

Innovation and developments in aviation



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How Man's Dream Became Reality

Abstract

Through its short history, Aviation has come a long way. This paper highlights the events and technological advancements that contributed towards its development, beginning back to its birth when it was being created by adventurous and practical airmen, as well as engineers and businessmen. Back when aviation was biplanes, experimental aircraft, balloons, dirigibles, airships, first flights, and record flights. Or when it was test pilots, military aviators, sport flyers, exhibition flying, the development of infrastructure and the Government legislations. All in which gave birth and influenced the world of aviation and the industry that it is present day.

What was aviation in its early days prior to the development of heavier-than-air-flight? For more than a century aviation was about lighter-than-air aircraft. It began in 1783 with the invention of the first lighter-than-air balloon by Joseph and Jacques Montgolfier. The Montgolfier brothers invented, constructed, demonstrated, and improved the balloon as an aircraft. Soon after, on November, 21, 1783 Jean-Francois Pilatre and Francois Laurent became the first to fly one of the balloons, untethered. By the late eighteenth century, ballooning had become extremely popular, and a major spectator sport. Publicity created a new wave of eagerness to conduct navigable flights and aviation became more than hot air and hydrogen balloons. In 1852 a Frenchman named Henri Giffard designed and made the first flight in what was called a dirigible, a direct-able, steerable balloon. From the dirigible came the airship, a semi-rigid or rigid dirigible.

(Solberg, 1979 p. 20) Most notably was the Zeppelin, a large rigid airship designed in 1900, by a retired German officer named Count Ferdinand Zeppelin. The zeppelin would go on to reach a high degree of practicality. As balloons and airships soared the skies around the globe, human flight had become a phenomenon of some 125 years of practice, and many believed that dirigibles would prove the most practical means of air travel in the future. (Solberg, 1979 p. 26) The dirigible era certainly added much to flight experience in power plants and navigation. These early developments produced a heritage of flight and experienced pilots, yet the enthusiasm for ballooning, dirigibles, and airships diverted resources from the mechanical and aeronautical development of airplanes, heavier-than-air- craft. (Caves 1962 ps. 18-19). Experimenters were ready to challenge the suzerainty of lighter than air vehicles, flying a strange new contraption with wings instead of balloon.

Practical heavier-than-air flight evolved from fixed wing aircraft in the form of gliders. Although no practical engine was available for many years, thousands of short flights were made in gliders. Later, with the addition of propellers and engines, airplanes became a reality. As a nine-year-old boy, George Cayley (1774-1857), had been one of hundreds of Englishmen thrilled by accounts of the Montgolfier balloon flights. As an adult, he became one of Europe's leading scientists and commanding figure in aeronautical research. He had a major influence towards the discovery of flight. Beginning in 1799, Cayley experimented with several versions of gliders and wings designs. (Bilstein, 2003, P. 33) By 1809, Cayley's ideas crystalized into several model gliders with angled wings and tail assemblies, including vertical and

horizontal stabilizers. Before he died in 1857, Cayley had designed and flown numerous gliders as well as full sized craft capable of carrying a person. (Bilstein, 2003, p. 34).

During the 1890s German engineer, Otto Lilienthal (1848-96) constructed and flew gliders himself, making over 2000 successful flights. He was able to demonstrate that man could fly a heavier-than-air craft without an engine, and thereby gain the flight experience he believed necessary for the design and control of a powered airplane. Lilienthal played a huge role towards the discovery of flight. He died in 1896, when one of his gliders stalled and crashed. French-born, Octave Chanute was one of the country's leading civil engineers. Following Lilienthal's example, Chanute built man-carrying gliders around the same period. He became fascinated by aviation, and in 1894 published *Progress in Flying Machines*. It gathered and analyzed all the technical knowledge that he could find about aviation accomplishments. (Burkey, 1951) His book also served as a valuable practical reference for contemporary researchers. Such a researcher was Samuel Langley (1834-1906), a distinguished astronomer and head of the Smithsonian Institution in Washington D. C. Langley was determined to be the first to perfect a powered airplane piloted by a human. He built a model of a plane that included a steam engine, which he named Aerodrome. The assistant secretary of the Navy, Theodore Roosevelt, recognized the possibilities of aircraft for military scouting and helped Langley receive a \$50, 000 grant from the War Department to build a full-sized Aerodrome at the time of the Spanish-American War. After successfully building the plane, two attempts were made to fly but were unsuccessful. Only Nine days later on December

