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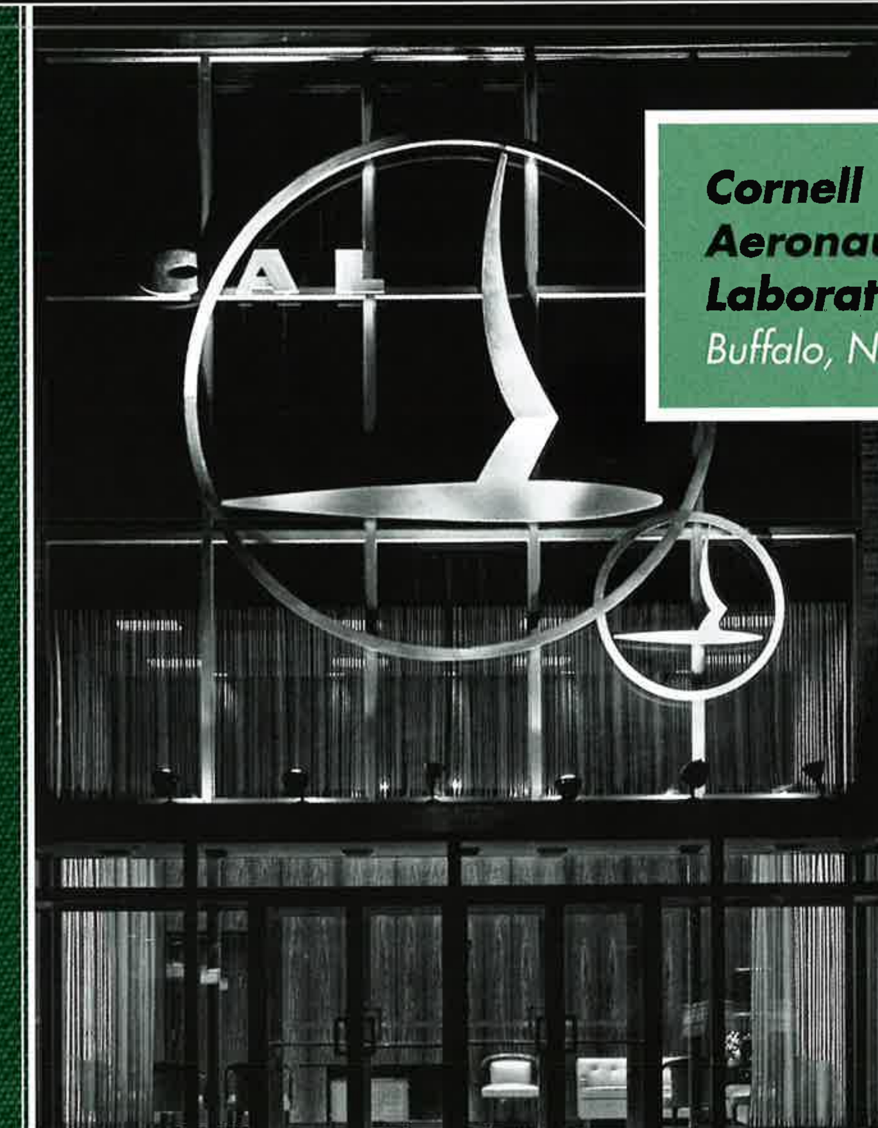

