From the Bicycle Shop to B-2 Bombers

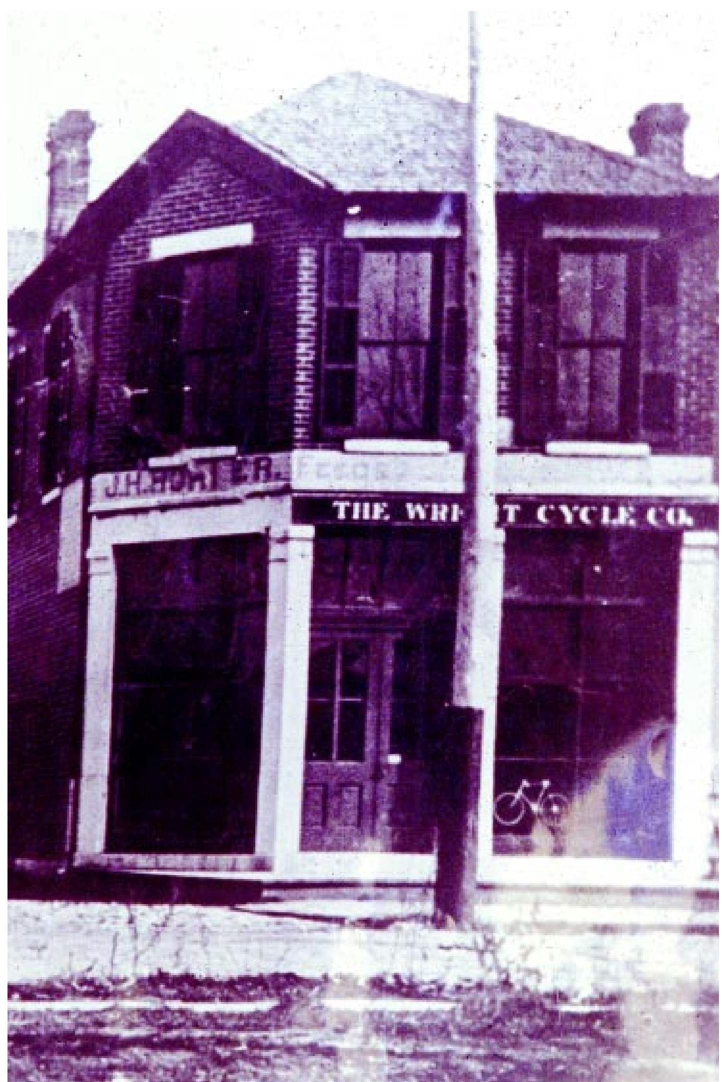
For nearly a century, Dayton, Ohio, has been a seedbed of the nation's military airpower.

By Robert E. van Patten

DECEMBER 1903 was the big month for "the Bishop's Boys" who ran the Wright Bros. Cycle Co., a bicycle shop in Dayton, Ohio. Orville and Wilbur Wright gave the world the gift of powered, sustained, controlled, heavier-than-air flight. Despite their intelligence, intellectual drive, creativity, and unbreakable spirit, it is doubtful that these two young Ohio men had any conception of the kind of impact their work would have on the world at large.

Looking back on the past century, we now see that Dayton, nestled in the rolling hills of Ohio, served as a cradle of innovation which made possible the development of the art and science of flight. The drama that began with brief flights above the sands at Kitty Hawk, N.C., on Dec. 17, 1903, soon shifted to Ohio, where it has continued into its 100th year.

Financial circumstances had dictated a relocation to Dayton, where the Wrights could conduct flying