17, 1903, the Wright Brothers achieved controlled flight with their flying machine named the “Wright Flyer,” at Kitty Hawk, North Carolina. The brother’s accomplishment marked a milestone in history. The Wrights began to build new airplanes and engines, and eventually reached agreements to sell to Great Britain, France, Germany, and the United States War Department in 1908. (Crouch, 2004 p. 49).

By 1909 the Wright, Henry, Farman, Curtiss, and Voisin biplanes as well as the Bleriot type XI, and the efficient *Antoinette*, monoplanes became the aircrafts in which the entire structure of modern aviation was to be built upon. Every airplane flying today is a direct descendant of this first generation of flying machines (Burkey, 1951). Aviation in the early 1900s spread rapidly over the civilized world. Women joined men as pilots; passenger –carrying soon became an everyday event and virtually every kind of activity in the air was born during this expansive phase of flying. These activities included: radio communication to and from the ground; night flying; seaplane flying; military flying, including reconnaissance in actual warfare; artillery spotting; practical bombing; shipboard take-offs and landings; long distance flying; dangerous trans-Alpine and over-water flying; airmail flying; the formation of national air forces; parachuting from airplanes, the successful inherently stable airplane; and aerobatics. (Anderson 1999 p. 38)

World War 1 was a grand stimulant to the aviation industry, it created a far much greater demand for aircraft and of war-time production than of the pre-war capacity of the industry. In military aviation, the United States entered the war as an amateur. For the U. S., entering a conflict three years

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in progress, the process of catching up to Europe in aircraft production proved to be a rude awakening. The allies naturally expected a boost from American personnel and production potential, and America confidently expected to meet those demands. (Crouch, 2004 p. 110). In order to meet such demands, the joint Army and Navy Technical Aircraft Board called for the production of a total 20, 475 aircraft to be completed in 12 months. Such large demand from an “ industry” which had only produced 411 planes the previous year, almost seemed impossible. Congress appropriated \$640 million to do the job. By 1918 American production peaked, and an industry capable of producing such large demands had grown to 200, 000 people. (Anderson, 1999 p. 111) That first year they delivered 14, 020 airplanes, roughly 18 times that of the previous year. Some extraordinary engineering feats were accomplished. One of the most notable productions involved the Liberty engine which was used by the hybridized DH-4. As war surplus, the Liberty-powered DH-4 planes, and the Curtiss JN-4 trainers played a useful role in the evolution of American aviation during the postwar era.

That same year, Congress appropriated \$100, 000 to the Post Office Department who would be working alongside with the United States War Department, for the development of an experimental air mail service. (Caves, 1962 p. 62) The airmail service was a huge contributor in the development of Aviation, and it gave birth to some of the Airlines operating today. The first regular air mail route was established on May 15, 1918 between New York City and Washington, and by August 1918, the United States Post Office had assumed full responsibility of the mail service. An experimental Coast-Coast flight of mail took place on February 21, 1920, Jack