Cornell Aeronautical Laboratory
Buffalo, New York

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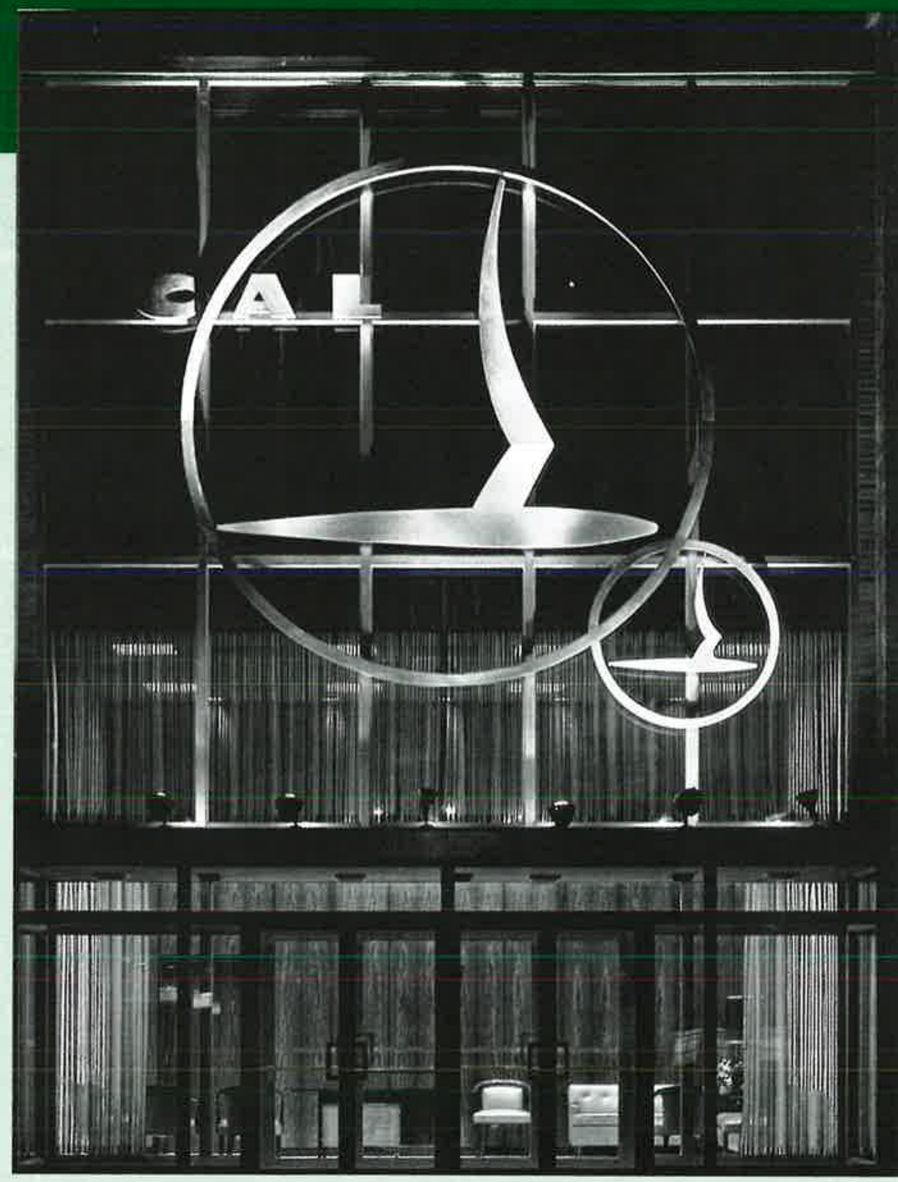

The Cornell Aeronautical Laboratory lobby.

automotive parts, bought Calspan in 1978. It has been owned by several other companies over the years, including Veridian and General Dynamics, but became independent again in 2005.

The company has continued to enhance its research in aircraft and automobile safety. In 1978, Calspan began work on the first National Automotive Sampling System (NASS) contract to collect data related to automotive crashes, and a year later began testing new vehicles for crash-worthiness. Their research also include airbags, child restraint systems, and car-to-car crash tests. They continue to add Learjets to their testing fleet, and did extensive wind tunnel testing on the Joint Strike Fighter. In 2010, the full-scale operations of Calspan's transportation division conducted its 2,500th crash test.

Starting as a small research organization, and having grown into a nationally-known and highly sophisticated research facility, the Cornell Aeronautical Laboratory and its many employees improved the lives of countless people in the U.S. and around the world for over 26 years. The employees of its successor, Calspan, embrace that same spirit today and continue to strive for safer highways and safer skies.

