(U) History of Aviation and Modern Rocketry

From Intellipedia

The twentieth century marked a turning point for mankind, from the industrial age to the space age. Some may argue that we are in the information age and if so, it was brought about through the knowledge and technology gained from our aviation, rocket, and space pioneers. The rapid transfer of information today cannot, and would not, have occurred, for example, without satellites. In turn, satellites could not have occurred without aviation and rocket technology. And soon, early in the 21st century, these two technologies will converge to produce an aerospace plane that will make traveling to space as commonplace as airline travel is today. This is not a detailed history of all aviation or rocketry, but only those events that led mankind toward spaceflight.

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(U) Birth of aviation

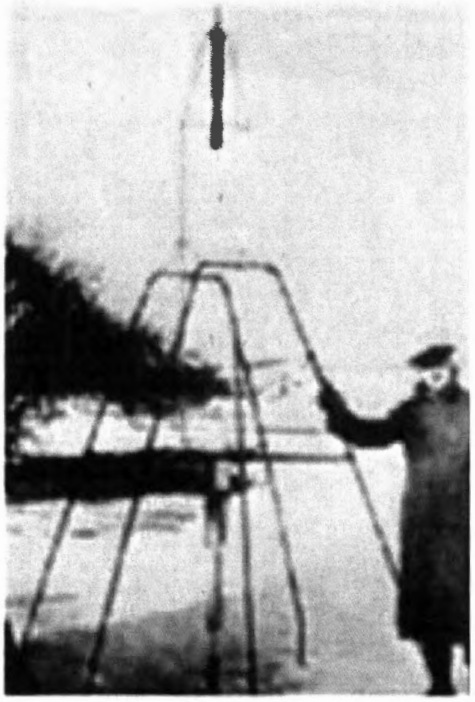
Aviation history began on December 17, 1903 at 10:35 a.m. from Kill Devil Hills outside the village of Kitty Hawk, North Carolina. Orville Wright took off, in the face of a 27 mile-per-hour wind, and covered 120 feet in 12 seconds during the world's first powered, sustained, and controlled flight. He had "won" this place in history from his brother, Wilbur, by a flip of a coin.

(U) Modern Rocketry Pioneers

Modern rocketry was started by three men, on parallel paths. These three "fathers of modern rocketry" were Dr. Robert H. Goddard, recognized as the most important figure in American rocket history, Hermann Oberth, a Romanian born Physicist working in Germany, and Kanstantin Tsiolkovsky, an obscure Russian school teacher and mathematician. Although Tsiolkovsky never built any rockets, he did work out many of the principles of astronautics, designed suitable rockets and was know as the father of "Cosmonautics" in Russia. He authored a series of remarkable technical essays on such subjects as reaction propulsion with liquid-propellant rockets, attainable velocities, fuel compositions, and oxygen supply and air purification for space travelers. He also wrote what apparently was the first technical discussion of an artificial Earth satellite.

(U) Robert Goddard

Robert Goddard's interest in rocketry started in 1898 when, as a 16 year old, he read *War of the Worlds* written by the English science fiction writer and novelist, H.G. Wells. In an autobiography written in 1927 (published in 1959) Goddard acknowledged his debt to Wells and even wrote to him in 1932. Goddard began his experiments in rocketry while studying for his doctorate at Clark University in Worcester, Mass., and, on May 26, 1919, wrote a progress report to the Smithsonian Institution entitled "A Method of Reaching Extreme Altitudes." It was published by the Smithsonian in January 1920. In this paper, Goddard first suggested that a liquid fueled rocket could be sent to the moon. Despite the scientific merit of his paper, he was ridiculed by the public and the press for this one "absurd" idea. Mainly because of this outcry, he would never seek to publicize his work again.



From his aunt Effie Goddard's farm in Auburn, Mass. and far away from the public eye, Robert Goddard launched the world's first liquid-powered rocket, on March 16, 1926. Designed and built by Goddard, this rocket, fueled by liquid oxygen and gasoline climbed 41 feet, traveled 184 feet in 2.5 seconds and landed in a cabbage patch. Although not much farther than Orville Wright's first manned flight, it was, none the less, significant and considered the "Kitty Hawk" of rocket history. Being liquid fueled was crucial. Up until then, all rockets were based on a solid fuel, gunpowder, which dated back to China in the late third century before Christ. Solid fueled rockets did not have adequate power to do the things that Goddard wanted to do, like fly a rocket to the moon.

Goddard was the first of the early rocket pioneers to go beyond theory and design. He entered the realm of "systems engineering" - the complex business of making airframes, fuel pumps, valves, and guidance devices compatible. Besides being the first to launch a liquid-propellant rocket and adapt the gyroscope to guide rockets, he was the first to install movable deflector vanes in a rocket exhaust nozzle for stability and steering, patented a design for a multistage rocket, developed fuel pumps for liquid-rocket motors, experimented with self-cooling and variable-thrust motors, and he developed parachutes that automatically deployed for recovering his instrumented rockets. Goddard put rocket theory into practice and at the time of his death in 1945, held 214 patents in rocketry. These patents still produce royalties for his estate.

