferred alternative suggests removing all commemorative reconstructions from the site, although a compromise has been reached to retain the 1905 replica hangar. All intrusive elements would be removed, including an access road and shooting ranges adjacent to the flying field. Ground level masonry pads would mark the size and location of the non-extant 1904 and 1910 hangars.[4] The stone masonry would mirror the materials and construction methods of the low chevron-shaped walls that mark each of the seven corners of the field. Concrete markers would be retained, but may be lowered to ground level so they do not interrupt the ground plane.

The predominant challenge to interpreting the site is determining an appropriate level of passive exhibits. Although there is pressure to interpret the entire 1904 to 1916 period, providing literal representations of all the hangars would give a false impression to visitors and obstruct historic views. In addition, the U.S. Air Force will not have unlimited staff or funds to establish scheduled tours, so the site will have to be at least partially self-explanatory. Simple, appropriately sited exhibits would solve the problem of interpreting the site without additional manpower.

All in all, the site provides an excellent opportunity to interpret those remarkable first days of aviation history. The site remains relatively intact, and has the advantage of having a major Air Force installation surrounding it to dramatically show how far aviation has come in less than 100 years. At one site, the visitor can see both the beginnings of aviation and its latest, state-of-the-art manifestations. Careful tending of the landscape and thoughtful interpretive treatments will ensure the site endures into the next century of flight.

Notes

1 Tom Crouch, *The Bishop's Boys: A Life of Wilbur and Orville Wright* (New York: W.W. Norton & Company, 1989), 279.

2 A total of 116 men and women trained at Huffman Prairie Flying Field from 1910–1916.

3 Other than intermittent exceptions, the flying field was closed to the public from 1917 to 1991.

4 The 1904 hangar site has not been definitively located. Until substantive documentation of its location is found, it will not be represented at the site.

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Tom D. Crouch

Octave Chanute

Aeronautical Pioneer

Octave Chanute, American aviation pioneer.

Each year more than a million people journey to northern Indiana to relax in the sun and sand and savor the natural beauty of Dune country. All too few of the visitors to Indiana Dunes National Lakeshore realize what an important role this area played in the story of the invention of the airplane. It was here, in the spring and summer of 1896, that Octave Chanute and four young assistants helped to set the stage for the achievement of powered flight with a series of important glider trials.

A native of Paris, France, born on February 18, 1832, Octave Chanute immigrated to the United States with his father in 1838. Educated in New York schools, he took his first job in 1844 as a member of a surveying crew laying out the route of the Hudson River Railroad. Over the next 30 years he rose to the rank of chief engineer with a number of the most important railroads in the nation. He was responsible for building the first bridge over the Missouri River and supervised the construction of railroads that opened the West to settlement. Virtually every cow driven north from Texas passed through the stockyards Chanute designed for Chicago and Kansas City. His services as a civil leader and urban planner were critical to the development of towns across the West.

By 1890, Octave Chanute, now one of the best known and most successful civil engineers in the nation, had established both a consulting practice and a wood preservation firm in Chicago. At last he would have some spare time to pursue his hobby—flying machines. Chanute had been fascinated by the problem of flight for almost two decades. He had corresponded with virtually every major aeronautical experimenter in the world and sponsored discussions of flight at important engineering conferences. In the process, he had created an informal network of serious aviation experimenters that would shape the early development of the technology. The first fruit of his effort was the publication of *Progress in Flying Machines* in 1894. One of the most important books published on aviation up to that time, the volume provided a remarkably complete record of what had been accomplished in the past and pointed the way to the future.

As early as 1894, inspired by the work of the German glider experimenter Otto Lilienthal, Chanute began to design gliders capable of carrying human beings into the air. Anxious to provide employment for younger engineers and flying machine enthusiasts, he began contracting for the construction of several gliders. He selected the sand dunes along the southern shore of Lake Michigan as the perfect place to test his creations. The area was close to Chicago. The little train station at Miller, Indiana served as an entry point into Dune country. The area offered a number of other important advantages, including steady winds, dunes from which a glider could be launched in any direction, an abundance of sand for soft landings, and, Chanute hoped, relative isolation.

Chanute and his four assistants pitched their tents on a spot within the present city limits of Gary, Indiana, on June 22, 1896. Augustus Herring, the most experienced member of the group, had brought a glider based on the standard Lilienthal monoplane design. William Avery, a Chicago carpenter, had constructed a multi-wing glider designed by Chanute, while William Butusov would attempt to launch his own glider, the Albatross, down a wooden ramp. Dr. James Ricketts, a Chicago physician with "a slack practice and a taste for aeronautics," would cook for the group and provide emergency med-

ical service as required. Chanute's dogs, Rags and Tatters, rounded out the party.

Herring and Avery did most of the flying. The Lilienthal glider proved to be a disappointment. Chanute's glider, featuring multiple sets of wings that could be arranged in various configurations, was more interesting, covering distances of from 50–116 feet through the air. The group returned to Chicago on July 4. They would spend the next month repairing their various craft and building a new glider featuring three wings set one on top of the other, all linked together with a truss of the sort that Chanute had employed in constructing railroad bridges. Herring was apparently responsible for the cruciform tail.

The five men returned to the Dunes on August 21, 1896, establishing a new camp some five miles down the beach from their original site. After some disappointing test flights, Chanute ordered the bottom wing removed from the new glider, producing a biplane design. With that modification complete, Herring and Avery were soon making repeated flights of over 200 feet in length, occasionally traveling as far as 350 feet through the air. By the time the group broke camp for good on September 25, 1896, they had completed several hundred flights with the biplane. For the moment, the little craft was the most successful heavier-than-air flying machine in the world.

The 1896 biplane tested on the Indiana Dunes proved to be a key step on the road to the invention of the airplane. Herring continued to experiment with the design on his own over the next five years. Chanute's publication of the plans and specifications for the glider helped to spark a renewed interest in flight both in America and Europe. In May 1900, Octave Chanute received a letter from Wilbur Wright. "Afflicted with the belief that flight is possible to man," the Wrights had designed a glider of their own. "In appearance," Wilbur noted, "it is very similar to the 'double-deck' machine with which the experiments of yourself and Mr. Herring were conducted in 1896–97."

The letter marked the beginning of an association that would continue until Chanute's death in November 1910. During the years 1900–1905, when the genius of the Wright brothers carried them far beyond any of their predecessors to the ultimate goal of the invention of the airplane, Chanute was their closest friend and most important supporter. While disagreements drove the three men apart after 1905, the Wrights never forgot how important the friendship and inspiration of Octave Chanute had been to them during the early years.

"His labors had vast influence in bringing about the era of human flight," Wilbur Wright observed at the time of Chanute's death. "No one was too humble to receive a share of his time. In patience and goodness of heart he has rarely been surpassed. Few men were more universally respected and loved."

Modern visitors to Indiana Dunes National Lakeshore and Indiana Dunes State Park will find little to remind them of the significance of the area to the history of flight. The dune from which the Chanute party conducted their first experiments (June 22–July 4, 1896) stood within the present city limits of Gary, Indiana, northeast of the Lake Street Bridge and west of the refurbished Aquatorium building. Streets and buildings cover the actual site of the dune, but the spot is commemorated with a plaque. A National Soaring Society historic marker is located in front of the Aquatorium. Current plans call for the installation of exhibits on Chanute and on the Tuskeegee Airmen of World War II in this building.

There is nothing to identify the site of Dune Park, where the second round of flight tests were conducted (August 21–September 26, 1896). The area is some five miles east of the Miller Beach site, where, Chanute noted: "the hills were higher, the solitude greater, and the path ... more obscure." The historic dunes from which the first Chanute–Herring biplane was flown is now covered by the remains of a Midwest steel plant.

Octave Chanute tries the famous biplane glider on for size during the Indiana Dunes trials of 1896. Chanute did not make any flights himself.

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Jeanne Palermo

Restoration, Preservation, and Conservation of the 1905 Wright Flyer III

The 1905 Wright Flyer III at Carillon Historical Park in Dayton, Ohio, is one of the most significant aircraft in the history of aviation. This relatively unknown airplane is called the world's first practical airplane because, with this aircraft, the Wright brothers solved all the remaining problems of sustained and controlled flight. The 1905 Wright Flyer III is also the first plane ever to carry a passenger.

History

Following their first flights at Kitty Hawk, North Carolina, in December 1903, Wilbur and Orville Wright returned home to Dayton for Christmas knowing that, while they had succeeded in their dream of flying, much work remained to make flying practical. The 1903 Wright Flyer flew four relatively short, straight-line flights before winds overturned it and damaged it beyond repair. Having succeeded in their dream of flying, the Wrights returned their base of operations to Ohio. Their work over the next two years would result in the Wright Flyer III.