Most of the above text is from "The History of Aerospace Research at Cornell Aeronautical Laboratory" by Kevin Burns.

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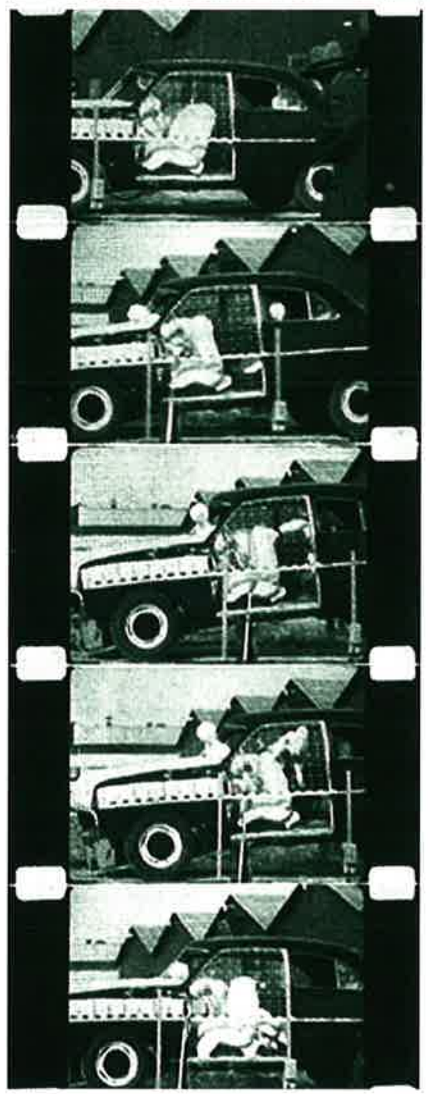

(Above) A technician with a model in the wind tunnel, 1968.

(Left) Images like these, broadcast on nationwide TV in 1951, focused the attention of the American public on the need for seat belts.

with extremely sensitive all-weather electrostatic field meters.

One of the Lab's most important research contributions was in automotive safety. It had started at Cornell University in 1942 when Hugh De Haven was appointed director of a project called Crash Injury Research (CIR) at Cornell University Medical College. The research in aerodynamic stability and control in the Flight Research Department under department head Bill Milliken (an early race car driver who participated famously at the first Grand Prix at Watkins Glen), started looking at automotive vehicle stability and control. As the work at mitigating injury in aircraft started being applied in automobile safety, new groups were formed in the Lab, and in 1955, the Liberty Mutual Insurance Company financed new research at the Lab in car safety. This work was touted in the 1960s by Ralph Nader as proof that the automotive industry had the technology to make cars safer.

In the early 1950s, to show the world the work that the Lab was doing in automotive safety, Walter Cronkite broadcast from the facilities in Buffalo on CBS. In this broadcast, two dummies, one an adult size in the driver's seat and the other child size in the back seat, were shown in a simulated crash by welding a cable to the frame of a vehicle and "snubbing" it to a stop when the cable played out. Viewers saw the need for crash safety when the "driver" went through the windshield area and the "child" was tossed around like a sack of potatoes.

By 1966, CAL began to re-evaluate its relationship with the University, and several factors led to their eventual split. Cornell faced pressure from student activists during the 1960s who were concerned with CAL's ties to national defense research that would likely be used to fight the Vietnam War.

Cornell was going through a financial crisis at the time, and the Board of Trustees saw an opportunity to make money by selling the lab for $25 million. Cornell took the first step by incorporating CAL in 1972, when it became known as the Calspan Corporation. Arvin Industries, a manufacturer of

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Cornell Aeronautical Laboratory

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Dr. Clifford Cook Furnas (1900–1969)

In addition to serving as the director of the Research Laboratory, he was a math teacher, a physics researcher, an expert on guided missiles, a university chancellor, and an Olympic athlete (Antwerp, 1920, athletics).