(U) Charles Lindbergh

Goddard's experiments inspired another aviation pioneer, Charles Lindbergh, who, on May 20-21, 1927, became the first person to ever cross the Atlantic Ocean in an airplane. Lindbergh helped find support for Goddard's experiments and corresponded with him throughout the 1930's. Goddard went on to test rockets pressurized by liquid nitrogen and, on March 28, 1935, launched the first rocket with gyroscopic controls. It flew to a height of 4,800 feet and 13,000 feet downrange at a speed of 550 MPH.

(U) Hermann Oberth

Meanwhile back in post World War I Germany, Physicist Hermann Oberth was receiving an enthusiastic response to his 1923 book on the theories of space travel, *The Rocket into Interplanetary Space*. One of those inspired was a German teenager, Wernher von Braun, who read Oberth's book in 1925 and a short five years later, would assist Oberth in liquid-fueled rocket experiments with about 15 pounds of thrust. Von Braun always considered Oberth to be his mentor and more like Tsiolkovsky (a theorist) than Goddard

(a practical builder).

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(U) Wernher von Braun

Radio commentator Paul Harvey tells a story of how young von Braun's interest in rocketry almost got him labeled as a juvenile delinquent. At the age of 13, von Braun exhibited an interest in explosives and fireworks. One day, the young teenager obtained six skyrockets, strapped them to a toy red wagon and set them off. Streaming flames and a long trail of smoke, the wagon roared five blocks into the center of the von Braun family's home town, where they finally exploded. As the smoke cleared, the toy wagon emerged as a charred wreck. Young von Braun emerged in the firm grasp of a policeman and despite being severely reprimanded by his father, the youngster's interest would not be denied. By the age of 22, he had earned his doctorate in physics and two years later he was directing Germany's military rocket development program.

By 1932, the German Army was beginning to show an interest in the German Rocket Society's efforts, of which von Braun was a part. On October 1, 1932, he obtained a civilian position to work on liquid propelled rockets in the Army rocket program. Most of the German Rocket Society followed von Braun into national service and the society disbanded.

Von Braun scored his first success in December 1934 with an A2 rocket powered by ethanol and liquid oxygen. The rocket researchers quickly outgrew their facilities in the outskirts of Berlin and, in 1936, operations were transferred to a remote island of Peenemuende on Germany's Baltic coast. It was here that von Braun and his colleagues designed the first successful ballistic rocket, the A4 otherwise known as vengeance weapon number two or the V-2 for short.

On October 3, 1942, the space age began with the successful launch of the V-2 on its third attempt and the world would never be the same. Made as a weapon of war and not for science or adventure, the 46-foot alcohol and liquid oxygen V-2 had a velocity of 3500 mph and could carry a 1,650 pound warhead to a range of 200 to 250 miles. It is the ancestor of practically every rocket flown in the world today and, in September 1944, was launched against England toward London but came too late to affect the outcome of the war.

In January 1945, von Braun knew the war was over and made plans to move his team of about 125 rocket scientists and engineers south to surrender to the Americans. Hitler had ordered their execution to prevent their capture by the Allies. On the same day that Berlin fell to the Soviet Army, May 2, 1945, von Braun and his rocket team entered the American lines to safety. "Project Paperclip" was instituted to find as many German rockets, scientists and engineers as possible and enough parts were found to build 100 V-2's.

By February 1946, all the German rocket scientist were moved to White Sands, New Mexico and, on April 16, 1946, the first of the captured V-2's was launched in the United States. This signaled the start of the

U.S. space program or, at the very least, the ballistic missile program. The most memorable launching at White Sands, however, came on February 24, 1949, when a V-2 boosted a WAC Corporal rocket developed by the Jet Propulsion Laboratory 244 miles into space and to a speed of 5,510 miles per hour, the greatest altitude and velocity yet attained by a man-made object.

(U) Jet airplanes

At the end of World War II, Muroc (today known as Edwards Air Force Base) was the place to be if you were a pilot. This was where the first American jet airplanes were being tested. The U.S. had amassed the largest fleet of military airplanes in the world, and, with one test flight, they would all become obsolete. The Bell X-1, shaped like a 50 caliber bullet, was the rocket plane designed to break the sound barrier.

(U) Breaking the sound barrier

During 20 previous successful flights, the Bell X-1 had achieved mach 0.80 (80% of the speed of sound) but Bell test pilot, Chalmers "Slick" Goodlin, wanted to renegotiate his contract to over $150,000 before making an attempt at the sound barrier. This brought the program to a halt. He knew the risk involved. At the time, about 50% of the engineers believed it couldn't be done.

This was when the U.S. Air Force took over. For the normal pay of a few hundred dollars a week, which included flight pay, an Air Force pilot would make the attempt. The man chosen was World War II ace Captain Chuck Yeager, one of the most junior pilots but also the best. He believed and trusted his chief engineer, Jack Ridley, that it could be done. During trial flights, there had been severe buffeting and loss of elevator control at mach 0.94 but Ridley designed a moving tail that fixed the problem.