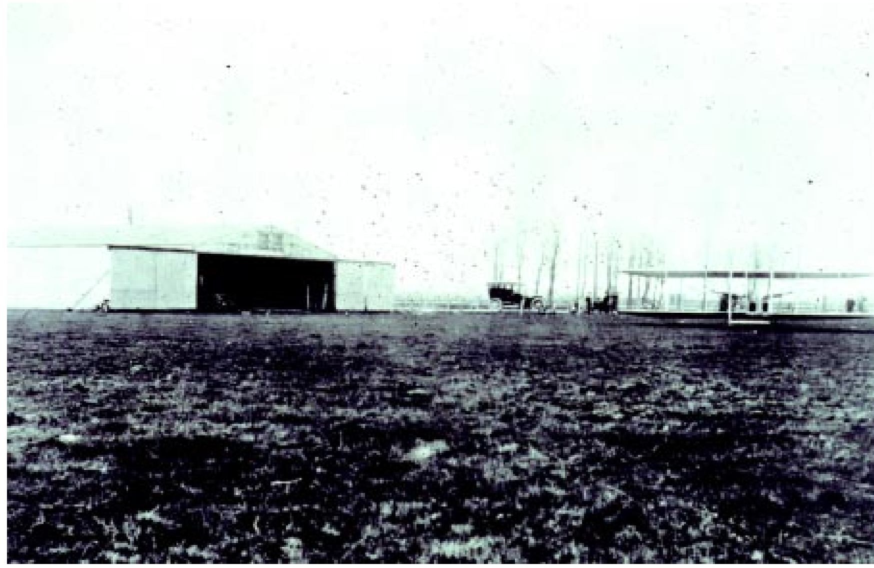
The Wright Cycle Co., Dayton, Ohio, pictured circa 1896.

and experimental work at less expense. Following their successful flights at Kitty Hawk, the Wrights set up shop at a flying field on Huffman Prairie, which is now within the boundaries of Wright–Patterson Air Force Base near Dayton. In May 1904, the Wrights made their first successful flights there. For nearly a decade, the brothers honed their flying skills and refined their machines, teaching fledgling aviators along the way. The on-site hangar and repair facility constituted the world's first airport.

The next decade was marred not only by the death of Wilbur Wright in 1912 (of typhoid) but also by consuming litigation with Glenn H. Curtiss over the aileron aspects of the Wright patents. Even so, Orville and, until his death, Wilbur Wright continued to make major contributions to basic technologies and techniques of flight. On Feb. 10, 1908, the Aeronautical Division of the Army's Signal Corps accepted the Wrights' bid to provide the first military flying machine. The price was $25,000.

In late 1909, aviation formally became an industry in Dayton, with the founding of the Wright Company. Soon, the firm's manufacturing plant was turning out two airplanes a month. The Great War in Europe, which erupted in August 1914, left America untouched for years, but, in April 1917, the US was drawn into the conflict. War, as always, provided a great stimulus for technological advances. Less than a week after the United States entered the war, the Dayton–Wright Airplane Company was organized. The war also stirred a sudden awareness that US aviation capabilities—research, development, and production—had fallen far behind those found in Europe.

This realization led to the Army's establishment, later in 1917, of an Ohio military installation intended to be the Research and Development arm of the brand-new Air Service. The new facility, set in a bend of the Great Miami River near Dayton, was named McCook Field. Over the years, this seed of aeronautical science and technology was nourished by the environment of innovation and the entrepreneurial spirit of the Dayton community as well as by the courage and intelligence of the airmen who blazed the aviation trail in America.



In 1904, the Wrights made their first successful flights at Huffman Prairie, near Dayton, Ohio. By 1909, aviation formally became an industry in Dayton with the founding of the Wright Company.

McCook Field was the focus of Air Service flight-test activities from 1917 through most of 1927. By the late 1920s, however, it had become too small to handle the demands of military aviation, and a bigger facility, Wright Field, was built. That, however, was still well in the future.

The Kettering Bug

In Ohio, the name "Wright" continued to be at the forefront of the new field of aviation.

In 1918, Orville Wright collaborated in the invention and production of what is now seen to be the world's first cruise missile—the Kettering "Bug." His partner was Charles F. Kettering, a prominent Dayton inventor and entrepreneur who invented the auto self-starter and mechanized the drive of the National Cash Register machines.

The Bug partook of Orville's "automatic pilot" concept, patented in 1913. It was a small biplane with a wingspan of about 15 feet, powered by one De Palma 40-hp four-cylinder engine. It took off from a dolly that ran on a track. Kettering went to Wright because he was dissatisfied with the complexity of his guidance system.

The Bug, after it had been airborne for a predetermined length of time (based on a count of engine revolutions), would shut down its engine and disconnect the wings. Then, the Bug would plummet to earth. The impact would detonate its 180-pound warhead.

