

Wright Brothers History: The Tale of the Airplane

A Brief Account of the Invention of the Airplane

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Abstract:

How many people know the importance of the month of December 2003 in world history? Hundred years ago, in a cold foggy winter in December, two determined and courageous men from America conquered sky for the first time in the history of mankind and opened the era of aviation. But their life story was not a fairy tale at all. This article describes how a pair of self-taught engineers working in a bicycle shop made the world a forever smaller place.

A Puritan Fairy Tale:

The story of the invention of the airplane is a Puritan fairy tale. It is the story of how two honest, straightforward, hard-working men from America accomplished something fantastic and magical - creating a craft of stick and fabric that mounted the air like the chariots of the gods, opening the skies to all humankind. It is a story of how a pair of self-taught engineers working in a bicycle shop made the world a forever smaller place. Their success came so suddenly and from such an unexpected quarter that their contemporaries could not believe the Wrights had done what they claimed.

Around the turn of the nineteenth century, dozens of people were working to invent the airplane. The period of active experimentation begins in 1891, when noted German engineer Otto Lilienthal (1849-1896) began experimenting with hang gliders. Lilienthal took seriously the ideas advocated by Sir George Cayley almost a hundred years earlier. Through an extensive study of birds and bird flight, Cayley realized that the lift force and the thrust force of bird wings were separate and distinct, and could be imitated by different systems on a fixed-wing craft. Lilienthal began his work on heavier-than-air craft not by developing a complete airplane, but instead by focusing his efforts on a fixed-wing glider. Lilienthal brought a much-needed respectability to the enterprise of inventing an airplane. Up to that point, efforts to

invent airplanes were considered to be the province of crackpots and wild-eyed dreamers. But when a hardheaded German engineer entered the game, other respectable people were soon to follow. In addition to the respectability he brought to the field, Lilienthal made two more important contributions to the nascent field of airplane invention: the style of perfecting a glider before attempting powered flight (which Gibbs-Smith refers to as the 'airman' approach), and a table of the lift provided by curved wings. Unfortunately, Lilienthal was killed in a gliding accident August 10, 1896.

Following in Lilienthal's footsteps, efforts to invent an airplane became commonplace in the 1890's. The majority of the efforts were in Europe, including Captain F. Ferber, Henri Robart, Solirene, Levavasseur, Clement Ader, Percy Pilcher, and Sir Hiram Maxim. In the U.S., prominent attempts were made by Octave Chanute and Samuel Pierpont Langley.

Against this backdrop, we see the Wright brothers efforts to develop an airplane. The Wrights first craft in 1900 was approximately equal to the best that had been done prior to that time. They made steady progress in 1901 and 1902. The 1902 glider was the first truly effective heavier-than-air craft. In 1903 the Wrights created their first powered craft, which successfully flew on December 17, 1903. More capable airplanes were developed in 1904 and 1905, which culminated in their stunning European and American flights in 1908.

Here it is apparent there is a real mystery in the invention of the airplane: How did the Wrights begin at the top of the field and make sustained progress when their contemporaries could not? Unlike mystery novels, there is no simple answer to the mystery, but the answer is fascinating and instructive nonetheless.

About the Wright Brothers:

Bishop Milton Wright and Susan Catharine Wright had four sons, Reuchlin, Lorin, Wilbur, and Orville,

and one daughter Katharine. Wilbur, their third son, was born on a small farm near Millville, Indiana April 16, 1867, while Orville (1871-1948) and was born on August 19, 1871 at 7 Hawthorn Street in Dayton, Ohio state, USA.

The Wright household was a stimulating place for the children. Orville wrote of his childhood: "We were lucky enough to grow up in an environment where there was always much encouragement to children to pursue intellectual interests; to investigate whatever aroused curiosity." The house had two libraries: Books on theology were kept in the bishop's study, while the downstairs library had a large and diverse collection. Although Bishop Wright was a firm disciplinarian, the parents were loving and the family was a close one. As children in the late 1800's, Orville and Wilbur Wright adored flight. They both had their own kites, and for a while they had a balsa wood wind-up plane.