Knight and two other pilots, flying night and day in relay fashion crossed the United States to demonstrate the feasibility of transcontinental airmail. In the process they set the east-to-west coast transcontinental flying record of 33 hours and 20 minutes. (Schwantes, 2003 p. 67) The increasing value of air-mail service encouraged postal officials to plan around the clock flying schedules, including night flights. One of the many contributions of the Post Office Department to the development of aviation during this period was the demonstration of the practicability of regular night flying over regular routes on fixed schedules. (Anderson, 1999 p. 117). Pilots made experimental flights over the route at night and eventually by August 1923, lighted airways and a system of flashing beacons allowed for a regular night flying schedule to be established, expanding to a transcontinental route in two years. A series of floodlighted main terminals, plus a string of intermediate emergency fields, added to air mail's reliability. (Martin, 2013) As the sophistication of air mail improved during the twenties, the government eventually transferred its operation to private enterprise. Following the passage of the Air Mail Act of 1925, (The Kelly Act), The Postmaster General was allowed to issue contracts to private companies for transportation of the mail by air. (Harrison, 2011 p. 30) Shortly thereafter, The Air Commerce Act of 1926 was established as a means for the Government to get involved in aviation business once again, this time as a regulator of the private carriers created by the Kelly Act. (Crouch 2004 p. 120). The Act also established an Aeronautics Branch within the Department of Commerce to promote aviation through additional lighted airways, navigational equipment, and other aids. The branch was also responsible for the licensing of pilots, airworthiness regulations, and other federal activities in civil aviation. (Caves, 1962 p. 39).

Around this same period in time, experimentation with the use of radio for communication and for navigation was beginning to emerge. The development of radio navigation and instrument flight, changed the world of aviation. Beginning in World War 1, pilots were communicating to soldiers on the ground through the use of Radio Communications, the Airlines followed soon after by installing and using radio to transmit weather reports from the ground to pilots during flight. Beginning in late twenties through the late thirties, acting under the Air Commerce Act of 1926, the department of Commerce's aeronautical department developed, installed, operated, and upgraded radio navigation aids on the nations ground based airway system. (Glines, 1996) The Federal Airways System began small in 1927 with the transcontinental airway acquired from the Post Office Department. The military also participated in radio communications and radio navigation development during this period. The skills of Lt. James H. ("Jimmy") Doolittle who was already well known for several speed records and other aeronautical exploits, helped to refine the necessary equipment for instrument flight. This included a radio homing device with visual clues; the sperry artificial horizon, the sperry directional gyroscope, and better accurate barometric altimeter. (Burkey, 1951). The first complete "Blind" instrument flying occurred on September 24, 1929. "Flying the plane from a cockpit completely hooded to block his external vision (a back-up pilot occupied the front cockpit), Doolittle took off on instruments, flew a complete circle, and landed-without once seeing the ground."(Harrison, 1996 p. 210). The new era of instrument flight had emerged.

On May 1927, the young American pilot Charles Lindbergh successfully flew solo across the Atlantic Ocean in his Ryan monoplane, *Spirit of St. Louis*. The effect of this fine achievement was immediate and decisive, and American aviation was never again to look back. “Lindbergh’s flight and its profound influence on aviation, is one of the great examples in human history where the enterprise and bravery of one individual can influence the fate of nations, and help transform the world we live in.” (Solberg, 1979 p. 49) Charles Lindbergh’s historical flight opened the Golden Age of Aviation in which new aircrafts and new aviators met new aeronautical challenges. A series of broken records for speed, distance altitude, and publicity flights punctuated the decade and symbolized milestones along the path of aeronautical progress in the 1930s. In 1931 Wiley Post along with his navigator Harold Gatty, made a world record when he piloted his Lockheed Vega, the *Winnie Mae*, around the world in less than nine days. (Schwantes, 2003 p. 96) He topped his record in 1933 when he flew around the world again in under eight days. In 1935 Post completed a substratophenic research flight from which he discovered the Jet-stream. Post enlisted for the help of the B. F. Goodrich Company in developing a pressure suit for him to wear during the substratophenic flight. The suit was later used for research involving the X-15 research plane of the 1960s and for the Astronauts. (Solberg, 1979 p. 90). Post completed the flight in once again, his Lockheed Vega, *Winnie Mae*, with its engine modified for high altitude flight. The American Lockheed Vega, designed by John K. Northrup had a configuration fairly new to the industry. It was a brilliantly designed single engine, high wing monoplane, with a seating capacity of six passengers. The Vega had a cruising speed of some 155 mph and could travel over distances of 500-900 miles. (Milton, 2013).