The real history of the "Lab," as it's always been affectionately known by its employees, started with the first flight at Kitty Hawk over a century ago. One of the main objectives of the Wright brothers was to secure a federal government contract for airplanes. After the historic flight of 1903, the two brothers, Wilbur and Orville, formed a company that became the Wright Aeronautical Corporation.

When Alexander Graham Bell read of the flying experiments, he formed the Aerial Experiment Association, and Glenn Curtiss became the driving force behind it as the operations were moved to his bicycle shop in Hammondsport, New York. This eventually became the Curtiss Aeroplane and Motor Company.

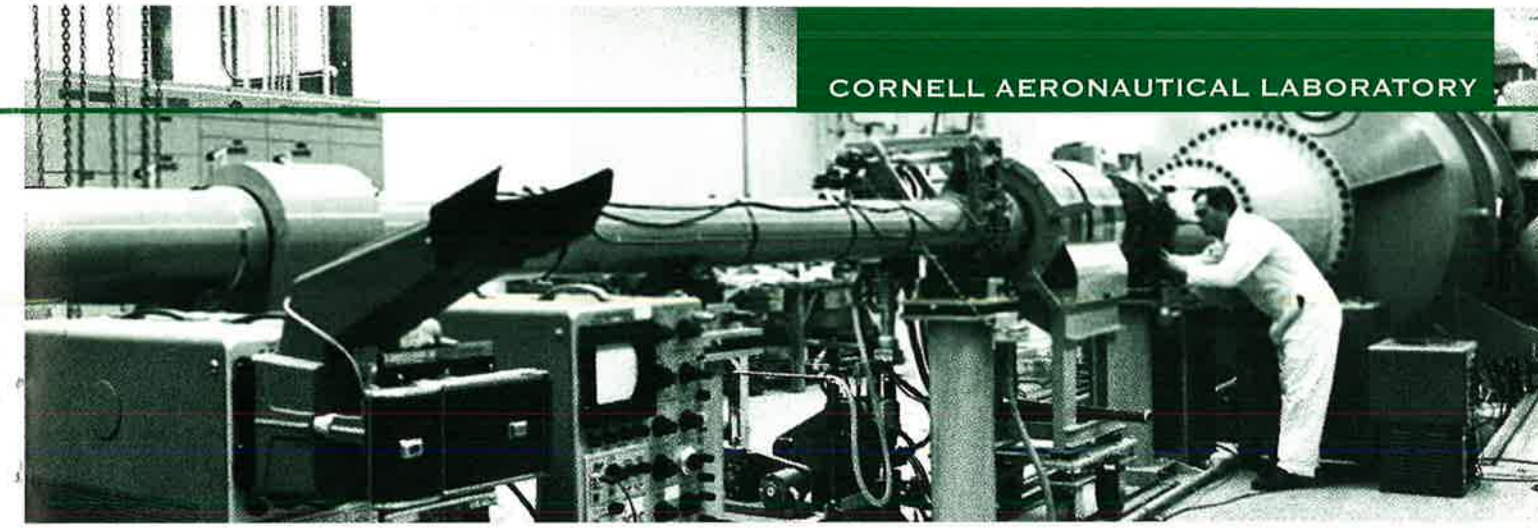
In August 1929, the two companies merged to become the Curtiss-Wright Corporation and built a new aircraft factory in Tonawanda, New York. As the winds of war began to blow around the world in the late 1930s, Curtiss-Wright's P-40 came into high demand, with orders from France and England. By 1940, the Tonawanda plant had 5,300 employees and went from six production lines to seven to fulfill an order for 100 aircraft that would become the three squadrons of the Flying Tigers.

As planning and construction took place for a new factory in Buffalo, which would be the largest privately owned airplane factory in the world, several Curtiss-Wright executives discussed the need for a research laboratory. The concept was unique at that time, because no aircraft company in the country had ever established a separate research laboratory. Research in the field of aviation had traditionally been performed by universities or government-sponsored groups.

The decision to build a wind tunnel as part of the laboratory was made in April 1942, and construction started in June of that year. On 11 February 1943, the new Research Laboratory of the Curtiss-Wright Airplane Division was dedicated, and Dr. Clifford C. Furnas was appointed its first director.