The Bug was successfully demonstrated, and the US bought roughly 50 of them before the armistice. The Air Service conducted some postwar tests with the air vehicle, but a lack of funding soon put an end to its development.

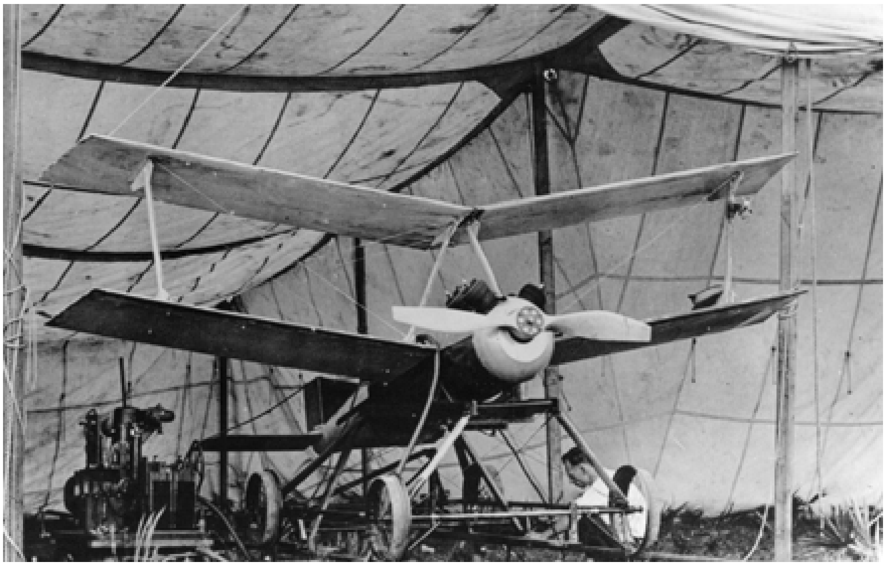
The Dayton inventor, Kettering, also had a major role in developing the use of tetraethyl lead as an additive that permits modern high-compression-ratio auto and aircraft engines.

During World War I, Kettering and his cohorts at the Dayton Engineering Laboratories Co. (now more familiar as Delco) began to experiment with chemical additives to eliminate detonation in automobile engines.

Kettering left Delco after the armistice and formed a research division for General Motors. He intensified his Edison–style research (try everything until you find something that works), which soon uncovered the fact that tetraethyl lead caused a dramatic reduction in detonation.

This opened the way to the eventual development of high-octane aviation gasoline, leading to a major jump in performance of aircraft engines. The fact that World War II Allied fighters burned 130 octane avgas and the Nazis used 87 octane was a big advantage for the Allies.

Wright's contributions continued



Orville Wright collaborated with Charles Kettering to invent the Kettering "Bug," now recognized as the world's first cruise missile. The US bought about 50 of the aircraft before the World War I armistice.

into the postwar period. In 1920, the Dayton–Wright organization produced an amazing racing airplane for entry into the Gordon Bennett trophy race in France. This airplane, the Dayton–Wright RB-1, incorporated a number of aviation firsts, including:

- Practical retractable landing gear.
- Monocoque fuselage with a totally enclosed cockpit.
- Wing structure with no wires or struts.
- A flight-adaptive airfoil.

The airfoil worked with the landing gear deployment system. When the wheels were down for low speed flight, both leading-edge slats and trailing-edge flaps were deployed by the airfoil. As the gear was retracted, so were the slats and flaps, an action that converted the airfoil to its high-speed configuration.

This combination of features was not duplicated in any production aircraft until the advent in 1954 of the Lockheed F-104. Such high-lift devices have contributed greatly to the performance and safety of military and civil aircraft.

Reaching for Altitude

Of all the early achievements at McCook Field—and there were many—high-altitude flying was possibly the most important. The source of military interest in high-altitude flying was, of course, the experience of World War I. High-flying German dirigibles bombed England with impunity, while the German Rumpler high-altitude airplanes were almost invulnerable.

The first of the high-altitude pilots at McCook Field was Capt. Rudolph W. "Shorty" Schroeder. Schroeder's work began in 1918. The Air Service had fielded a new biplane—the LePere type C-11 with a 12-cylinder Liberty engine. In Schroeder's hands, it became America's first dedicated research aircraft, the X-15 of its day.

