Early History of Wind Tunnels

Dreams of flight most probably date back as far as mankind itself. Great minds, and some not so great minds, throughout history toyed with the idea. Some put their ideas on paper, while others threw caution, and their bodies, to the wind, leaping from towers in futile efforts to realize their ambitions. Beginning in the nineteenth century, however, fanciful dreams of flight began to become grounded, so to speak, in scientific research which promised to make the dream a reality. One of the most important tools employed in that effort was the wind tunnel.

Researchers in the nineteenth century realized that in order to fly, would-be aeronauts needed to understand far more about the flow of air over surfaces. Experiments employing natural winds or a whirling-arm devise proved both disappointing and inaccurate. Then in 1871, a British scientist by the name of Frank H. Wenham created a tool which revolutionized the study of aerodynamics. Wenham designed and operated the world's first wind tunnel. Wenham's small wind tunnel proved that, contrary to Newton's ideas, certain wing shapes had surprisingly high lift-to-drag ratios. That meant certain wings could support large loads and, as a result of his work, powered flight seemed much more possible.

Wenham's small tunnel, however, had to employ scale models rather than full-scale aircraft. A question remained: Could the results obtained using scale models be applied to full-sized aircraft? Another British researcher, Osborne Reynolds, proved the validity of wind tunnel tests using scale-models. A new technology was now in place and tested which could provide researchers with the accurate data needed to achieve manned, powered flight. Despite the availability of the wind tunnel, however, three of the most important flight pioneers of the nineteenth century, Otto Lilienthal, Hiram Maxim, and Samuel Langley, continued to

base their work on results obtained from whirling-arm experiments. It remained to a unlikely pair of bicycle manufacturers from Dayton, Ohio, to use the wind tunnel to achieve manned, powered flight.

The Wrights and the Wind Tunnel

The story of how the Wright brothers, Wilbur and Orville, progressed from experimental kites to the successful flights in 1903 is the stuff of legend. Most people with any interest in aviation are familiar with the basic details. One detail which was often either lost or misreported was the brothers' use of a wind tunnel. Some accounts leave out the wind tunnel entirely. Other accounts have implicitly, if not explicitly, given the Wrights credit for inventing the wind tunnel. What Wilbur and Orville did was use a known tool, but use it in a spectacularly successful fashion.

The Wrights were very disappointed with the results obtained with Glider No. 2, flown at Kitty Hawk in 1901. They had been using available standard data to calculate the lift-to-drag ratios of the airfoils employed on their gliders. After the 1901 tests the brothers came to the reluctant conclusion that the standard data was wrong and they began a series of experiments to recalculate it.

Like Lilienthal (a hero of theirs), Maxim and Langely, the brothers first employed a whirling-arm devise. Unsatisfied, they determined to build a more accurate measuring devise. On the upper floor of their bicycle shop, the brothers constructed a wind tunnel 16 inches square and about six feet long. The tunnel was not perfect. For example, they placed the two-bladed fan upstream in the air flow. That meant in order to obtain valid results, the two had to make sure that absolutely nothing moved in the room during the tests. Nonetheless, the tiny wind tunnel with its delicate set of balances provided data so accurate that Wilbur and Orville were able to move far beyond their contemporaries and produce the world's

first controlled, powered, manned, heavier-than-air-vehicle within two short years of their wind tunnel experiments.

The US and Aeronautical Research 1903 to World War I

Because of the Wright brothers' work the United States began the early twentieth-century with a leading position in aeronautical research. Within a few years, however, the United States fell far behind the rest of the world. While the Wrights focused on the fights over their patents and the US military and government remained slow to comprehend the importance of flying machines, researchers in Europe, using ever more sophisticated wind tunnels, moved swiftly ahead.

By the time World War I had broken out in Europe, prominent scientists in the US had grown alarmed by just how far the United States had fallen behind in aeronautical research. Very early, the National Academy of Sciences directed an effort which resulted in the appointment of a Presidential commission in 1912. Commission members recommended that the United States establish a national aeronautical laboratory, similar to those established by European nations. When the government failed to respond, the Smithsonian determined to reopen Langley's old research facilities. With that goal in mind, the institution send Albert Zahm and Jerome Hunsaker to Europe to visit the laboratories there. Those two completed their trip in 1914 and their subsequent report highlighted the advanced nature of aeronautical research in Europe. The following year the Smithsonian led a successful effort to persuade Congress to establish and fund a National Advisory Committee for Aeronautics (NACA).