The Wrights reported to the Aero Club of America in 1906, "From the beginning the prime object was to devise a machine of practical utility, rather than a useless and extravagant toy."[1] They succeeded with the Wright Flyer III. In the fall of 1905, this airplane made record-breaking flights over Huffman Prairie Flying Field outside Dayton, finally and irrevocably breaking the bonds of earth forever. This was the first airplane to consistently fly under the complete control of the pilot; take off and land without mishap; and stay aloft for as long as it had fuel. This graceful aircraft was the prototype for the Wrights' Model A airplanes which the brothers flew into international celebrity in 1908 and 1909.

In the mid-1940s, Orville Wright's personal friend, Col. Edward A. Deeds, chairman of The National Cash Register Company (NCR) in Dayton, conceived of the idea for a historical museum village which he proceeded to build and endow. A major theme of the museum would be transportation: how it changed Dayton, and how Dayton changed transportation. Deeds' desire to include a Wright airplane in his museum led to the restoration of the 1905 Wright Flyer III.

Initially, Deeds expected to construct a replica of the 1903 "Kitty Hawk" Flyer. It was Orville Wright who felt that enough parts of the 1905 machine existed to do a restoration. Wright himself was in possession of the engine, propellers, and metal chain guides that the Wrights had brought back to their shop in Dayton. The frame had been left in a shed at Kitty Hawk following the plane's final flights in 1908. That May, the plane had been refitted from its original configuration with a pilot prone on the lower wing, to two upright seats for a pilot and passenger. The Wrights tested their ability to carry two men prior to Orville's flights for the United States Army Signal Corps whose contract required carrying a passenger.

Fortunately, Zenas Crane of Massachusetts, with Orville Wright's permission, had salvaged the 1905 airframe. The parts to the 1905 airplane would remain in the basement of the Berkshire Museum until the 1940s, waiting in vain for Wright to assist with a restoration.

Restoration

Finally, with Deeds' new museum in mind, Orville Wright asked for the return of the 1905 airframe from Massachusetts. Other crucial pieces were obtained from former residents of the Kitty Hawk area who had broken into the Wrights' shed as boys in search of souvenirs. Carl Buest of NCR was put in charge of locating the now-grown gang of boys. He later wrote, "One had become a banker, another a minister. They were scattered all over the U. S.... The minister admitted that he was one of the boys who took souvenirs and that as a way of making it up he would help round up parts of the plane from all the boys. He did."[2]

Orville supplied the 1905 engine, chain guides, and propellers. The engine was missing its original crankshaft and flywheel which had been used to replace those missing parts in the 1903 engine now in the National Air and Space Museum, Smithsonian Institution.

The pieces of the 1905 airplane were finally reunited in Dayton in a small wooden building called "the annex" on the factory campus of NCR where Deeds was now chairman of the board. The next problem to overcome was a lack of drawings. There were no systematic sets of drawings for the Wright Flyer III. Its design was evolutionary and numerous changes had occurred over the summer of 1905. Additionally, when the Wright brothers last flew the plane in 1908, they had replaced the hip cradle with two seats for a pilot and passenger.

Deeds hired Louis P. Christman, an NCR draftsman, to make new drawings for the Wright Flyer III. Christman's complete set of drawings is preserved today at the Smithsonian Institution. Harvey P. Geyer, a talented member of the Wrights' staff from the early years of The Wright Company, was hired as project director. Orville Wright would regularly meet for lunch with Deeds at NCR as the project advanced. Replacement parts were painstakingly fashioned and new "Pride of the West" muslin fabric was obtained to cover the frame. The photography department of NCR documented the restoration on at least three separate dates—December 22, 1947, September 7, 1948, and December 1, 1948.

Meanwhile, Orville Wright also collaborated on the design of Wright Hall, the building at Carillon Historical Park which enshrines the Wright Flyer III. The building is a simple one-story plan. Its most interesting feature is the sunken space in which the airplane is set. Similar to the experience the visitor gets at Les Invalides, Napoleon's tomb in Paris, France, the visitor to Wright Hall looks down at the airplane from an encircling walkway. The story is that Orville felt this was the best way to view the airplane in order to understand how it operated.

Restoration of the Wright Flyer III, December 1, 1948. Courtesy Carillon Historical Park.

The restoration of the airplane was well underway when Orville Wright died in 1948. Work on Wright Hall was completed and the airplane was moved the short distance from NCR to Carillon Historical Park. When asked about the restoration's authenticity, Harvey Geyer is quoted as saying that he could fly it across the street to Wright Hall. The airplane is estimated to be about 80% original. The airplane was the centerpiece of Carillon Historical Park's grand opening to the public on June 3, 1950. And there it has remained for nearly 50 years.

Preservation

For its first 35 years at the park, the airplane benefited from Carillon Historical Park's quiet low key existence. The park was practically unknown outside the region, and was open to the public only seasonally. Moreover, visitors of this era had to be personally guided from building to building, and so the airplane sat in darkness much of the time. The pit area had been painted a swimming pool green, and the walls, tile, and floors were a medium green as well. These factors kept the light levels low. Also, the building's heating system was kept at a low temperature throughout the winter months, which helped to keep the plane's wooden framework from drying out.

With the beginning of on-site, full time administration in the mid-1980s, Carillon Historical Park awoke from a long slumber. Fortunately, the park was also beginning to receive professional conservation advice. In 1984, Robert B. Adair, objects conservator at the U.S. Air Force Museum, completed a conservation assessment of the 1905 Wright Flyer III. He noted most of the same problems that we still face today: generally good condition with some rusting of the wires and some "foxing" or mold growth on the fabric. Adair also noted that any conservation treatment of the airplane would be futile until the environmental issues in Wright Hall were addressed and corrected.

In 1988, I was hired as Carillon Historical Park's first curator, and in 1991 the Wright Flyer III was named a national historic landmark. That same year we began to focus on conservation of the park's collections. The park applied for and

received a conservation assessment, or CAP, grant from the Institute for Museum Services (IMS). This assessment was invaluable for addressing conservation issues in the park's long range planning. The reports that ensued from this grant gave us the tools we needed to systematically plan improvements. As noted in our earlier assessment, improvements to the environmental conditions were seen as the most important first step in our conservation plan.

Following the recommendations outlined in the CAP report, at Wright Hall, vegetation was removed from around the building, gutters and downspouts were checked more frequently, foundation cracks were caulked, and roof slates replaced. In 1992, a new roof on the rear half of the building was installed to eliminate leaking. To facilitate improved custodial care, a dedicated backpack vacuum cleaner was purchased to make dusting the airplane safer.

Hygrothermograph recordings were kept which showed that despite a lack of air conditioning, temperature variations inside the building were not extreme. Humidity fluctuations, however, were a problem, particularly in the humid Ohio summers. Portable dehumidifiers were installed to help with the high humidity, but a lack of water in the building made humidifying the winter air impossible. Problems with insect infiltration and moisture were noted.

In October 1992, Dayton Aviation Heritage National Historical Park was established with Wright Hall and the Wright Flyer III as privately owned and managed partnership sites. With the centennial of the Wright brothers' first flight 11 years away, planning began in earnest for Carillon Historical Park, and especially Wright Hall and the Wright Flyer III, to be ready.

In 1994, the park made major improvements to the building. A local architect designed a protective shelter made of PVC pipe, three-ply cardboard, and plastic sheeting in which the airplane was temporarily encased. Water lines were run to the building and a dry line fire suppression system was installed. New electrical wiring, track lighting, and ceiling insulation were added. The interior was repainted a light color, and UV protective film was applied to the windows.

With funding from The 2003 Committee and the state of Ohio, work began on the Wilbur Wright Wing that connects Wright Hall with the replica Wright Cycle Shop; the wing opened in 1997. The HVAC system installed in this wing was designed to carry half of the air-conditioning load for Wright Hall. The new wing also made Wright Hall handicapped accessible.

A capital fund-raising campaign began with a major goal of raising the necessary funds to build the matching Orville Wright Wing on the west side of Wright Hall. The two new wings would provide much needed space for interpretation and act as a buffer for the environment within Wright Hall itself. The hall could return to its original function as a shrine for the airplane, and Wright artifacts that, over the years, had been added to the room could help interpret the Wright story in the adjacent wings. The Orville Wright Wing will complete the John W. Berry, Sr. Wright Brothers Aviation Center, providing HVAC controls to Wright Hall, closing off the main door, and isolating the Wright Flyer III from direct contact with outside air.

Carillon Historical Park's affiliation with the National Park Service has greatly benefited the present and future condition of the Wright Flyer III. The park's small staff has been able to tap the resources and expertise of interpreters and conservators within the National Park Service. In March 1999, Carillon Historical Park engaged a conservation team to conduct a condition assessment of the airplane. This report contains an extensive condition assessment of the Wright Flyer III and conservation recommendations for implementation. As the results of the recent conservation assessment have become known, an improved HVAC has been planned. As interpretive planning for the center goes forward, the needs of the Flyer will strongly influence the lighting design as well.