Schroeder's early attempts set altitude marks of 24,000 and 27,000 feet. He then attempted another high-altitude mission, and new problems were identified; at 23,000 feet, Schroeder was experiencing hypoxia symptoms, which he later described as making him feel sleepy, tired, cross, and hungry. The symptoms were relieved by gulps of oxygen. As he reached 25,000 feet, Schroeder again experienced hypoxia symptoms and cranked up his oxygen supply, also noting in a log that the temperature was 50 degrees below zero Fahrenheit. At 27,000 feet, he could not see through the frost on his goggles and raised them to read the altimeter. The air was so cold that his eyes watered excessively, but he saw that he was at almost 29,000 feet.

At this point, his aircraft ran out of fuel and he began to spiral downward where, at 20,000 feet, he had mostly recovered from his symptoms. Schroeder continued his descent through clouds and snow and finally broke out into the clear over Canton, Ohio. He had set a new world record.

Supercharging

On Feb. 27, 1920, Schroeder set a new world record of 33,113 feet in the LePere, which had by then been equipped with a gear-driven centrifugal supercharger. It was based on a turbosupercharger designed by Sanford A. Moss and built by the General Electric Co. The flight took one hour and 47 minutes.

Schroeder's pioneering work was carried on by another of Ohio's high-altitude pioneers, 1st Lt. John A. Macready. He was the recipient of some timely engineering breakthroughs. Between 1919 and 1921, intensive work had gone on at McCook Field in the development of a new propeller for the LePere, one that would not overload the engine in "thick" air at low altitudes but permit the engine to develop full performance in "thin" air at altitudes exceeding 35,000 feet. The final design was large and two-bladed, which proved superior to earlier four-bladed designs.

On Sept. 28, 1921, Macready and the aircraft were ready. Following takeoff, Macready flew in circles over McCook Field to be within gliding range of the airstrip. Soon, he had reached a record altitude of 36,750 feet, and his circles had expanded to 70 miles in diameter.

An hour after takeoff, Macready reached an indicated altitude of a bit over 41,000 feet. Five more minutes passed, and he became convinced that the aircraft had topped out. He reduced throttle to begin a descent. He reported that the bottom seemed to drop out of the airplane, and down it went—quickly. Macready regained control at 30,000 feet and was later confirmed to have set a new official altitude record at 36,750 feet.

Later, Macready set his final record, which was logged at 38,704 feet.

These early flights of supercharged aircraft engines provided the basis for warplanes such as the B-17, B-24, B-29, P-38, and P-47.

Another early McCook Field experiment in high-altitude flight took place June 8, 1921, and it was designed to try out the concept of a pressurized cockpit. A cylindrical chamber was bolted into the open-cockpit DH-9A biplane and taken up for a test. The contraption was not much more than a tank with a viewport and some sealed connections for control cables. It was pressurized by means of a propeller-driven pump.

On the test hop, the airplane was piloted by Lt. Harold R. Harris. Soon after takeoff, Harris found to his dismay that the output of the pressurization pump was far greater than expected; the chamber exhaust valve could not cope, and the pressure in the chamber was rising alarmingly.

It finally reached a pressure altitude equivalent of about 3,000 feet below sea level and the temperature had risen to 150 degrees Fahrenheit. Harris could not get the chamber to open and did not have a hammer to smash a hole in the port. Fortunately he was able to get the airplane down quickly enough. The contraption was never tested again, but it had proved a principle.

High G Combat Maneuvers

Dayton technicians were deeply involved in the 1922 Pulitzer race that identified a menace that is still killing pilots today.

The problem was G–induced Loss Of Consciousness, better known as G-LOC. G-LOC was correctly perceived as a major barrier to the development of fighter aircraft. Jimmy Doolittle, while stationed at McCook Field, developed an interest in the subject. He knew that, since 1914, fighter pilots were subject to what was usually called "fainting in the air."

Doolittle's MIT master's degree thesis included work on blackout and G-LOC in high G combat maneuvers and was done in March of 1924. Tests were flown in a Fokker D.XI (PW-7), an experimental Dutch fighter. The airplane was instrumented with recording accelerometers that indicated that his maneuvers reached +7.8Gs.