The family moved from Richmond, Indiana back to Dayton in June of 1884, the month Wilbur was to have graduated from high school. Wilbur left Richmond without receiving his diploma, and returned to Central High School the next year for further studies in Greek and trigonometry. The Wright brothers lived the most proper lives imaginable. They neither smoked, drank, nor married and always wore conventional business suits even when tinkering in a machine shop. During the years 1900, 1901, 1902, and 1903, the two brothers developed the first effective airplane.

Starting at the Top:

The Wrights began their efforts to invent the airplane by carefully studying what others had done before. They read everything they could get their hands on, including Octave Chanute's *Progress in Flying Machines*, the 1895, 1896, and 1897 volumes of the *Aeronautical Annual*, and popular articles in newspapers and magazines. It seems obvious to begin with a systematic study of past efforts, especially trying to understand the failures and limitations of previous work. Still, many never bothered to put in the effort; by ignoring the lessons of the past, they frequently suffered greatly. The Wrights took the time to do their homework. The brothers exhibited an unusual ability to judge the

worth of ideas they read, discarding as useless some widely held superstitions in the field, identifying the hard facts, and carefully integrating bits and fragments of knowledge scattered through the literature.

The Wrights followed the example set by Lilienthal and continued by Chanute of beginning with the glider. Only after they solved the problems of gliding flight did they feel it worthwhile to tackle the more difficult challenge of building a powered airplane. This decision was doubtless influenced by Chanute's arguments in *Progress in Flying Machines*, but Lilienthal and others also advocated the same approach. The Wrights also chose to pattern their aircraft after the Chanute-Herring biplane, a sturdy and relatively successful biplane glider. Lilienthal's data on the lift of wing surfaces were used in their design of the 1900 and 1901 gliders.

By careful study, the Wrights identified the best features of past aircraft and employed aeronautical theory about the lift of wings to design their first craft. Although it did not perform as expected, it was among the best gliders that had ever been built.

Doing It Wright:

The Wrights found the trap door out of this unhappy method. Instead of designing and building whole craft, the two brothers constantly found ways to test individual components and sub-systems of their designs. Early on, Wilbur realized that a plane could be controlled on its lateral axis (one wing tips up while the other tips down) if the wings of a plane were twisted, turning the craft into "an animated windmill." Instead of building an airplane with this design, the two brothers fashioned a 5-foot biplane kite. By flying the kite in the breeze, the two brothers were able to show that twisting the wings had the intended effect in causing the kite to roll.

The identification of an effective method of lateral control is universally recognized as being one of the most important contributions the Wrights made to aviation, and was the idea protected by their patent issued May 22, 1906. Thus, it may be somewhat surprising to learn that when the broth-

ers tested their first glider in 1900, in Kitty Hawk, N.C., the controls for twisting the wings were tied off, preventing any testing of this important breakthrough. In 1900, the Wrights were not concerned with lateral control. They knew they had already solved the problem given their experience with the small kite. To fly, their craft had to generate sufficient lift, and this was the issue they were exploring in 1900. As Figure 3 shows, the Wrights often tested the 1900 glider as a kite, attempting to determine the amount of lift generated by the wings.

The 1900 glider did not produce as much lift as the Wrights predicted, on the basis of Lilienthal's tables, that it would. Unfortunately, they had designed the craft to be 18 feet wide, but were only able to find 16 foot spars at Norfolk, Virginia, on their way to Kitty Hawk, so they were unsure about whether the problem was the original design, or because they had to substitute shorter spars than their design called for. The two brothers built a new glider in 1901, this time obtaining the long spars in advance of their journey. The two brothers also realized they could not rely on the Kitty Hawk weather station for accurate statistics about wind velocity at their site, and so brought along an anemometer, so they could measure wind speed and the angle of attack of their craft, and obtain a reasonably- accurate estimate of the lift of the airplane.