The park's fund-raising campaign and the conservation assessment came at a most opportune time. The Save America's Treasures grant program, announced in January 1999, is a White House Millennium Council initiative to protect the nation's most significant artifacts as part of the National Millennium Commemoration. It is part-

Wright Hall at Carillon Historical Park. Courtesy of Carillon Historical Park.

nering with the National Trust for Historic Preservation to celebrate and preserve our nation's irreplaceable historic and cultural legacy. Applicants had to demonstrate the national significance of their project and assure a match for any requested funds. Carillon Historical Park submitted an application for conservation of the 1905 Wright Flyer III, and our efforts were rewarded on May 19, 1999, with the announcement that our project was one of four projects funded through the Institute of Museum and Library Services.

As Wright Hall evolves into the new Wright Aviation Center, we will refine an interpretive plan and complete a conservation treatment plan for the restored 1905 Wright Flyer III. We are supported with the professional advice we receive through our affiliation with Dayton Aviation Heritage National Historical Park. This unusual form of private/public partnership benefits not only the taxpayer and the partnership sites, but also the irreplaceable national historic landmark, the 1905 Wright Flyer III.

Notes

1 *NCR World* (September–October 1970): 16.
2 *NCR World* (September–October 1970): 18.

Jeanne Palermo is Director of Curatorial Services at Carillon Historical Park.

John Donnelly

Flying Off Rooftops

Nestled in the center of 366 historic acres of the Vancouver National Historic Reserve lies peaceful little Pearson Field; a general aviation field located in the heart of downtown Vancouver, Washington.

For a small general aviation field, Pearson has a lot of ties to both national and international aviation milestones. It is one of the oldest continuously operating airfields in the entire country as its aviation history dates back to a dirigible flight by Lincoln Beachey in 1905. This flight was the first aerial crossing of the Columbia River and the first aerial landing at Pearson.

Fixed wing flying began at Pearson in 1911 when Charles Walsh was the first pilot to build a Curtiss Pusher and fly from Pearson Field on June 15, 1911. The following year, Silas Christofferson became the second aviator to fly from Pearson when he piloted a Curtiss type biplane and made two flights on May 12, 1912. Silas logged over 200 flights at Pearson Field in 1912, but his most famous flight occurred on June 11 in front of a crowd of Portland, Oregon, Rose Festival celebrants estimated at 50,000.

The reason for the large crowd was that Silas was going to attempt the first flight off of a rooftop of a hotel in downtown Portland. In preparation for his flight from the Multnomah Hotel, Christofferson flew the Curtiss biplane to the Waverly Golf Links along the Willamette River just south of Portland where it was dismantled. The plane was then transported to the hotel where it was hoisted to the roof and reassembled on top of a wooden ramp that was constructed on the hotel rooftop. Christofferson sped down the 170-foot ramp and leaped into the air. He climbed to an altitude of 900 feet while he flew over the Willamette and Columbia Rivers on his way to Vancouver. This was the first crossing of the Columbia River by an airplane.

It was a drizzly day and Silas got lost in the haze. He finally found a moving point of reference to orient himself. "Looking down I saw an object on the water; it did not look more than a foot long, and there was black smoke coming out. That must be the ferry boat from Vancouver to Hayden Island, I thought, and then I knew where I was."

After a 12-minute flight, he landed at the Vancouver Army Barracks at what had been nicknamed "Aviator's Field." Eighty-three years later, Pearson Air Museum re-enacted that historic flight with a Curtiss Pusher replica that was built in 1946. Gaining permission from both the Federal Aviation Administration and the City of Portland, a 200-foot ramp was built on top of the Multnomah Hotel.

Tom Murphy from Hood River, Oregon, was the brave pilot who flew the replica off of the rooftop and traveled to Pearson Field where he landed safely some 26 minutes later. Tom experienced the same drizzly weather for a much longer flight, as he had to avoid the airways of the Portland International Airport. The replica Curtiss Pusher can still be seen in the Pearson Air Museum in Vancouver, Washington.

John Donnelly is the Executive Director of the Pearson Air Museum.

Ann Deines

Roy Knabenshue

From Dirigibles to NPS

At the turn of the 20th century, one of the recognizable aviation pioneers was Roy Knabenshue. In an age where few people had seen a manned flying machine and many questioned the possibility of human flight, Knabenshue made a name for himself as a dirigible pilot and balloonist. Interested in aviation throughout his life, he later applied his knowledge in a variety of ways: he built dirigibles, managed the Wright brothers' exhibition team, and started an aviation program for the National Park Service (NPS). It was this broad range of activities, and the importance of each, that made Knabenshue's achievements so noteworthy.

Born in Lancaster, Ohio, in 1876, Roy Knabenshue developed an interest in aeronautics at an early age when a professional aeronaut performing in Columbus, Ohio, offered him a ride in his captive balloon. Knabenshue's interest in ballooning increased over the years, and he purchased his first balloon in his early twenties. Regularly employed as a "telephone man," Knabenshue supplemented his income by offering balloon rides to the public for one dollar per person.

In 1904, Knabenshue traveled to St. Louis, Missouri, to participate in the Aeronautic Competition at the World's Fair commemorating the Louisiana Purchase. In St. Louis, Knabenshue competed in the free balloon races and operated a captive balloon concession. Another contestant in the Aeronautic Competition was Captain Thomas Baldwin. Baldwin, who was an early balloonist from California, built the first dirigible in the United States, the *California Arrow*, and entered it in the Aeronautic Competition. Baldwin first flew the *California Arrow* in California, and then shipped it to St. Louis to prepare for the competition. During trial flights, Baldwin discovered that he was unable to pilot the dirigible due to his recent weight gain, and he searched for a pilot. Knabenshue readily volunteered, and on October 25, 1904, he flew the *California Arrow* for 11 miles in one hour and thirty-one minutes, winning the competition.

After his spectacular flight in St. Louis, Knabenshue maintained his association with Baldwin and began touring fairs and air shows in the western United States, demonstrating dirigibles to awestruck audiences. In one event in Los Angeles, California, Knabenshue piloted the *California Arrow* in a race with an automobile, crossing the finish line with a two-minute lead.

In 1905, based on his successful exhibition flights, Knabenshue decided to set out on his own, and he made plans to tour the eastern United States after constructing his own dirigible. He returned home to Toledo, Ohio, and immediately built a dirigible he named *Toledo I*. In its first flight, he flew from the Dorr Street Fairgrounds to the roof of the 10-story Spitzer Building in downtown Toledo, winning a prize of $500 from A.L. Spitzer who had offered the reward to the first airman who could land on the roof of his building. Over the next several years, Knabenshue built a total of three dirigibles and established a troupe that toured the eastern United States making exhibition flights.

Fascinated with anything having to do with aviation, Knabenshue read with interest about the work of Wilbur and Orville Wright and their invention of a power-driven, heavier-than-air machine. With his successful experience conducting exhibition flights of dirigibles, Knabenshue became excited about the possibility of exhibiting airplanes. He first contacted the Wright brothers in 1908 about purchasing airplanes from them to use for exhibition purposes. At that time, the brothers only had one airplane constructed and that was already sold to the United States Army Signal Corps. However, Wilbur and Orville agreed to contact Knabenshue if they were ever interested in entering the exhibition business.

In 1909, the Wright brothers, with some New York investors, formed The Wright Company to manufacture airplanes. In addition to manufacturing, the company entered the exhibition business, and in March 1910, they followed up on the brothers' earlier promise and contracted with Knabenshue to manage their exhibition team. While Knabenshue planned and scheduled public exhibitions, Orville trained the pilots in Dayton, Ohio, at Huffman Prairie Flying Field.

Col. W.R. Winston and Roy Knabenshue. Photo courtesy National Air and Space Museum, Smithsonian Institution.

The Wright Exhibition Company participated in exhibition flights throughout the country for the next year and a half. Their main competitors were the members of the exhibition team from the Glenn Curtiss Company. The pilots of both teams competed to see who could complete the most miraculous stunts, fly the highest, or achieve the fastest speed. This proved dangerous, and many of the exhibition pilots suffered tragic accidents. Based partially on this fact, The Wright Company decided to close the exhibition business in November 1911.

With the termination of the exhibition team, the association between the Wright brothers and Knabenshue drew to a close. In describing Knabenshue's experience as their general manager, Orville found him to be "very successful in this. He not only was able to secure contracts where men under him failed, but he also succeeded in making the contracts satisfactory to both parties.... The business that he handled for us was very profitable."*

Knabenshue next moved to Los Angeles, California, and booked independent pilots for exhibition flights. As the exhibition business began to decline, Knabenshue turned his attention to building a commercial dirigible capable of carrying 13 passengers. Completed in 1913, Knabenshue hoped to use the dirigible to start a passenger flight service. When there was not enough transportation business, Knabenshue turned once again to exhibiting dirigibles throughout the United States.