The original laboratory staff was divided into three technical departments—Physics, Materials, and Structures. Their role was to investigate problems with aircraft and associated equipment being developed by Curtiss-Wright, and to perform some contract research for the military. During the war, the lab and its staff grew at a steady rate, but there were construction problems with the wind tunnel. It was difficult getting materials, or even reliable workmanship, as efforts went into the more pressing needs of the nation. By the end of the war, the lab had a compilation of test equipment, the world's largest altitude chamber, and an unfinished subsonic wind tunnel.

When Japan surrendered, ending the war, Curtiss-Wright was deluged with



1960–High energy shock tunnel.

One of those was project Bumblebee, whose purpose was to develop a surface-to-air missile to counter the threat to ships from Kamikaze type attacks. The Navy Standard Missile (SM), which is the primary surface-to-air Fleet defense weapon and is widely deployed on Navy ships today, is a direct descendant of the Bumblebee program.

Another missile researched and designed by CAL was the Lacrosse, a highly classified outgrowth of the Bumblebee program that was conceived by the U.S. Marine Corps shortly after World War II to destroy enemy strongholds such as concrete pillboxes and reinforced bunkers that could not be eliminated by conventional artillery weapons. It was designed to be launched from a rearward position so as to fly with preset controls in the general direction of a target specified by a forward observer. At an appropriate time, the observer would take over terminal control of the missile and direct it by Command Guidance to the target. It was this guidance technique that gave the weapon system the code name LACROSSE. In the game of lacrosse, goals are scored in much the same manner, with the ball being passed downfield to a player in position to hurl it into the net.

In a totally different direction, CAL started working on aircraft safety projects in 1947, and after receiving funding from the Guggenheim Foundation, was renamed the Cornell-Guggenheim Aviation Safety Center. The center studied crash problems, and methods of reducing the hazards associated with crash landings. As an internal research project, the "Thin Man" was constructed to simulate the motions of the human body during crash decelerations. Their research found that 75% of the fatalities in airplane crashes were due to skull or brain damage and that the body contributed forces to increase the head impact. The use of seatbelts was found to reduce the head impact blow to approximately one-half of the no-seatbelt blow.

A second group investigated fire safety, which led to improved fire protection for jet aircraft, and a third group researched air traffic control, particularly the final approach procedure. Around this time the government established the Air Navigation Development Board (ANDB) to analyze the growing problems with air traffic control, promote research and development work on appropriate solutions, and advise on changes in equipment and regulations to improve the air traffic control system. Its purpose was to make the best use of equipment and information currently available, and develop equipment to be used fifteen years out.

The Lab also performed weather and atmospheric research. As early as 1947, using airborne equipment at sea, CAL had generated a 28-mile-long fog bank for the Navy in less than a minute. Better understanding of the internal structure of violent storm clouds was being obtained through the use of specialized instruments devised by scientists at the Lab and the use of Doppler radar. Also in the mid-1950s, the Lab embarked on research to determine if the jet stream could be detected rapidly and remotely by taking electrical measurements

The Thin Man, used to simulate the motions of the human body during crashes.

(Right) Director Furnas (left foreground) proudly shows a model of the Bumblebee Missile.

1957–Liberty Mutual Safety Car.

space vehicles to the manufacture of components for the hypersonic shock tunnels.

Facilities were divided to two locations, one owned and the other leased. The principal building of the Research Laboratory was an all-brick two-story structure of approximately 94,000 square feet of floor space housing the Aerodynamics, Materials, and Structures Departments, a portion of the Physics Department, the Library, the Model Shop, and the executive and administrative offices. On the same owned property, there were two additional small buildings which held the fuels laboratory and the combustion laboratory.