The Vega's long-distance flight capability made it favored amongst many record-breaking pilots. Such pilot was Amelia Earhart, an inspirational pioneer of aviation who made headlines when she became the first woman to cross the Atlantic solo. She went on to set other records and became an international celebrity before she mysteriously disappeared over the Pacific during a world flight attempt in 1937.

As the Post Office continued to grow into mature transportation systems, Postmaster General Walter Folger Brown encouraged another amendment to the Kelly Act. Known as the Air Mail Act of 1930. The act permitted the Postmaster General to consolidate the airmail routes, if he believed it would serve the interest of the public. Brown organized a meeting which became known as the Spoils Conference of 1930, because he only invited the heads of the larger carriers to attend. He reorganized the mail routes which forced the small operators out of business and awarded a large amount of the remaining business to the larger operators in which he felt were most qualified. (Grant, 2017 p. 50). Independent airline operators, who felt they were left out from a profitable business, angrily accused the former Postmaster General Brown, of favoritism in awarding the contracts. A congressional investigation headed by Senator Hugo Black turned up evidence that tended to substantiate the complaints. Based on the Black investigation, President Roosevelt directed his Postmaster General, James Farley, to cancel all the air mail contracts and ordered the Army Air Corps to take over flying the mail. (Caves, 1962 P. 101) Within one month of the Army taking over, ten pilots had died in either operational or training accidents. President Roosevelt was forced to retreat from his plan for the air mail. By

the Air Mail Act of 1934, authorization was given for new one-year contracts that were subject to review before renewal. Also, former contract holders that were represented at the spoils conference were not allowed to bid at all. This would have meant the end of airlines, as an industry. (Harrison, 1996 p. 102). However, General Farley, privately directed all the airlines to reorganize which gave birth to American, Eastern, and United Airlines. In another major change, the government forced the dismantling of the vertical holding companies common up to that time in the industry, sending aircraft manufacturers and airline operators (most notably Boeing, Pratt & Whitney, a United Airlines) their separate ways. The entire industry was now reorganized and refocused. (Crouch, 2004, p. 98)

The Immediate Pre-World War II decade of the 1930s saw the steady growth of civil aviation, a sharp upsurge in military flying, and the development of a new generation of advanced aircraft. What may be termed the first modern-type airliner appeared in the United States in the twin engine Boeing 247 (in service in 1934), which had a load capacity of 10 passengers and could travel at speeds up to 150mph. The 247 used just about every advanced construction concept available at the time. (Glines 1996) By the time the DC-3 came into service in 1936 the form and nature of the modern airliner was standardized with the following features: low wing all metal, stressed skin mono-plane construction, two- (later four-) powerful super charged radial engines, on one of which the machine could still maintain level flight; variable pitch propellers; retractable gear, and flaps to allow for increased wing-loading with a slow stalling speed. (Crouch, 1988). Called the plane that changed the world, the DC-3 quickly became the

dominant aircraft in the United States, following its debut in 1936 with American Airlines (which played a key role in its design). The DC-3 was by far the most famous and successful airliner in history and was sold to nearly every nation. (Francillon 1988 p. 44). It was powered by two 1000-1200 hp engines, and was able to carry 21 passengers and travel at speeds up to 170 mph over a distance of 500 miles. By the time production ceased in 1945, some 13, 000 of these remarkable had been built, and some are still flying today.

The post war transition was complete, and the technology that came from WWII transitioned aviation in to an electronic age of jet planes, rockets, missiles, and spacecraft. The dream of jet-propelled aircraft was first realized in practice with the German turbojet airplane, the Heinkel He 178. German engineers, most notably Hans van Ohain had been working on parallel lines to that of the British Royal Air Force officer Frank Whittle from 1930 and onwards. The Heinkel He 178 was nearly a test bed for the Whittle engine, but the most outstanding turbojet airplanes of the period- and one of the classic airplanes in history was the German Messerschmitt Me 262 fighter, which first flew in 1942 and had a top speed of 525 mph.(Thompson, 2018) The United States with its great was inexplicably slow in this all- important new field and took little interest in jet propulsion before 1941. In that year a British Whittle engine had been shipped from England to the United States, and in 1943, a de Havilland jet engine was also sent over. From these two British engines alone, the great turbojet industry of the United States was developed. In the late 1940s and early 1950s, jet propulsion made giant strides, spurred on by the demands for combat aircraft and the rapidly