Doolittle identified man's average, unprotected tolerance for limited time at about +4.5Gs and stated that blackout and G-LOC were results of a loss of cerebral circulation. The idea was ridiculed by aeronautical experts of the day, their view being that the problem was neurological. Doolittle's work held up and was affirmed eight years later in other experiments.

For the Pulitzer race, the Wright organization of Dayton collaborated with the Navy on the design of a sesquiplane racer known as the NW-1. This aircraft spawned a generation of Navy fighters—the Wright Apache line—in both landplane and seaplane configurations.

In 1928, Navy Lt. Carleton C. Champion flew the Wright Apache seaplane to a new world altitude record of 38,455 feet. In 1929, Navy Lt. Apollo Soucek flew the landplane version to a new world altitude record of 39,140 feet. In 1930, Soucek once again set a world altitude record in an Apache. This one, equipped with a Pratt & Whitney 450-hp engine, soared to a height of 43,166 feet.

On Sept. 28, 1921, 1st Lt. John Macready set a world altitude record of 36,750 feet in this supercharged LePere aircraft, with a propeller designed for both "thick" and "thin" air.

It was at McCook Field that aeronautical visionaries laid the foundation for instrument flight. On March 7, 1924, Lts. Eugene H. Barksdale and B.Q. Jones flew a Liberty powered DH-4B aircraft on instruments from McCook to Mitchell Field, N.Y. In 1927, Wright Field superseded McCook as the showcase of the nation's military aviation research, and it was the scene of the world's first solo blind flight (without safety pilot). This instrument-only flight was carried out by Capt. Albert F. Hegenberger in May 1932.

Wright Field was also the site of the first successful demonstration of an automated landing system, which would prove to be vital to the future of both military and civil aviation. It was on Aug. 23, 1937, that Capt. George V. Holloman, flying a Fokker C-14B transport, took off from Wright Field and activated the system. The airplane then turned toward nearby Patterson Field and made a hands-off descent and landing, using a system of five radio beacons, without any intervention by the pilot.

For this accomplishment, Holloman and the system's inventor, Capt. Carl J. Crane, were awarded the Mackay Trophy.

Full Pressure Suits

The Aeromedical Laboratory, established at McCook, moved over to Wright Field after it opened. The lab came of age under the leadership of Capt. Harry G. Armstrong, a physician of energy and vision who spearheaded development of aviation medicine, personal equipment for the flight environment, and aircrew life support research.

The laboratory had a couple of altitude chambers large enough to permit human studies and capable of simulating very high-altitude environments without the cost and danger of conducting physiological studies in flight. An important early piece of work done was not connected with military flight at all. It started with Wiley Post, a former oilfield roughneck who became a record-setting aviator.

Post was not interested in the simple up-and-down sorties used in the contemporary altitude record flights. His interest was setting speed and distance records at altitudes where he knew he could pick up 125 mph–plus tailwinds in what we now call the jet stream. In his compound supercharged Lockheed Vega monoplane, *Winnie Mae*, he needed physiological protection from the effects of exposure for long periods to the rarefied pressures at those altitudes. He wanted "a rubber suit" that could sustain him with an atmosphere of about five pounds per square inch (a pressure altitude of about 25,000 feet).

With backing from Phillips Petroleum, Post convinced B.F. Goodrich Corp. of Ohio that the suit was necessary. Goodrich assigned engineer Russell Colley to help Post. Post also gained permission to conduct developmental tests in the chambers at Wright Field.

After testing three pressure suit designs, Post and Colley had one that worked. It was not the first such suit, but it was the first one that was practical for prolonged flight. (Decades later, Cowley received a belated NASA decoration as "The Father of the American Spacesuit.")

In December 1934, Post made a record attempt in *Winnie Mae*. Those associated with the test flight were convinced he had set a new record of 50,000 feet. However two recording barographs required by the certifying FIA did not agree within the permitted tolerance, so this accomplishment was not certified as a record.

In 1935, Armstrong published a new Air Corps Technical Report on the physiological requirements of sealed high-altitude aircraft compartments. This formed the basis of pressurization specifications for the Lockheed XC-35.