Continuously associated with lighter-than-air flight, Knabenshue worked during World War I building captive observation balloons for the U.S. Army and later for the B.F. Goodrich Company. In 1933, Knabenshue was employed by the NPS as senior aeronautical clerk. In this position, he developed a plan for the NPS to test autogiro airplanes in the national parks for spotting forest fires, observing the progress of fires, and suppressing fires. Additional suggestions for use of the airplanes included surveying remote areas proposed as additions to the national park system, aerial photography, wildlife surveys, and emergency transportation. The NPS proposed to acquire four autogiros, one for each region.

Two autogiros were eventually transferred from the U.S. Army to the NPS in 1941, and two pilots were trained to operate them. The first pilot was Dave Driscoll, who worked for the NPS in Manteo, North Carolina. H. Clay MacBrair was hired next. Driscoll remained in North Carolina with one autogiro, while MacBrair was assigned to Boulder City, Nevada, although during the months of June to September, MacBrair would be based at Yellowstone National Park.

As individuals became knowledgeable about the autogiro program, requests were submitted for the use of the planes. These included a wildlife census at Isle Royale National Park; a bighorn census at Death Valley National Monument; aerial photography of the beaches at Cape Hatteras National Seashore; an aerial survey for wilderness roads and archeological features at Natchez Trace Parkway; and many others. Due to reductions in the 1942 budget many of these projects were never completed, and the autogiro program was terminated. The airplanes were eventually transferred to the Navajo Reservation in Window Rock, Arizona. With the conclusion of the autogiro program, Knabenshue transferred from NPS headquarters to White Sands National Memorial in Alamogordo, New Mexico, where he stayed until the end of his career.

When Knabenshue retired from the NPS, it brought an end to a long career in aviation. In the many years that Knabenshue was associated with aeronautics, he saw the invention and development of new technology that changed the way we all see the world. His achievements as an early aviator and his role in the development of aviation in the United States was recognized in 1965 when he was inducted into the National Aviation Hall of Fame.

Note

* O. Wright to E.K. Summerwell, April 14, 1917, R. Knabenshue Papers, National Air and Space Archives, Smithsonian Institution, Washington, DC.

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Fort Myer, Virginia's Place in Aviation History

Not many people knew of the Wright brothers' 1903 achievement until years after it occurred. There were few witnesses at Kill Devil Hills or newspaper accounts of the event, and those who heard the news were quite skeptical. In September 1908, Orville Wright made a number of exhibition flights at Fort Myer in Arlington, Virginia (adjacent to Arlington National Cemetery). Several thousand people witnessed these flights which finally showed the American public that powered flight was a reality (Wilbur made his first public flight a month earlier in Paris).

In December 1907, the Army's Chief Signal Officer requested bids for a flying machine with specifications 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 and delivered the machine to Fort Myer in August 1908. It could carry two people, fly more than 40 miles per hour, make a one-hour endurance flight, and was controllable in flight in any direction. Signal Corps Airplane No. 1 was the first military airplane in the world.

The specification required flights to demonstrate performance, and Orville Wright circled Fort Myer's parade ground in the airplane built for the Signal Corps. A national historic landmark district, designated in 1972, includes the parade ground and a number of historic buildings at Fort Myer. In 1958, the Army dedicated a large marble marker in commemoration, and recently produced a walking tour brochure that highlights the flights. In 1995, an Army sergeant found film of the first military airplane in flight at Fort Myer in the basement of the headquarters building. This edited version of two original films included footage never seen before by current-day experts on early aviation, and it was transferred to the National Archives and Record Administration in 1997.

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Orville Wright flying the first military airplane at Ft. Myer, Virginia, 1908. Photo courtesy Special Collections and Archives, Wright State University.

Paul R. Green

Conserving Aviation Heritage Resources in the U.S. Air Force

The U.S. Air Force is a study in dynamism, enforcing the Nation's defense aims through about 400% more deployments and with some 40% fewer personnel than at the height of the Cold War. Today, the Air Force maintains about 70 active bases throughout the U.S., comprising some 9,000,000 acres. The average size of a base is about 5,000 to 10,000 acres, although a few large ranges and test facilities in the western U.S. have more than a million acres. Think of a typical installation as a medium-sized town or community, with a similar population size and infrastructure. Preserving sensitive historical resources on or over lands owned or controlled by the Air Force is a challenge, involving warfighting operational commanders, land managers and engineers, preservation experts, regulatory agencies, tribal, state and local governments, and the public.

Air Force Missions, Policies and Organization

Air Force policy is to follow the spirit and letter of federal, state, and local laws regarding historic preservation and cultural resource management. The primary requirements are summarized in *Department of Defense (DoD) Instruction 4715.3, Environmental Conservation,* and *DoD Directive 4710.1, Archeological and Historic Resources Management.* The key documents for the Air Force are *Policy Directive 32-70, Environmental Quality,* and *Instruction 32-7065, Cultural Resources Management.*

At the Pentagon, HQ Air Force develops policy and advocates for funds before Congress. Below this level, major commands (MAJCOMs) direct key functional parts of the department. There are three large land-managing commands, focused on warfighting (Air Combat Command or ACC), weapons development, testing, and production or acquisition (Air Force Materiel Command or AFMC), and education and training (Air Education and Training Command or AETC). These and the other major commands are typically led by a four-star general, the military's highest rank and in many respects a role comparable to the chief executive officer of a major corporation in its scope and complexity. The MAJCOMs are composed of a headquarters and individual bases, and they have staffs that incorporate the general policy of the Pentagon level with their particular missions and funding profiles. Day-to-day guidance comes from cultural resource professionals at the command staffs in the headquarters, the Air Force Center for Environmental Excellence (Brooks Air Force Base, San Antonio, Texas) or at the few bases with such personnel.

Within the Air Force's civil engineering community, environmental organizations have grown up since the 1970s to address legal requirements, including those dealing with cultural resources. Cultural resources management duties were typically aligned with natural resources (forestry, wildlife biology, and management) and environmental impact analysis under the National Evironmental Policy Act (NEPA). Over the past decade professional archeologists, most with advanced degrees, have been added to the environmental staffs at larger bases and ranges and at some of the major command headquarters. These individuals identify the work to be done and the funding required. In the 1988–91 period, the Air Force developed a comprehensive system to identify environmental projects required to comply with federal and state laws and regulations. Archeological studies were part of this system. Base cultural resource managers fold the archeological and other cultural resource requirements into their environmental budget and forward it to the command headquarters for validation. The service headquarters at the Pentagon disburses funds each fall to the commands based on these budgets, although the final word on funding distribution is at the discretion of the MAJCOM commander.

Until the early 1990s, Air Force cultural resources surveys were undertaken mainly as part

Hangar 9 (1918), Brooks AFB, San Antonio, Texas. Courtesy U.S. Air Force.

of environmental impact statements prepared to comply with NEPA, or to comply with inventory needs of the Section 106 process under the National Historic Preservation Act (NHPA). Since then, however, funds were made available to begin inventories in compliance with Section 110 of NHPA. During this same period Congress created the DoD Legacy Resource Management Program, through the DoD Appropriations Act of 1991, P.L. 101-511, Sec. 8120(a). The Legacy mandate emphasizes inventory and protection of sensitive natural and cultural resources and increasing public awareness of DoD resource stewardship. With more than $70,000,000 spent in the Legacy Program since fiscal year 1991, bases in partnership with federal and non-federal agencies, academic institutions, and other groups performed hundreds of projects.

The Recent Past: Historic Buildings and Structures

The Air Force by nature is a creature of the Cold War, established in 1947 from the old Army Air Forces. Most of its thousands of buildings and structures date from the Cold War era (1946–1989) and are less than 50 years old. In addition, the number of bases today is far smaller than a generation ago, due to successive downsizing at the end of World War II and the Cold War. In 1943, at the height of World War II, the Army Air Forces had 345 main bases, 116 subbases, and 322 auxiliary airfields. When Strategic Air Command (SAC) and Tactical Air Command (TAC) were disestablished in 1992 and Air Combat Command created in their place, it comprised more than 40 major bases and ranges. Today ACC includes 17 bases.

There are a few bases whose roots extend back into Army days as either Western frontier garrison posts or early centers of military aviation. For example, Offutt AFB, the former home of SAC near Omaha, Nebraska, contains the 1890s Fort Crook Historic District from its Army days. Francis Warren AFB in Cheyenne, Wyoming, contains the 19th-century Fort David A. Russell National Historic Landmark District. Kelly AFB in San Antonio, Texas, and Langley AFB in Hampton, Virginia, date to World War I and contain National Register eligible or listed properties. In 1976, Hangar 9 (1918) at Brooks AFB became a national historic landmark as the only surviving hangar built by the U.S. Army Signal Corps Aviation Section, and the oldest Air Force aircraft storage and repair facility. These were some of the first installations to incorporate building types and planning schemes tailored to the aviation mission.