increasing needs of the airlines for large and fast jet transport machines. (Francillon 1988, p. 67) The growing production of airliners, which flooded from the world's factories after the war was over, began making air travel across oceans and continents as practical and common as journeying by rail or boat. (Burkey, 1952) Pressurized cabins soon became the rule, allowing jet aircrafts to fly at optimum speeds at heights where ordinary breathing would be impossible. It was Britain who pioneered the jet-propelled passenger transport, with the de Havilland Comet being the first to enter airline service in 1952. Britain also pioneered the airliner with turbo-prop propulsion and achieved world-wide success with the Vickers Viscount, which first went into service in 1953. Then arrived the two main types of giant jet airliners, the American Boeing 707 and the Douglas DC-8, the former entering airline service in 1958. These great four engine aircraft could carry over 170 passengers at speeds of over 500 mph, non-stop over distances of 4000 miles flying at 30, 000 feet. By the end of the 1950s air travel had revolutionized transport. (Francillon, 1988 p. 90)

The industry's growth brought new problems in aviation. In 1956 two aircraft collided over the Grand Canyon, killing 128 people. Congress responded by passing the Federal Aviation Act of 1958. (Crouch, 2004, p. 98) The legislation created a new safety regulatory agency, the Federal Aviation Agency, later called the Federal Aviation Administration (FAA) when Congress created the Department of Transportation (DOT) in 1967. The end of the 1970s brought the first arrival of the so-called wide-bodied " Jumbo Jet," the Boeing 747, which could carry up to 500 passengers and could fly at nearly 600 mph for over 6000 miles. Douglas was quick to follow with the

development of a wide-bodied jet of its own, the DC-10. Lockheed also unveiled its contender, the L-1011, one month later (Schwantes, 2003 p. 88)

In October of 1957 Russia Shocked the world by launching the first space satellite named Sputnik. The U. S. followed by launching a satellite of its own named Explorer in January of 1958. The same year, the United States transformed the National Advisory Committee on Aeronautics (NACA), into the civil National Aeronautics and Space Administration (NASA). Aviation. (Milton, 2013) Aviation had turned into Aerospace, and the space race had begun. On May 21, 1961 President Kennedy announced to the nation the goal of sending an American to the moon by the end of the Decade. Project Mercury, Project Gemini and Project Apollo were developed to accomplish this goal. Project Mercury involved launching single man capsules in to space to explore sub orbital and orbital flights. Project Gemini capsules carried astronauts to extended space flight, space walks, and the rendezvous of two space crafts. Gemini also explored new issues that could arise while going to the moon. (Grant, p. 77) The Apollo Program consisted of 11 missions to the moon in a capsule designed to carry three men. The Saturn V Rocket was designed to launch the capsule and its support module. Neil Armstrong became the first man to walk on the moon on July 20, 1969. After the Apollo program came to an end, NASA continued its space exploration with the development of the Space Shuttle. Between the first launch on April 12, 1981, and the final landing on July 21, 2011, NASA's space shuttle fleet — Columbia, Challenger, Discovery, Atlantis, and Endeavor — flew 135 missions, helped construct the International Space Station and inspired generations. Two of the shuttles, Challenger, and Discovery were lost along

with the crew onboard during one its missions. (Milton, 2013) The new age brings the possibility of low cost, reusable rockets, as well as NASA plans for exploration of Mars. Companies such as SpaceX and Boeing have started vying for more large-scale government contracts. In February 2019 SpaceX demonstrated the most powerful rocket in the world since the Saturn V, when it launched its Falcon Heavy rocket. Some other companies such as, Blue Origin and Virgin Galactic, have shown interest in specializing in space tourism. (NASA, 2019)