With NACA's establishment in 1915, the United States began the long road back to prominence in the field of aeronautical research. Much of the effort would be focused at NACA's Langley Memorial Aeronautical Laboratory in Virginia. However, the 5' wind tunnel constructed at McCook Field in the early 1920s

represented another of the important steps in the US effort to, once again, be a world leader in aeronautics. It also was a factor in the emergence of the Dayton area as a center of aeronautical research. As Dick Hallion pointed out in his book, Test Pilots, Wright Field, the eventual home base of the wind tunnel, was so well-known for the aeronautical advances its researchers produced that in the years before World War II it was referred to simply as "the Field."

The 5' Wind Tunnel and Aeronautical Research in Dayton

During World War I, the US Air Service located its Engineering Division at a new, small field across from downtown Dayton. McCook Field quickly emerged as an important center of technical and experimental work within the Air Service. During the war engineers at McCook Field worked to solve problems related to engine and aircraft development, to improve the airplane's reconnaissance value with the installation of better cameras, and to perfect synchronized machine guns. After the war, McCook Field continued to contribute to the advancement of military aviation and aviation in general. At tiny McCook -- with its sign, "This Field Is Small, Use It All" -- engineers used all their abilities to produce controllable and reversible pitch propellers, aircraft engine superchargers, bullet-proof and leak-proof gas tanks, the radio beam, a non-magnetic aircraft clock, an ambulance plane, the air-cooled radial engine, and the free-fall parachute. McCook Field also became the first home of the Air Service Engineering School, the forerunner of the Air Force Institute of Technology (AFIT).

The engineers at McCook Field did not have much money. They needed to find the best ways to spend every dollar. By the early 1920s the Air Service was spending $30,000 per year on contracts for the use of outside wind tunnels. It made sense to the engineers at McCook to build their own in-house tunnel.

As construction of the 5' wind tunnel began at McCook in 1921, the field not only had on-hand technical expertise, but also the use of many highly skilled craftsmen. The history of Dayton is filled with the contributions of the skilled craftsmen, many of them German, who migrated to the Miami Valley. Here they built the famous Barney and Smith railroad cars and the durable and clever NCR cash registers and business machines. And at McCook Field, a number of those highly skilled workmen, under the direction of R. J. Myers, built the enduring, landmark 5' wind tunnel. In the words of the Historic American Buildings Survey/Historic

American Engineering Record, when completed the tunnel at McCook "was the most powerful and efficient tunnel in the world, and was extolled as a remarkable wood working job." Although NACA's variable density wind tunnel completed the following year would soon surpass it, the McCook 5' wind tunnel nonetheless went on to a long and distinguished career.

While still at its original home, the wind tunnel was used to test models of the XNBL-1, the infamous Barling Bomber. Whatever one may think of this bomber in hindsight, at the time it was one of the largest airplane's ever built and it set some important aviation records in 1923 which proved the concept of the heavy bomber. Wind tunnel tests at McCook provided critical performance and stability data. According to General Henry "Hap" Arnold, who had no great love for that particular airplane, the lessons learned from the successful development of that first heavy bomber proved important in the subsequent development of the B-17 and the B-29.

By the early 1920s McCook Field proved simply too small and plans quickly evolved to move the field's facilities, including the wind tunnel, to a new location being prepared about 10 miles from downtown Dayton. Wright Field, or Area B as it is now known, became the wind tunnel's new home in 1929. As it had before, the wind tunnel, housed in Building 19, continued to contribute to the advancement of aviation and continued to help make the Dayton area a center of aeronautical research.

During the 1930s, engineers at "the Field" used the wind tunnel to study the problem of flutter, conducting control surface flutter, wing flutter, and flutter model tests. The series of flutter tests ended in 1939, but the 5' wind tunnel continued to prove its worth. In 1958 the predecessor of the Flight Dynamics Directorate of Wright Laboratory ensured that the wind tunnel would continue to contribute to future generations of aeronautical research when it presented the 5'

wind tunnel to the Air Force Institute of Technology. For the last 37 years students at AFIT have used the tunnel in their thesis projects. The Aerodynamics Division has also used the tunnel for tests related to such aircraft as the X-29, the F-15, the C-130 and a number of missile systems.

In recent years the 5' wind tunnel has also been used by such organizations as the Army, the Navy, the Central Intelligence Agency and private contractors. It has been used to test skyscraper aerodynamics, soap box derby models and bicycle wheels -- how appropriate as Orville Wright served on the final inspection team for the then-new wind tunnel in 1922.

Whether testing models of pre-World War II fighters or models of the latest additions (or proposed additions) to the US air arsenal, the 5' wind tunnel has, over the more than seventy years of its useful life, contributed greatly to aeronautical research in the United States. And it stands as a clear example of why the Dayton area has remained a center of aeronautical research ever since those two brothers first set out to fly.