In the early 1920s, lack of military appropriations led to deplorable conditions at Army Air Service stations because they only had temporary buildings from the first world war. The Air Corps Act of 1926 authorized an expansion program to strengthen the air arm. It produced permanent construction at almost all of the 32 stations and depots retained after the war, as well as two new airfields with innovative layouts, Barksdale Field (now AFB) in Shreveport, Louisiana, and Randolph Field in San Antonio, Texas. The Army Quartermaster Corps designed substantial buildings for the Air Corps in a variety of historic architectural styles, including the Spanish Colonial Revival and "French Provincial." Both Barksdale and Randolph AFBs have historic districts listed in the National Register of Historic Places.

These pre-World War II buildings, structures, and districts have all the maintenance and repair problems and challenges familiar to readers of *CRM*. Particularly acute is the DoD perception that older historic quarters are excessively expensive to maintain. General officer quarters are often singled out by Congress for special scrutiny. The Air Force has an enviable track record in staying within statutory limitations on per quarters spending for maintenance and repair

while preserving the attractive appearance and historic qualities of these properties. However, beneath the surface of these decades-old buildings looms the need for major overhaul of their building systems. The Air Force, the Administration, and Congress must weigh budget factors, mission importance, and historic preservation when considering the destiny of these attractive quarters.

The National Register Process

Air Force policy on the National Register process fluctuated through the 1990s in response to political and budget pressures in Washington. In the early part of the decade, results of cultural resource inventories were just coming in and bases forwarded several nominations to the Pentagon for approval. Some of the properties listed during this period include historic districts at Barksdale AFB in Louisiana and Pope AFB in North Carolina, and the Titan Missile Complex near Davis-Monthan AFB, Tucson, Arizona. In 1994, the new AFInstruction 32-7065 required bases to forward nominations within 24 months of a determination of eligibility, a move intended to bring closure to the growing number of "eligible" properties being identified by contract inventories.

However, over the next two years the Air Force, the Texas State Historic Preservation Officer, and the Keeper of the National Register consulted at length over the proposed nomination for the Randolph Field Historic District at Randolph AFB in San Antonio. Air Force senior leadership was and remains concerned over the number of historic buildings in large historic districts, all requiring adherence to the Secretary of the Interior's *Standards for Rehabilitation* (part of the Secretary of the Interior's *Standards for the Treatment of Historic Properties*). Consequently, HQ Air Force declared a temporary moratorium on processing Register nominations until a new policy could be developed, one that reflected a commitment to stewardship and support for maintaining a high state of readiness within budget limitations. The Air Force recommitted itself to the preservation and management of historic properties in a September 1995 joint proclamation signed by the Vice Chief of Staff, the Assistant Secretary of the Air Force (Manpower, Reserve Affairs, Installations, and Environment), other senior Air Force leaders, the Chairman of the Advisory Council on Historic Preservation, the President of the National Conference of State Historic Preservation Officers, the President of the National Trust for Historic Preservation, and the Keeper of the National Register of Historic Places.

New policy on National Register nominations was issued on November 21, 1996. Among other things, this policy rescinded the AFInstruction requirement for nominations

Randolph Field, San Antonio, Texas, c.1935. Courtesy San Antonio Card Co., San Antonio, Texas.

within 24 months of eligibility determination. It did, however, remove the moratorium and accept new nominations for listing. Historic districts, multiple property, and national historic landmark nominations are now required to pass through a more rigorous review at the command and Pentagon levels, focusing on potential impacts to maintenance budgets and project uses of the property.

History, Museums, and Aircraft

"History" has a unique meaning in the U.S. Air Force, i.e., the history of the service, its units, missions, leaders, and men and women memorable for their particular achievements. This history is the purview of the Office of Air Force History, which employs a small cadre of professional historians to write and maintain unit histories. Civilian and military historians also serve at the command and base levels, typically reporting to the commander or the director of staff. At base level, wing historians are typically non-commissioned officers or junior level commissioned officers and have little knowledge of base history apart from its connection with the operational units they chronicle. Conversely, cultural resource managers and others in the civil engineering organization, charged with managing real property assets, often have little awareness of the missions of the units that occupied the buildings and structures.

Within the last few years, the Office of Air Force History has also assumed direction of the Air Force Museum and its holdings, both at the main facility at Wright-Patterson AFB, Dayton, Ohio, and at bases throughout the department. Unlike the Army, the Air Force does not maintain local or regional museums at installations around the country. The Air Force Museum at Wright-Patterson AFB is the world class institution which preserves unique historical or representative specimens of the Army Air Corps and U.S. Air Force aviation heritage. Visitors to Air Force bases or to neighboring communities may see Air Force aircraft on static display. Most of these aircraft were acquired by base or private groups on loan from the Air Force Museum, which maintains accountability for them through the history offices at the relevant major commands. Bases may also have collections of aviation memorabilia on display or in storage. Accountability of these collections is also maintained through the Office of Air Force History and major command history offices.

Under National Register guidelines, intact aircraft are classified as structures for purposes of listing. Few U.S. Air Force aircraft are listed in the National Register of Historic Places to date, and it is the exception rather than the rule that base static displays of aircraft contain noteworthy historical specimens. Most of the latter are maintained at the Air Force Museum. At least within Air Combat Command, any potential nominations of aircraft for National Register eligibility would be coordinated through the Air Force Museum, reflecting their special cognizance in this area. Wrecks of Air Force aircraft occur on or near military installations throughout the nation. These are particularly numerous around World War II training bases and ranges. Pre-1961 aircraft wrecks on non-Air Force property are considered abandoned by the Air Force, largely due to a Pentagon fire at that time which destroyed the relevant known records. For subsequent wrecks, the Air Force retains accountability and control. Archeological surveys record wrecks as sites for cultural resource management purposes.

In conclusion, over the past decade the Air Force expended considerable sums to inventory and evaluate the surviving pieces of its aviation heritage. We now have a much clearer understanding of our significant properties and their preservation needs. Air Force cultural resource managers will discuss these needs in the context of a smaller, more fiscally constrained Air Force at a DoD cultural resources symposium during the 2000 Society for American Archaeology conference in Philadelphia, and at a special Air Force natural and cultural resources session at the Air Force Center for Environmental Excellence in the spring of 2000.

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The opinions and conclusions in this paper are those of the author alone and do not necessarily reflect those of Air Combat Command, the United States Air Force, or the federal government.

Jody Cook

A Place Called Langley Field

National Significance in American Military and Civil Aviation

One of the most significant places in our nation's aviation history is found in southern Virginia at Hampton, just down the peninsula from Williamsburg, Yorktown, and Jamestown. The airfield known historically as Langley Field played a unique role in the development of American aviation. Now known as Langley Air Force Base (AFB), it is the Headquarters of Air Combat Command (ACC), the largest major command in the United States Air Force (USAF). Reorganization of USAF after the end of the Cold War integrated most of Strategic Air Command and all of Tactical Air Command into a single new major command. ACC controls all fighter aircraft based in the continental United States, all bombers, reconnaissance platforms, battle management resources, and intercontinental ballistic missiles.

Langley AFB requested assistance from the National Park Service Southeast Regional Office in Atlanta, Georgia, to survey its cultural resources and nominate eligible properties to the National Register of Historic Places, in compliance with Section 110 of the National Historic Preservation Act. Work required for the project was quite different than planned in the original scope of work. After the survey was underway, it became clear that the historic context needed to evaluate Langley's cultural resources was national in scope, not just a local or state context. Also, two different federal agencies have occupied Langley since its establishment in 1917 and still have facilities there—the USAF as well as the National Aeronautics and Space Administration (NASA). Survey and nomination of NASA's cultural resources at Langley were not part of the original project.

Much has been written about Langley over the years, but USAF histories focused on Army aviation and USAF activities at Langley, and NASA histories have concentrated on the NACA (National Advisory Committee for Aeronautics, NASA's predecessor organization) and NASA.

Original Site Plan (1917) for Langley Field, Virginia. Courtesy 1st Civil Engineer Squadron, Langley AFB, Virginia.

The NPS study brought a new perspective to Langley's history because it considered all historic aviation-related resources and activities at Langley, and evaluated them in a relevant historic context. Two contexts were required, both national in scope—the history of American military aviation and the history of American aviation.

Origins

In December 1916, the land that became Langley Field was the first property ever purchased by the United States for aviation purposes. The War Department bought the site for the Army's young air "arm" to build an Aeronautical Experimental Station and Proving Ground, an airfield for aeronautical research, experiments, and flight tests. An air base for national defense purposes was not yet conceived in the early years of aviation.