Some of the recent innovative technologies that have been adopted by the industry are allowing for the production of a much more energy efficient aircraft. New markets and business opportunities are continuously opening up for American companies and carriers to explore alternative energy sources and propulsion systems that can provide better fuel efficiency with less noise and fewer emissions. Engineers and manufacturers are developing unique vehicle concepts that will use different fuselage shapes; longer, skinnier and more blended wings; innovative materials and components; and highly-integrated propulsion (engine) systems. (Thompson, 2018) It's already happening. Some new planes, like the Boeing 787 and the colossal Airbus 380, are built with lighter “ composite materials” rather than heavier old-school metals, so they burn less fuel, increasing Airline profits. Many researchers feel we are only a few steps away from a major aviation revolution, and that a commercial aircraft using hybrid-electric or turboelectric propulsion technology could be flying to an airport near you in the not too distant future. (Science & Innovation, 2013)

References

- Anderson, J. D. (1999). *Introduction to Flight*. P. 38, 11, 117 New York: McGraw-Hill.
- Bilstein, R. (2003, March). Defining moment in the history of civil aviation. *Air & Space Magazine* 22 33-34
- Burkey, D. (Writer & Director). (1951). Aviation History [Television Series Episode]. United States Army Signal Corps (Producer). *Aviation History: The Big Picture* Retrieved from <https://www.youtube.com/watch?v=hTwo4vfiK90>
- Caves, R. E. (1962) *Air Transport and its Regulators*. (pp. 18-19, 39, 62, 101, 110) Cambridge, MA: Harvard University Press.
- Crouch, Tom P. (1988) *Dream of Wings: Americans and the Airplane, 1875-1905*. New York: W. W. Norton, 1981; reprinted., Washington, D. C.: Smithsonian Institution Press, 1988
- Crouch, Tom D. (2004), *Wings: A History of Aviation from Kites to the Space Age*, (pp. 98, 110, 120) New York New York: W. W. Norton & Co;
- Dallos, R. E. (1986 April) Pioneer Western Pilot Recalls Day It All Began: *Airline Has Come a Long Way Since 1st Flight in 1926.* " *Los Angeles Times*, April 06, 1986
- Francillon R. J. *McDonnell Douglas Aircraft since 1920: Volume I*. (pp. 44, 67, 90) Annapolis, Maryland: Naval Press, 1988.
- Glines C. V. (1996, November) *Aviation History Magazine*
- Grant, R. G. (2017), *Flight: The Complete History of Aviation*, 2nd Ed. (pp. 50) DK Publishing

- Harrison, James P. (1996 May) *Mastering the Sky : A History of Aviation from Ancient Times to Present* . (pp. 30, 96, 102, 210) New York: Sarpedon, 1996.
- Martin, J. (Producer & Director). (2013). *The Century of Flight* [DVD]. Barns Trust Television.
- Milton, D. (1966 February) *Wings of Mystery ; True Stories of Aviation History*. New York, Dodd, Mead (1966).
- Mola, R. A. (2009, August). *The Birthplaces of Aviation*. *Air & Space Magazine*, (pp. 34-36, 73)
- National Aeronautics and Space Administration, (2017, August). *Space Shuttle Era* . Retrieved from https://www.nasa.gov/mission_pages/shuttle/flyout/index.html
- Schwantes, C. A. (2003, October) *Going Places: Transportation Redefines the Twentieth Century West*. (pp. 67, 88) Indiana University Press (2003)
- Science and Innovation, (2019, April). *Future of Spaceflight*. Retrieved from [https:// www.nationalgeographic.com/science/space/space-exploration/future-spaceflight/](https://www.nationalgeographic.com/science/space/space-exploration/future-spaceflight/)
- Solberg, C. (1979 January). *Conquest of the Skies: A History of Commercial Aviation in America*. (pp. 20, 26, 49, 78, 90) Boston: Little, Brown, c1979
- Thompson, T. E. (2018, October). Retrieved from <https://www.techbriefs.com/component/content/article/tb/features/articles/33101>