In the XC-35, pressurization consisted mainly of reducing all the windows to slits and covering everything else with sticky rubber tape. Cabin pressure was provided by a turbosupercharger. Control was all manual, handled by Pvt. Raymond U. Whitney, who still lives in Fairborn, Ohio. This approach was good enough to maintain a cabin pressure altitude of 12,000 feet when the airplane was flown at 30,000 feet.

Aeromedical Laboratory conducted exhaustive research on explosive decompression and established human limits for gas expansion. This work was crucial to pressurized flight and led to the first mass-produced pressurized aircraft: the Boeing B-29.

Breaching the Sonic Wall

Much has been written about the Bell X-1 and how Chuck Yeager flew it to become the first man to breach the sonic wall and enter the realm of supersonic flight. Very little has been written about the man who made that flight possible.

Ezra Kotcher truly deserves the accolade of Father of the X-1. One of the most brilliant and visionary engineers ever, Kotcher worked as a civilian at Wright Field. With the outbreak of World War II, Kotcher entered military service and continued to advocate rocket-propelled supersonic research aircraft. By 1943, US officials had heard reports of German gas turbine and rocket systems, and were primed to listen to Kotcher.

During 1944, Army Air Forces and National Advisory Committee for Aeronautics engineers worked to outline a joint research airplane program. Kotcher's view that the aircraft should be rocket-powered rather than a turbojet prevailed. However, the NACA group provided critical technical data leading to the recommendation that the horizontal stabilizer of the XS-1 should incorporate not only movable elevators but also the capability to move the entire stabilizer as a unit. This resulted in the distinctive high T–tail empennage found on the X-1 and many other supersonic aircraft.

In November 1944, Kotcher met with Bell Aircraft Corp. Bell reached the same conclusions as Kotcher. The final decision to go with an air-launched vehicle dropped at high altitude by a B-29 was driven by weight and space requirements. The final design and its fuselage profile was chosen for its similarity to a .50-cal. machine-gun bullet; it was known to be stable at supersonic speed. The rest, as they say, is history.

For Ohio, the coming of World War II brought a quantum leap in aviation activity. Various types of military test aircraft filled the skies over Wright Field. Wright Field test pilots and engineers were kept busy trying out and verifying the latest and best ideas of aeronautical engineers.

Wright Field became the testing ground for scores of US and allied aircraft. The same sort of attention was given to captured German and Japanese aircraft.

With the end of World War II, a major change occurred. The flight testing of most new jet aircraft began to move to Muroc Field, Calif. Meanwhile, in January 1950, the Air Force pulled its R&D function from Air Materiel Command and established a separate Air Research and Development Command. About a

This circa late 1940s view of Wright Field shows some of the aircraft that frequented the field as a primary testing ground for aeronautical ideas. Visible here are B-17, B-29, B-46, and C-97 aircraft.

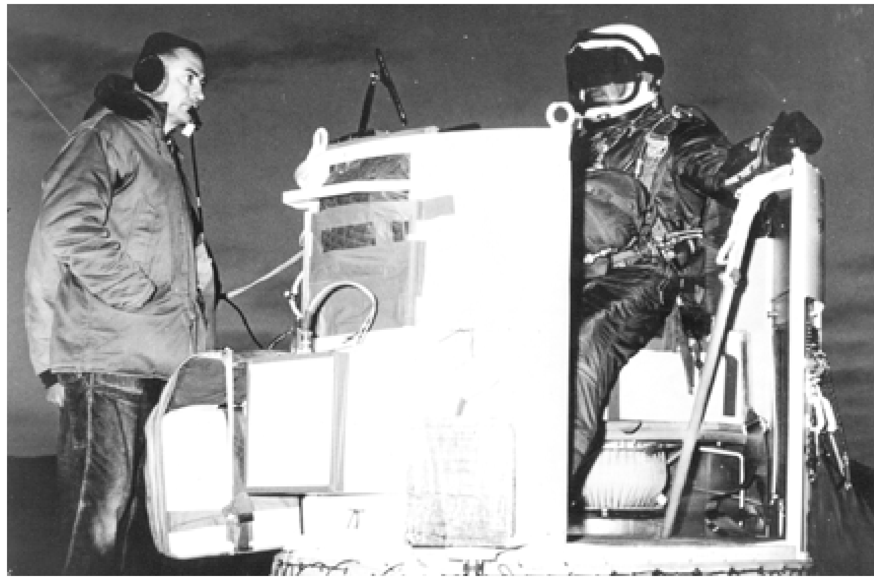
year later, ARDC established at Wright Field what eventually became known as the Wright Air Development Center, later to become known as Aeronautical Systems Division and then Aeronautical Systems Center.