After construction was underway at the new experimental station, the Army set aside a section of Langley Field for the National Advisory Committee for Aeronautics, an independent agency established in 1915 to advance American aeronautics. The NACA began construction of its first aeronautical laboratory at Langley Field in 1917. It was the federal government's first and only civilian aeronautical laboratory in the 1920s and 1930s, the "Golden Age" of aviation between the world wars.

In April 1917, the United States entered the first world war, and wartime mobilization altered Army plans for Langley Field. The Army transferred most of its aeronautical work from Langley to an early Army airfield in Dayton, Ohio (McCook Field, a predecessor of Wright-Patterson AFB). Langley's new Army mission was military, rather than aeronautical research, and it became an air station with coastal defense responsibilities. The NACA, however, retained its aeronautical laboratory at Langley. This change in the Army's mission broadened the influence of Langley Field, making it a key airfield in the history of American aviation, military and civil. Aeronautical research at the NACA's Langley Laboratory was crucial to the development of American aviation. Army aviation activities at Langley Field were critical to the development of American air power and also led to independence for the Army air arm, which eventually became the U. S. Air Force.

Organization of Army Aviation

In 1907, the Army established military aviation in the Signal Corps because observation and reconnaissance were the only functions for the airplane known to the military. During the first world war, Gen. John J. Pershing, commander of American forces in Europe, removed Army aviation from Signal Corps control. He established an Air Service of the American Expeditionary Force, which clearly proved its effectiveness in supporting ground troops. But the war ended before military aviation could demonstrate it was a powerful, independent striking force—real air power.

The organization (and, therefore, the control) of Army aviation was a controversial problem that dominated the postwar period. Old-line conservative military leaders, especially the War Department General Staff, favored organization of Army aviation merely to support ground troops. Younger airmen, including pioneer thinkers like Brig. Gen. William "Billy" Mitchell, saw the potential of an air force with its own strategic mission. They wanted to conduct independent operations, and they also wanted a new organization separate but equal to the Army and the Navy. Top military brass at the War and Navy Departments were united in opposing any kind of independence for Army aviation, and fought every effort "to increase the power or prestige of the air arm."[1] This power struggle greatly affected Army aviation and development of American air power, and took all of the interwar years to resolve. Against this backdrop, Army aviation's development at Langley after the Armistice was especially remarkable. Langley Field became the hub of the Army Air Service and the Army Air Corps, with no rivals for its position as the air arm's principal airfield.

Secretary of War Weeks (in civilian clothes) and Generals Pershing and Mitchell (second and third from right) at Langley Field. The airplane, a Martin bomber, was the type that sank the warships. U.S. Army Air Service photo in Aircraft Year Book, *1922.*

Headquarters Building (1919), Langley Field, Virginia. Courtesy Curt Teich Postcard Archives/Lake County (IL) Museum.

Organization at Langley Field

Langley's pivotal role began in 1919 when the Army located key components of its postwar aviation organization at the airfield. The War Department authorized two wings for the Army Air Service, and stationed the headquarters and key units of the Second Wing at Langley Field. By the spring of 1923, President Harding's strict economic policy eliminated the First Wing and left the Second Wing as the only one in the Air Service. The Second Wing's premier unit was the Second Bombardment Group, based at Langley from 1922 until 1942. This basic combat unit of the Air Service and the Air Corps was Army aviation's only bombardment group in the early years. It is generally credited with development of heavy bombardment, also known as strategic bombardment and air power.

Langley Field became the center of Army aviation tactical training[2] after the Second Bombardment Group arrived. In 1922, a National Guard aviation unit began summer camp field training at Langley, and the Guardsmen usually flew old Curtiss JN-4 trainers (Jennies) from the first world war. A report by Maryland's 104th Observation Squadron clearly illustrated the airfield's status at that time. The squadron did not take its Jennies to Langley, where the pilots flew real service planes, because that would have been "like taking a ham sandwich to a banquet."[3]

Battleship Bombing

Brig. Gen. William "Billy" Mitchell was a well-known, controversial Air Service leader after WWI. He saw the potential of air power in Europe during the war, and proposed a test of airplanes against warships shortly after his appointment to the Director of Air Service's staff. Mitchell was sure he could demonstrate that airplanes with bombs had made battleships obsolete—at that time there was little information about aerial attacks on war vessels. Eventually the Army agreed to participate in tests controlled by the Navy, the "naval ordnance tests." They became more popularly known as the battleship bombing tests, a landmark in American military history that the Air Service conducted out of Langley Field in the summer of 1921.

Mitchell wanted well-prepared airmen and began training at Langley Field way before the tests received official approval. The Navy trained for the tests just across the James River at Norfolk, and the Hampton Roads area was the site of the "greatest aerial activity in the country"[4] since the Great War. The 1st Provisional Air Brigade organized at Langley with 250 planes and 1,000 men, many transferred from other stations and posts. They practiced with dummy and live bombs in the Chesapeake Bay and in nearby marshlands on an outline of a 600-foot battleship. The Army did not even have a bomb big enough to sink a battleship, so Mitchell's ordnance specialist designed 2,000- and 4,000-pound bombs. At that time, they were the largest bombs ever made.[5]

Remnants of the German imperial fleet, acquired by the Navy under the terms of the Versailles peace treaty, provided targets for the tests. They were anchored on the 50-fathom line off the coast of Virginia, requiring the airplanes to cross 75 miles of open water with heavy bomb loads. Navy admirals were confident that airplanes could not sink battleships. They planned for Mitchell's failure to have a large audience and "show as many Congressmen as possible how little could be done by the air force."[6] A day before the tests, a naval transport sailed from the Washington Navy Yard with the Secretaries of War and Navy, high Army and Navy officers, members of Congress, foreign diplomats, and about 50 newspaper correspondents and photographers.

The first target was a German submarine that sank 16 minutes after Navy seaplanes bombed it. Mitchell's brigade got their first shot at *Frankfurt,* a light cruiser that sank 35 minutes after they dropped the first 600-pound bomb. The last and most formidable target was a huge dreadnought, *Ostfriesland,* a floating fortress with heavy steel walls. Army, Marine, and Navy planes began operations on July 20, but they were

restricted to small bombs. The next day, Mitchell's Martin bombers dropped their first 2,000-pound bomb, and *Ostfriesland* sank in 21-1/2 minutes. That night General Mitchell threw a big party at the Langley Officers Club.

The tests did not demonstrate conclusively to War and Navy leaders that battleships were obsolete, but these and other bombing tests conducted from Langley in the 1920s proved military aviation was a powerful striking force on its own, and fueled the air arm's drive for independence from the Army. The Navy also reconsidered the importance of military aviation, and formed the Navy Bureau of Aeronautics immediately after the bombing tests. Mitchell's outspoken promotion of air power led eventually to his conviction by court-martial (ironically on December 17, 1925). He resigned from the Air Service in 1926, but by World War II Billy Mitchell was widely recognized as a visionary and prophet of air power.

Air Doctrine

The first school in the world to teach the tactics of military aviation opened at Langley Field in November 1920. It was also the first Army school for professional education of air officers, whose educational opportunities were not comparable to those for officers of other arms of the service. The school was first called the Air Service Field Officers School, but it became the Air Service Tactical School in 1922 due to a shortage of field officers (major and above).

The Tactical School played a critical role in development of Army air doctrine. In 1921, Maj. William C. Sherman wrote the school's first major text, *Air Tactics*, "a classic Air Service text on air doctrine,"[7] followed by a 1922 school manual titled *Fundamental Doctrine of the Air Service*.[8] Initially the school's doctrinal texts followed concepts officially imposed by the military establishment—success in war depended strictly on the infantry and all air operations were auxiliary to the ground battle. But by the mid-1920s, Tactical School instructors began to write the air doctrine that Army airmen really believed, and it was "a far different concept of the nature of war and the role of airpower."[9] Air doctrine attained its final, detailed form after the school relocated to Maxwell Field in Montgomery, Alabama in 1931, but Langley Field was the breeding ground for these visionary and revolutionary ideas.

Aeronautical Research

Aeronautical research was indispensable in the development of American aviation. The NACA's first aeronautical lab opened at Langley Field in 1918 and, according to the Smithsonian's National Air and Space Museum, "in the years 1928–1938, no other institution in the world contributed more to the definition of the modern airplane than the Langley Laboratory of the U.S. National Advisory Committee for Aeronautics." It is known today as the mother lab of all NASA's research centers. The aviation *CRM* in 2003 will include an article about this laboratory's exceptional significance.