The 1901 glider conclusively demonstrated the lift of the airplane was not as great as the formula predicted. The two brothers realized they could not continue to build expensive gliders and convey them to Kitty Hawk for testing. Once again, they found a way to test a piece of the craft: they developed a state-of-the-art wind tunnel. Unlike previous wind tunnels, the Wrights created instruments that quantified the lift and drag of wing segments. They tested between 80 and 200 different wing shapes in their wind tunnel. In the process, they discovered the coefficient of lift (known as "Smeaton's coefficient") that was commonly accepted was wrong, and they also identified a highly-efficient wing shape in their tunnel.

This knowledge allowed the brothers to create the first effective heavier-than-air craft, the 1902 glider. Although the longest flight the glider was ever to

make covered only 662 feet on the ground, it was flying into a stiff wind, and so was flying a much greater distance through the air. Had the brothers taken the trouble to launch their craft from a high cliff, or from a hot-air balloon, or tow it from an automobile or boat, the magnitude of their accomplishment in 1902 would be better understood.

At this point, the Wrights only needed to add a system of thrust to make a powered airplane. They developed a wonderful 4-cylinder gasoline engine, returned to the wind tunnel to test propeller shapes, and designed their 1903 craft. By the time they took the craft to Kitty Hawk, the two brothers knew it could fly. They had tested the horsepower of the engine, the thrust of the propellers, and knew their wings would provide sufficient lift. There was no guesswork in the 1903 trials — just a confirmation of something the Wrights already knew: They had built an effective airplane. On December 14, 1903 the Wright brothers made the world's first powered airplane flight off Kill Devil Hill at Kitty Hawk, NC. Thursday, December 17, 1903 dawned, and was to go down in history as a day when a great engineering feat was accomplished. It was a cold day with winds of 22 to 27 miles an hour blowing from the north. Puddles of water near the camp were covered with ice. The Wright brothers changed the world when Orville went up in this aircraft for the first successful controlled, powered, heavier-than-air flight on that day. Although fragile, the Wright Flyer, which is composed of wood and fabric, and braced with steel wire, achieves a balance between lightness and strength. The Wright brothers worked independently, as most heroes have done, free of the entanglements of large industrial or government organizations.

The Dark, Unhappy Ending:

Although the Wrights initially received wide acclaim for their invention of the airplane, the aviation community was quickly overcome by jealousy and greed. Airplane developers did not want to pay the modest license fee the Wright brothers asked when others employed their method of lateral control in heavier-than-air flight. To escape this fee,

the aviation industry engaged in a prolonged smear campaign against the Wright brothers, minimizing their contributions in the invention of the airplane.

France and Germany simply refused to issue the Wrights patents for controlling the lateral motion of airplanes by ailerons or wing-warping. Europeans were free to copy the Wrights ideas without restrictions, or the embarrassing admission that the Wrights had done something the Europeans had not. In America, an ugly patent fight erupted. The Wrights brought suit against Glenn Curtiss, who was selling airplanes with aileron control without paying royalties to the Wrights.

What reward did the people bestow upon the Wrights for all their pains, their creativity, and their generosity? Wilbur, worn out and exhausted from a prolonged legal fight in the patent battle against a set of well-financed, viscous, and self-serving collection of airplane developers, succumbed to a mild case of food poisoning. In a small measure of victory, the courts sided with the Wrights. From this outcome, Orville was able to obtain a tidy sum of money, although the sum was in no way commensurate with the importance of the Wright's contribution or the patent the brothers received for their method of lateral control. Of course, no money at all came from European countries, which simply stole the Wright ideas without compensation.

The smear campaign against the Wrights must be counted as one of the most effective in history. Today the common man recognizes the Wrights as the inventors of the airplane, but the prevailing attitude toward the Wrights is that they were bicycle mechanics that invented, perhaps by happenstance and chance, the first airplane. Few today realize the genius and hard work the Wrights brought to their chosen task. Even fewer appreciate the elegance of the sturdy Wright biplanes, how difficult it is to learn to fly as you invent an airplane, or have any idea how much longer society would have waited for airplanes if the Wrights hadn't taught us all the way.