On October 10, 1947, Yeager again reached an indicated speed of mach 0.94. However, frost formed on the inside of the canopy during the glide earthwards despite Yeager's persistent effort to scrape it off. Because of this, chase pilots had to talk him down to a blind landing on the lakebed. Analysis later that evening of the airplane's internal instrumentation revealed that instead of mach 0.94, indications were that the X-1 had actually reached mach 0.997 at 12,000 meters; this worked out to approximately 1059 kilometers per hour, infinitesimally close to the speed of sound.

All was ready for an attempt at the sound barrier when, over the weekend, Yeager broke two ribs while horseback riding. Not wanting to be pulled from the flight, he stoically had the ribs taped by a civilian doctor and didn't tell anyone except Walt Williams, a NACA engineer, and Jack Ridley, his flight engineer, who cut a broom handle to help Yeager lock the X-1's door. At Yeager's suggestion, crew chief Jack Russell rubbed the rocket plane's windshield with Drene shampoo, an old fighter pilot's trick to prevent frost from forming on the canopy at high altitude. So on October 14, 1947, with two broken ribs, a broom handle, and shampoo on his windshield, Chuck Yeager became the first person to break the sound barrier. Postflight data analysis indicated the X-1 had reached mach 1.06 at approximately 13,100 meters, an airspeed of 1125 kilometers per hour.

There was no public adulation or ticker-tape parade for this great achievement like there was for Charles Lindbergh when he first crossed the Atlantic. What was once a public test was now shrouded in cold war secrecy. The man with the "right stuff" would have to wait for the public recognition he richly deserved.

These became the golden years at Muroc. Each test pilot trying to go higher, faster or farther than the next,

"pushing the envelope" of each aircraft. Scott Crossfield was the next to achieve a milestone. On November 20, 1953, he became the first to go mach 2.01 in a Navy D-558-II only to lose the title of "fastest man alive" 22 days later to Yeager when he went to mach 2.5 in a Bell X-1A on December 12, 1953. Major Arthur Murray later took the X-1A to a record altitude of over 90,000 feet, the highest so far attained by man, on June 4, 1954.

(U) X-15 - most successful research airplane

While the X-1 was the first to break the sound barrier, the X-15 has the distinction of being the most successful research airplane ever flown. It made the first manned probes into the lower edges of space and was designed for speeds of up to 4,000 mph and altitudes of 50 miles, but these goals were exceeded on numerous occasions. Several X-15 pilots earned an "astronaut" rating by attaining altitudes above 50 miles and the X-15 flight program contributed significantly to the Mercury, Gemini, and Apollo projects.

Scott Crossfield participated in the first glided flight from 38,000 ft. on June 8, 1959, and the first powered flight on September 17, 1959. Other significant milestones include mach 3.2 by Joseph A. Walker on May 12, 1960 and the first man to take the X-15 past mach 4, 5, and 6 was Major Robert M. White. Neil Armstrong, the first man to walk on the moon, was also an X-15 test pilot. The final unofficial speed and altitude records for the X-15 were 4,520 mph (mach 6.7) and 354,200 feet (67.08 miles).

(U) Rocket research

While the sound barrier was being broken by aircraft, rocket research continued and it soon became evident that more room was needed than White Sands could provide. In 1949, the Joint Long Range Proving Ground was established at Cape Canaveral. This remote and deserted area on the east coast of Florida was ideally suited for launches and on July 24, 1950, a two-stage rocket call Bumper No. 8 became the first of hundreds to be launched from "the Cape." It consisted of a V-2 variant as the first stage which climbed 10 miles and an Army WAC Corporal as the second stage which climbed an additional 15 miles. On July 29, 1950 Bumper No. 7 was the second missile launched from the Cape, reaching the highest velocity (mach 9) attained by a man-made object to date.

(U) Suborbital flights

Coinciding with the transfer of launch operations to the Cape, the Army's missile program moved from White Sands to a post just outside of Huntsville, a north Alabama cotton town. Von Braun and his team arrived in April 1950 and started working on the next generation of the V-2, the Redstone. This rocket, destined to launch America's first satellite, Explorer I, and the first two U.S. manned suborbital flights of Alan Shepard and Gus Grissom, was first launched from the Cape on August 20, 1953.

(U) Sputnik

On October 4, 1957, the USSR blindsided the United States in what has been called a "technological Pearl Harbor" with the launch of Sputnik I, the first man-made earth orbiting satellite. The satellite was of little scientific value but was large politically. Circling the earth roughly every 90 minutes, its beeping radio signal shocked the U.S. and the world. This was followed closely by Sputnik II on November 3, 1957, which carried a dog named Laika, the first live organism launched into space. Although she died when her oxygen ran out, the flight did bring back scientific data on the effects of weightlessness and space travel on a living animal.

(U) American satellites

It wasn't until January 31, 1958 that Explorer I, America's first satellite, was launched on top of a version

of the Redstone rocket, known as the Jupiter C. On board was an important scientific experiment of James A. Van Allen and it discovered the radiation belts around the earth. These belts were later named after him. The U.S. had finally entered the space race but had a lot of catching up to do.

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