Historic Buildings

A cultural resources survey brought the National Park Service to Langley AFB in the first place. The survey report listed more than 35 buildings constructed between 1917 and 1920, and they are the oldest and largest group of permanent buildings historically associated with the Army air arm (which became the USAF in 1947 after 40 years in the Army). Langley has the oldest housing (duplexes for officers' families, quarters for bachelor officers and visiting officers), the oldest administrative headquarters (which also housed the Tactical School in the 1920s), and the oldest buildings for support of military aviation operations, including the oldest hangar.[10] These buildings have architectural significance as well as historical significance. They are substantial, well-built, and most are examples of the Renaissance Revival or Tudor Revival styles of architecture. Many feature intricate brickwork patterns embellished with colored tiles. Detroit's Albert Kahn, a preeminent early-20th-century architect known primarily for his innovative work for the automobile industry, designed many of the buildings and the airfield layout.

During most of the 1920s, Langley's buildings were in great contrast to other Army air stations with deteriorating temporary buildings from the first world war. Five permanent buildings at historic Rockwell Field on North Island, San Diego, California, were the only exception. It was the Army's first permanent flying school (Signal Corps Aviation School). Langley may have become the hub of Army aviation in the 1920s, and the birthplace of American air power, because it was the only Army airfield at a crucial time with a sizable group of permanent buildings, specifically constructed for aviation purposes.

Building that housed the Atmospheric Wind Tunnel, the NACA's first wind tunnel (1920). Courtesy NASA Langley Research Center Photographic Archives.

Comprehensive evaluation of Langley's historic aviation properties raised several problematic issues. Most controversial were the evaluation of Langley Field's history and cultural resources within a relevant historic context (i.e., the history of American aviation) and the use of primary sources to document Langley Field's early years. Inclusion of NASA history and cultural resources in a "USAF project" has also been criticized.

History in the USAF generally focuses on leaders, missions, and units, and Air Force base histories are generally chronological and descriptive with little analysis or historic context information. Some at Langley AFB disagreed with the NPS evaluation of Langley's cultural resources from a new perspective, one that judged properties within their historic context, and concluded that Langley Field's historical significance was extraordinary.

A National Register nomination followed the survey work, and it documented Langley's origins and early years with primary sources and early histories of the airfield. It also examined Langley Field as a historic place, a center of aviation activities, not as the separate government installations that exist today. The NPS project was the first since World War II to encompass operations and contributions by both federal agencies at Langley, the Army, and the NACA (now the USAF and NASA). The last "joint" study was compiled by the Army Air Forces in 1944, and relied on an interview to document Langley Field's origins, then more than 25 years earlier in 1915–1916. The man interviewed, the NACA's first employee, was not always a reliable source according to NACA/NASA scholars. Even so, the National Register nomination's account of the airfield's origins received a mixed reaction at Langley because it differed from folklore that originated during WWII.

NPS documented a large historic district at Langley (more than 300 buildings) that is eligible for the National Register. In addition to its oldest buildings, Langley has a large number of buildings from Army and Air Corps construction programs in the late 1920s and the early 1930s—most old buildings at other historic USAF bases were constructed during that period. The proposed Langley Field Historic District also includes NASA's oldest wind tunnels, constructed by the NACA, as well as other unique and important historic aeronautical research facilities.

The project was completed in June 1995. National Register recognition of the Langley Field Historic District should help to make Langley's great historic significance more widely known, but so far the nomination has not been forwarded for listing. Not only is the Langley Field Historic District eligible for the National Register of Historic Places, its national significance in the history of American aviation merits designation as a national historic landmark.

Notes

1 Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917–1941* (Washington, DC: Office of Air Force History, 1985), 22.

2 There were no strategic units at that time. All units supported ground troops, i.e., they were tactical units. Langley was essentially the center of aviation combat training.

3 Mauer Mauer, *Aviation in the U.S. Army, 1919–1939* (Washington, DC: Office of Air Force History, 1987), 96.

4 *Aircraft Year Book, 1922* (New York City: Aeronautical Chamber of Commerce of America, Inc., 1922), 48.

5 David Nevin, *Architects of Air Power* (Alexandria, Virginia: Time-Life Books, 1981), 60.

6 William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power-Economic and Military* (New York: G.P. Putnam's Sons, 1925), 43–44.

7 Mauer, 594.

8 Greer, 16.

9 Ibid., 41.

10 Langley's hangar (1918) may have a rival at Brooks AFB in San Antonio, Texas. The Brooks hangar, a national historic landmark, also dates from 1918. Langley's hangar clearly has the edge in architectural significance and it has a twin (completed in 1919).

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Suzanne P. Allan

From Obsolescence to Adaptive Re-use

Rehabilitating Building 661 at Langley Air Force Base

Old buildings are not ours.... They belong partly to those who built them, and partly to the generations of mankind who are to follow us.... What we ourselves have built, we are at liberty to throw down. But what other men gave their strength, and wealth and life to accomplish, their right over it does not pass away with their death.

John Ruskin (1819–1900), English author and critic

This quote from John Ruskin iterates what is perhaps at the crux of many preservation efforts. That is, that old buildings, like objects in museums, are direct links to the past and therefore in many instances, worthy of preservation. In the case of the renovation of Building 661 at Langley AFB in Hampton, Virginia, this ethic was not only considered, it was actually applied.

Originally known as Langley Field and established in 1916, Langley AFB is the world's oldest, continuously operating airbase. Now occupying 3,167 acres in Hampton, Virginia, Langley AFB played a unique role in the development of American aviation. It originally served as an aeronautical experimental station and proving ground for the Army and the National Advisory Committee for Aeronautics. Langley Field was also unique as the first permanent military airfield in the United States and today its prominence continues as Headquarters to the Air Combat Command, one of eight major commands in the Air Force, and the 1st Fighter Wing.

Albert Kahn, a prominent Detroit architect who designed industrial facilities for the Packard Motor Company, Pierce Arrow, and the Ford Motor Company among others, was selected by the Army as the chief architect for design of the aviation experimental station in Hampton. Kahn developed a Beaux-Arts inspired site plan, with a bridge over the Back River from Hampton leading to a traffic circle and streets that radiate outward—one to the housing and administrative area to the east and the other to the flight line and industrial area to the west.

Work began on the site in April 1917. Temporary barracks were completed, and the experimental station named Langley Field. In July 1918, the Army took responsibility for construction work from the original contractor. By the time of the Armistice in November 1918, when major construction work was halted temporarily, a number of permanent buildings had finally been completed, including the Machine Shop (now Building 661). All told, over $15 million was eventually spent to implement Kahn's plans and by 1920, Langley Field was firmly and permanently established.

Building 661: Design and Use

Building 661, one of the first permanent structures on the base, was designed as a machine shop with two rows of concrete-framed sawtooth skylights to illuminate the interior portions of the building. The exterior was built of load-bearing brick piers infilled with brick under concrete window sills and steel-framed windows. A continuous band of reinforced concrete at the lintel height supports concrete beams. A grid of interior columns spaced 20 feet on center also supports the beams, which in turn support the reinforced concrete roof slab and the skylight structures.

This two-component structural system, brick on the exterior and concrete on the interior, reflects a refinement of 19th-century industrial construction methods where load-bearing masonry walls enclosed interiors with heavy timber frames, and later, cast iron frames. Many of Kahn's industrial structures were of all-concrete construction including exposed concrete supports instead of brick piers, and glazing running the full width from column to column. But such a construction method was perhaps considered too raw and unfinished for the Machine Shop at

Machine Shop (c. 1918), Langley Field, Virginia.

Langley Field, which was intended to be a fairly prominent building. Attention was lavished on the decorative brickwork that adorns the exterior of the parapet and the re-entrant corner piers.

Building 661 was constructed as a machine shop, used for a time as a garage, converted to a Post Exchange and commissary, then used as a publications warehouse, mail distribution center, and cafeteria. At some point in the 1940s, a large addition was constructed along the entire length of the building's rear elevation. A subsequent undated drawing, likely dating to the 1950s, indicates the skylights were sealed with asbestos board and covered with roofing material. Insult was added to injury in the 1960s when a number of steel-framed windows were replaced with eight-inch glass block.

Project Background

The project to renovate Building 661 and two other historic buildings was first conceived in the early 1990s. It was programmed as a 1997 Military Construction (MILCON) project, the purpose of which was to provide administrative space for additional personnel resulting from the merger of the Tactical Air Command with the Strategic Air Command and the creation of Air Combat Command at Langley AFB.

The project scope included development of a design for adaptive re-use of the building, removal of the non-contributing and architecturally incompatible rear addition, and restoration of key architectural elements, including steel-framed windows and skylights. It also addressed repair of failing structural and masonry systems and complete replacement of roofing, electrical, mechanical, and plumbing infrastructure.