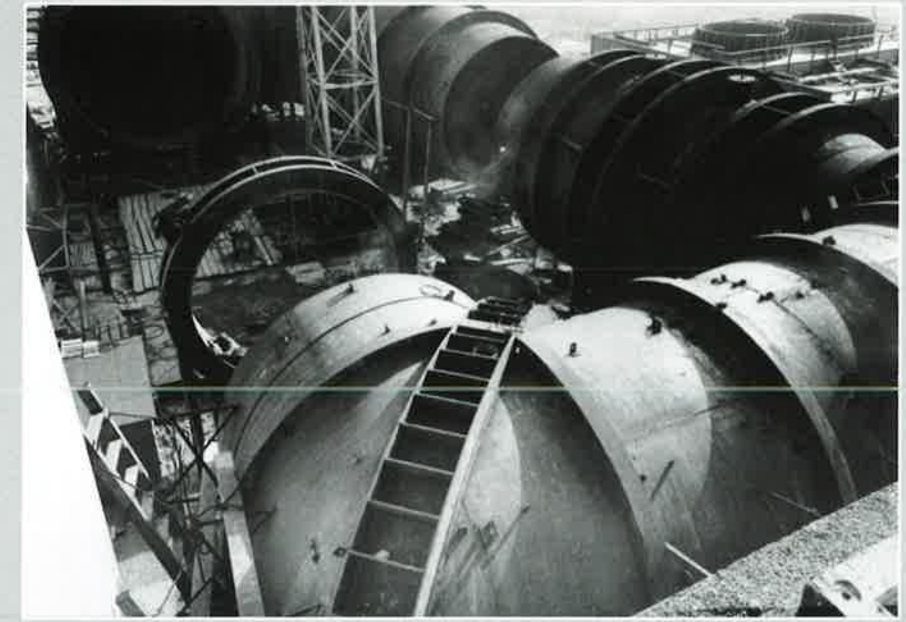
Building 2 consisted of three large hangar bays, plus office space. This area housed the Flight Research Department, a portion of the Physics Department, and the Development Division. This was leased from the War Assets Administration, and later from what is now the Niagara Frontier Transportation Authority.

The majority of the Laboratory's technical effort was concentrated on guided missile research. The first year, this accounted for 45 percent of the total workload. By the second year, this had been reduced to 27 percent. Most of the work was highly classified at the time. Working from research that was performed in Germany during the war, the Lab overcame many of the technological difficulties that had not been resolved by the war's end.

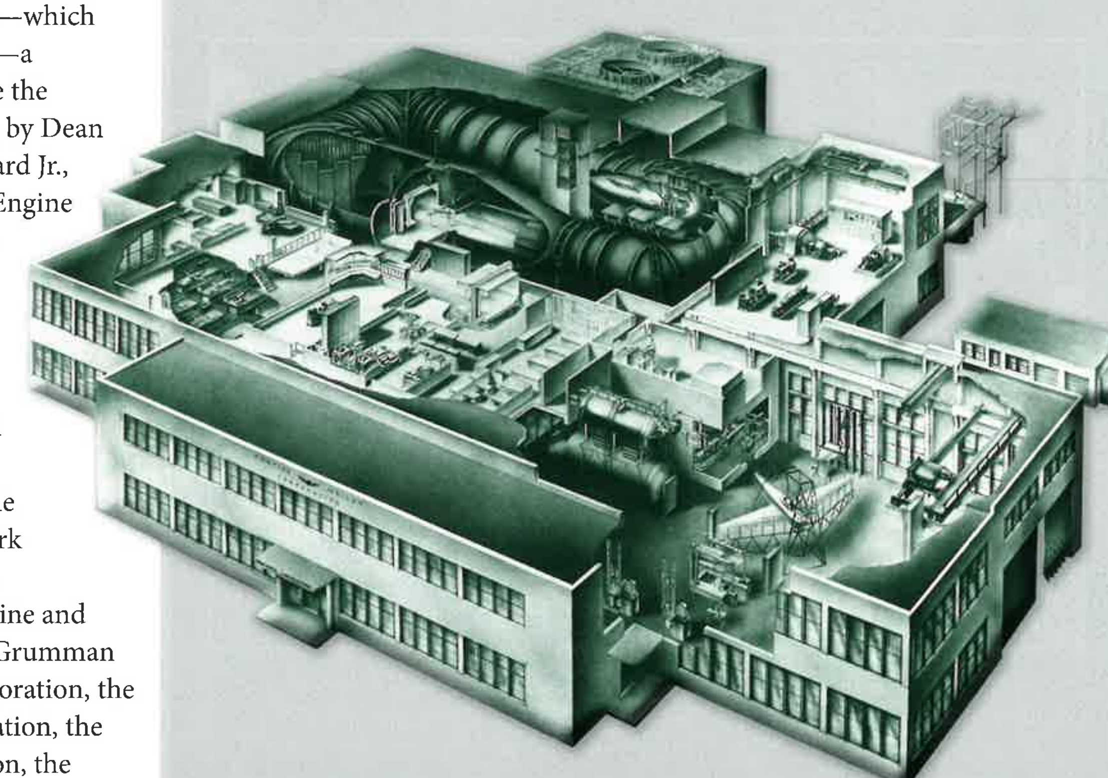
a flood of telegrams canceling contracts for wartime production of aircraft. Within weeks, production activities were reduced to a mere five percent of the wartime peak. After a series of hastily called meetings, Curtiss-Wright decided to abolish its Airplane Division in Buffalo and discontinue underwriting the activities of the Research Laboratory.