Fig. 1. The Chanute-Herring biplane

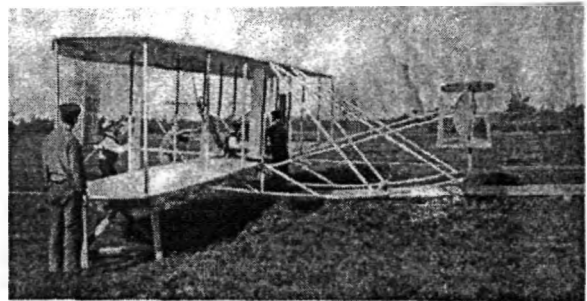


Fig. 2. Preparing the plane for takeoff

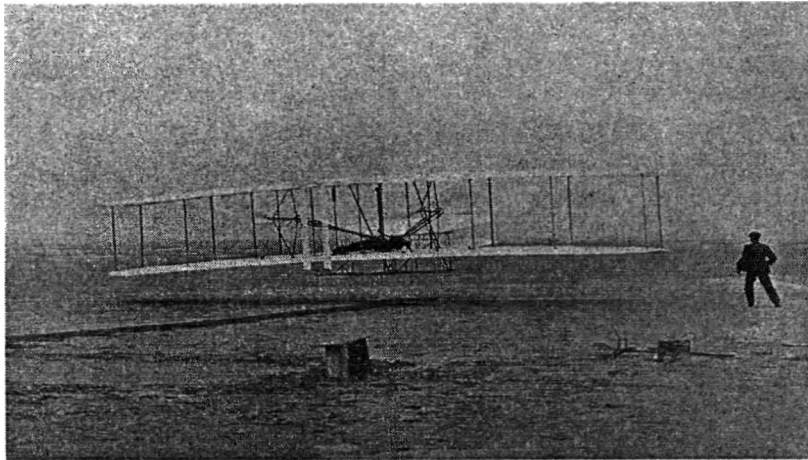


Fig. 3. The First Flight

Aviation pioneers Orville Wright, lying prone at the controls of the Flyer, and brother Wilbur watching from the ground during the first manned, powered and controlled flight, near Kitty Hawk, North Carolina, December 17,

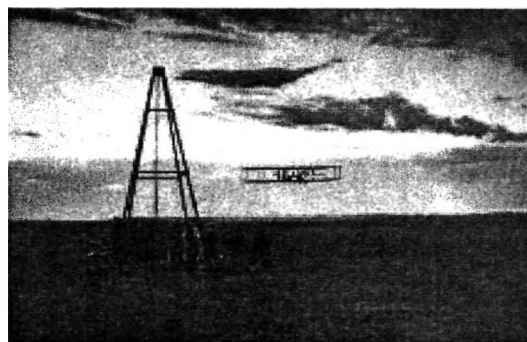
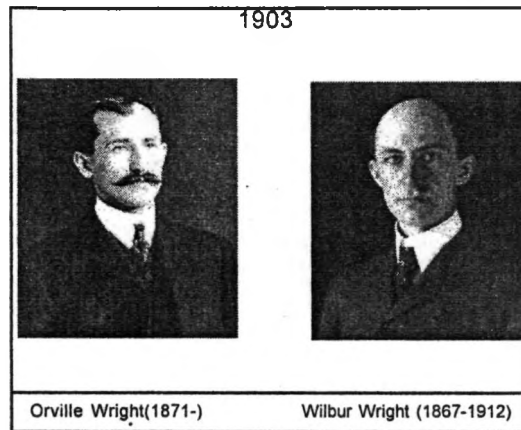


Fig. 4. Camp d'Auvours, September 21, 1908.
Wilbur's record flight of 1 hr 31 min 25 4/5 sec.