From the start, design was based upon two basic tenets: creation of efficient and functional building spaces to meet the needs of contemporary office users, and respect for and restoration of the significant historic qualities of the structure. Consultation with the Virginia State Historic Preservation Office (SHPO) began almost immediately and, in fact, preceded the actual start of design. In-progress design review board meetings were regularly attended by both the SHPO representative and the installation Cultural Resource Management Officer. As a result, the consultation process was nearly seamless and the final design solution one that all parties could agree upon.

Today, the facility is still under renovation and the new occupants not yet in place. Work began in January 1998 and the estimated completion date is June 2000. Project managers are confident that the goal of providing efficient building space will be met. As for restoration of the structure's significant historic features, the final consensus may be that the project was more a renovation than a restoration in the truest sense of the word. Throughout the demolition and construction process, numerous serious unforeseen conditions were discovered. Structural failure in many cases was severe and exacerbated by demolition of building components. As a result of budget constraints, money originally earmarked for restoration of exterior elements, lighting, parking, and landscaping had to be diverted to correct structural problems.

Lessons Learned

While there were many headaches, debates, and challenges associated with the Building 661 project, there is a common thread of thought among the architect, the government's construction representative, and the base cultural resource manager. That is, the intangible benefits of such a project cannot not be overlooked or undervalued. In fact, at many times, being mindful of these benefits made the difficult situations easier to bear. Some additional lessons learned:

- Involve your SHPO early and often.
- Be realistic in defining whether the project is a renovation or restoration; expect trade-offs given budget constraints.
- Conduct extensive structural testing prior to developing a final budget and design.

Building 661, former Machine Shop (c. 1995, before rehabilitation).

- Consider a design-build contract to maximize flexibility, consistency, and accountability.
- The importance and value of a qualified contractor cannot be understated. A great contractor for new construction is not necessarily a great choice for renovation/restoration of a historic structure.
- Educate your contracting officer on the differences between working on a modern structure versus a historic one. Make him or her sensitive to specific contractor qualifications. The same goes for your contractor, your building inspectors—anyone associated with the project.
- If you don't use the right kind of contractor, expect delays and the need to spend large quantities of time researching and selecting materials and restoration methods.
- Be specific about materials during the design phase. Is there a standard material for replacement brick or will it have to be custom made? There are cost ramifications here also.
- If contingency money is needed after the project starts, expect this to create delays, especially if the money is for a custom or special order item. Consider, too, that there will likely be costs associated with such delays.
- Finally, if you are the project architect, expect a need for your constant involvement. In the case of the Machine Shop, there have been extended periods when the project manager had to call the architect for advice and direction several times a day.

Photos courtesy 1st Civil Engineer Squadron, Langley AFB, Virginia.

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Building 661, former Machine Shop with rehabilitation nearing completion, December 1999.

Patrick Andrus

A New National Register Bulletin

In 1998 the National Register of Historic Places issued a new *National Register Bulletin: Guidelines for Evaluating and Documenting Historic Aviation Properties.* National Register bulletins provide technical information on surveying, evaluating, registering, and preserving historic places. Producing this National Register bulletin turned out to be almost as interesting as the historic property types it examines.

The aviation bulletin was financed in part by the Department of Defense Legacy Resource Management Program in partnership with the Naval Historical Center, and was prepared through a cooperative agreement between the National Maritime Initiative of the National Park Service and the National Conference of State Historic Preservation Officers. It was written by Anne Milbrooke (a historian of technology), David Whipple (historian with the National Maritime Initiative), Jody Cook (historian, Southeast Region, NPS), and this author. These four cooks produced a gumbo of a bulletin, with this one adding a little of this and the others a dash of that.

An immediate decision was the scope of the bulletin. Should it be only about historic aircraft (there is a bulletin on historic vessels) or broader? We opted to include all historic aviation properties in the bulletin because aircraft are only one part of the multi-faceted story of aviation history. The next question was what period to cover; should the bulletin be cut off at the National Register's 50 year point, or go into the more recent past? The 50 year point (1948) included the momentous events from the birth of aviation through World War II, but it left out the Jet Age and the Space Age, so we decided to include the fairly recent past.

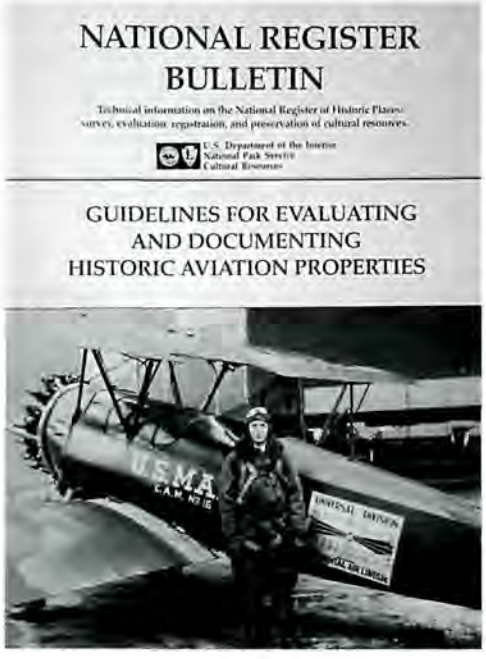

Photo courtesy National Register of Historic Places.

The draft bulletin sent out for review drew an unprecedented response both in numbers of comments and passion of tone. Our experience in dealing with specific property types has shown that enthusiasts hold strong opinions. The initial decision to include a section on the history of aviation in the draft bulletin was perceived much as Goldilocks reacted to the three bowls of porridge. One faction thought the section was way too brief (too cold), while another thought it too long, or even unnecessary (too hot). Other commenters thought the history section placed too heavy an emphasis on military aviation at the expense of the civilian experience, so we adjusted accordingly. The final form of the section (five pages of text plus a time line) provides sufficient contextual information for the novice and an extensive bibliography for more detailed information.

These concerns, though, were a tempest in the gumbo pot relative to the number of comments (of the heated variety) over the issues of integrity of location, setting, and materials for historic aircraft. While the bulletin includes discussions of eight broad aviation property types (aircraft, aviation wrecks, development and production facilities, air terminals, military bases, aids to navigation, administrative and education facilities, and missile launch sites and complexes), only the guidance on historic aircraft elicited a vigorous debate.

The issue of integrity of location is seemingly straightforward. The National Register has a long-standing policy that properties located in museums do not qualify for listing in the National Register. It would not be practical or useful to list the many millions of museum objects significant in our past. Museum objects do not have integrity of location and setting under National Register criteria because museums are not the location or setting where the properties achieved significance. The draft bulletin noted that "aircraft that are museum objects, in the traditional sense, will not qualify.... this includes aircraft removed from an avia-

tion setting and displayed in a museum as an object (hanging from the ceiling, mounted on a pedestal, etc.)." On the bright side, this statement provided the opportunity for a learning experience. It was pointed out that a strict reading of the location requirement would exclude from listing many (if not most) of the remaining aircraft from the historic period. Ouch!

The published bulletin explains at greater length why aircraft removed from an aviation-related setting and displayed in a traditional museum setting (such as those at the Smithsonian Institution's National Air and Space Museum on the Mall in Washington, DC), do not meet the National Register's requirement for integrity of setting, even though historically significant. Greater leeway is given beyond traditional museum settings. Aircraft are not disqualified simply because they are part of a collection, as long as they are in a setting which is appropriate to an aircraft and the setting allows it to convey its significance as an aircraft. Examples include a World War II dive bomber parked on a ramp or in a hangar at a naval aviation station, or a historic DC-3 maintained in a hangar at a municipal airport. Aircraft in modern buildings constructed to house a collection could qualify if the building is in an appropriate location (for example, located near a runway at an airport).

Another issue that provided heat (and eventually some light) was if an aircraft has to be located at a facility where it was historically associated. The short answer is no. Period aircraft are not required to be located at airfields where they were based historically. Aircraft are obviously mobile, and their significance is inherent in their ability to move. The general requirement is that historic aircraft must be located in an appropriate setting, such as an air-related facility.

A final area which elicited a wide diversity of opinion relates to the integrity of materials for historic aircraft. Some respondents thought the National Register should require historic aircraft to be airworthy in order to be listed. Others were of the opinion that a historic aircraft still able to fly probably has had extensive replacement of original materials (either through cannibalization of other aircraft or with modern parts) and is no longer authentic. An extended section of the bulletin deals with the issue of routine maintenance of aircraft and replacement of parts, provides the essential test for integrity of materials, and answers the almost philosophical question, "when does an aircraft stop being original?"

So, did the bulletin make everyone happy? No, it didn't, but National Register bulletins probably are not needed if there are no hard issues to consider. If you would like a copy of the bulletin for details on how the issues were resolved, it can be downloaded from the National Register web page <www.cr.nps.gov/nr>, click on "Publications." For a paper copy, call 202-343-8012 or write: National Register of Historic Places, National Park Service, 1849 C St. N.W., Room NC400, Washington, DC 20240.

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