Through the urging of the Lab's Director, Dr. Furnas, Curtiss-Wright entered into serious discussions with Cornell University, which had a strong interest in aeronautical engineering, and a strong advocate in its Engineering Dean, Solomon C. Hollister. Realizing that any business must have working capital—which Cornell could not provide—a dynamic campaign to raise the required funds was begun, by Dean Hollister and J. Carlton Ward Jr., the president of Fairchild Engine and Airplane Corporation (and an eminent Cornell alumnus).

In the space of a few weeks, the two had elicited pledges from six major companies. At a memorable dinner meeting in New York in November 1945, the six companies—Fairchild Engine and Aircraft Corporation, the Grumman Aircraft Engineering Corporation, the Republic Aviation Corporation, the United Aircraft Corporation, the Bell Aircraft Corporation of Buffalo, and the Avco Manufacturing Corporation—together pledged to

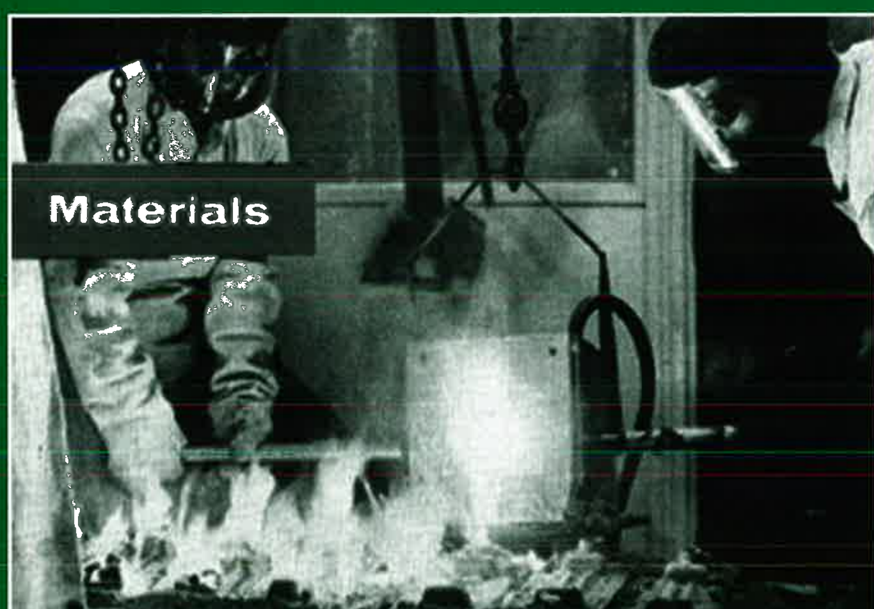


The windtunnel under construction, 1943.