On to Space

In 1954, the Air Force, Navy, and NACA launched the X-15 effort, a program to investigate hypersonic and extreme high-altitude flight. The Air Force managed the vehicle and the engine programs. On Nov. 19, 1961, the X-15 flew at an astounding 4,093 miles per hour. On Aug. 22, 1963, it reached an altitude of 354,200 feet. By the 1950s, it was obvious that manned spaceflight was the new frontier. To obtain information on cosmic radiation, astronaut selection and training, physiological monitoring, high-altitude bailout, and high-altitude hardware, the Air Force started two military programs. These were Project Man High and Project Excelsior. The Aerospace Medical Research Laboratory at Wright–Patterson Air Force Base contributed to both. (The Air Force merged Wright Field and Patterson Field in 1948.)

In 1957, Capt. Joseph W. Kittinger Jr., stationed at Holloman AFB, N.M., piloted Man High One—a gondola and balloon—to 96,000 feet, providing data critical to NASA's Project Mercury. In 1958, Kittinger moved to AMRL at Wright–Patterson, where he was test director for Project Excelsior. The Excelsior goal was to put man into near space via a balloon-supported gondola to test human tolerance to bailouts at extreme altitudes. Kittinger's jump from Excelsior I nearly cost him his life when his drogue chute tangled, throwing him into a flat spin that caused him to go unconscious. Fortunately his chute opened automatically at 14,000 feet.

Undaunted, Kittinger stayed with the project, and on the Excelsior III flight achieved a new altitude record by reaching 102,800 feet. He "stepped out" at that altitude and dropped in free fall for four minutes and 36 seconds, reaching supersonic speed and enduring temperatures of more than 100 degrees below zero during his descent.



Capt. Joseph Kittinger Jr., right, jumped from this open air gondola attached to a balloon to try man's tolerance for bailouts at extreme heights. The jump from about 100,000 feet nearly cost him his life, but he stayed with the project.

The information and experience gathered during these projects proved that pilots and astronauts could escape from aircraft and space vehicles at extreme altitudes and made it possible to equip the Gemini capsule with ejection seats. In December 1957, Wright Field engineers began work on the X-20 Dyna-Soar, an orbital vehicle capable of maneuverable re-entry and conventional landing. ASD's work on the X-20 aided in the development of the space shuttle.

The intensification of the Cold War brought about major changes in the way the Air Force conducted R&D. The emphasis shifted from the purely military laboratories at Wright–Patterson to consortia merging military labs, industry, and academia.

Explosive growth in the aerospace profession brought a boom in innovation and experimentation. These included G–protection equipment and techniques, aircraft noise and sonic boom studies, bioacoustics research, biodynamic modeling of the human body for crash, and ejection seat design research.

The 1970s saw development of technologies for the F-16 fighter and the B-1 supersonic bomber. In the 1970s and 1980s, Dayton scientists, engineers, and technologists were deeply involved in the study and development of low observables—stealth—undergirding such aircraft as the F-117A stealth fighter, the B-2 stealth bomber, various cruise missiles, and now the F/A-22 Raptor. There are, of course, other important contributions that remain highly classified.

In recognition of its storied aeronautical past, the Dayton community will hold numerous celebrations marking the Centennial of Flight this year. Among the largest will be the Air Power 2003 Open House in May at Wright–Patterson. Plans call for a display of all aircraft currently in the Air Force inventory. They will be parked on the ramp adjacent to Huffman Prairie, the same spot where the Wrights built, developed, and tested their aircraft. The Air Force Association's Wright Memorial Chapter plans to support these efforts.

The development of modern aviation required a unique convergence of scientific talent and inventiveness with a base of knowledgeable and entrepreneurial businessmen. That this incredible combination emerged in a single place—Dayton, Ohio—stands as one of history's more remarkable occurrences. ■

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