A view of the main building with the wind tunnel, 1947.

The first variable stability airplane at Cornell Aeronautical Laboratory.



A CAL metallurgy team pours a molten stainless steel alloy into shell molds for casting test bars to evaluate the load-carrying ability of stainless steel alloys.

match the Curtiss-Wright gift with an overall contribution of a $675,000 working-capital fund. On 16 December 1945, the Board's Executive Committee unanimously decided to accept the gift, under the condition that no University funds would be used to cover operating expenses.

On 21 December, Curtiss-Wright executed the documents bequeathing the Laboratory to Cornell as of 31 December 1945. At that time, it also provided a cash gift of $377,000 to complete the unfinished wind tunnel, and on 2 January 1946, with Dr. Furnas remaining as their Director, the 545 employees of the Curtiss-Wright Research Laboratory became the employees of Cornell Aeronautical Laboratory (CAL).

With the separation from Curtiss-Wright Corporation, it was necessary for the Laboratory to become a self-contained unit. Many functions, such as contracting and financial operations, had to be assumed by the laboratory, and it reorganized and strengthened its staff accordingly.

The technical activities of the Laboratory were carried out by various departments. The Research Division included the departments of Aerodynamics, Flight Research, Structures, Materials, Physics, and a Model Shop which served the entire group. The Development Division contained the departments of Development Engineering, Armaments, and Pilot-scale Manufacturing.

The Aerodynamics department was eventually renamed the Wind Tunnel Department after its most outstanding piece of equipment: a 12-foot variable-density, closed-circuit, single-return wind tunnel. This facility tested scale models at air speeds from 50 to 750 miles per hour. In 1946, there were three other much smaller wind tunnels, which tested models with a wingspan up to three inches at subsonic, transonic, and supersonic speeds. The supersonic tunnel was only able to develop an airstream of 1.7 times the speed of sound.

The principal building of the Research Laboratory.

The Flight Research department started out with equipment for handling tests and experiments in the research of stability and control, vibration, flutter, and dynamic loads on all types of aircraft. They had complete facilities for maintaining research aircraft in condition for flight, performing modifications to the aircraft, and instrumenting them for flight operations. This included a complete photography facility for taking both still and high-speed motion pictures. Early research here led to the development and building of one of the first variable stability aircraft, an aircraft that could be modified to simulate a different vehicle for testing and training purposes. The use of variable stability aircraft for in-flight testing and training remained a main focus of the Flight Research Department throughout its history.

One of the most advanced embodiments of the variable stability concept, the Total-In-Flight Simulator (TIFS), was the result of a seven-million-dollar conversion of a Convair C-131B, undertaken in 1966. The unique dual-cockpit aircraft was used extensively in research preparing for flights of the B-1 bomber and the Space Shuttle landing maneuvers. The TIFS is still in use today. Over the last forty-five years, thousands of Air Force and Navy test pilots have received first-hand experience at variable-stability controls in these flying classrooms.

The Structures Department included an electrical test laboratory where aircraft electrical systems and instruments underwent experimentation, and a complete hydraulics laboratory. At the time, the department's greatest pride was in the world's largest altitude chambers, capable of simulating altitudes up to 70,000-feet with a temperature range from 120 degrees Fahrenheit to minus 85 degrees Fahrenheit.

The Materials Department included the Metallurgical Section to perform tests on ferrous and non-ferrous alloys, and the Chemistry Section was equipped to analyze the content and behavior of all types of gasses and fuels. The Metal Fabrication Section had facilities for investigating problems of fabrication, such as hot dimpling.

The Physics Department had test equipment for use in radar, optics, communications, aircraft instrumentation, acoustics, electro-mechanisms, telemetering, and radio transmission and receiving.

The Model Shop was originally organized to construct wind tunnel models, but from its first years began performing a variety of services for all the other departments in the Lab. Some of that original equipment is still in use today, and the department still performs a variety of functions, from making wind tunnel models of