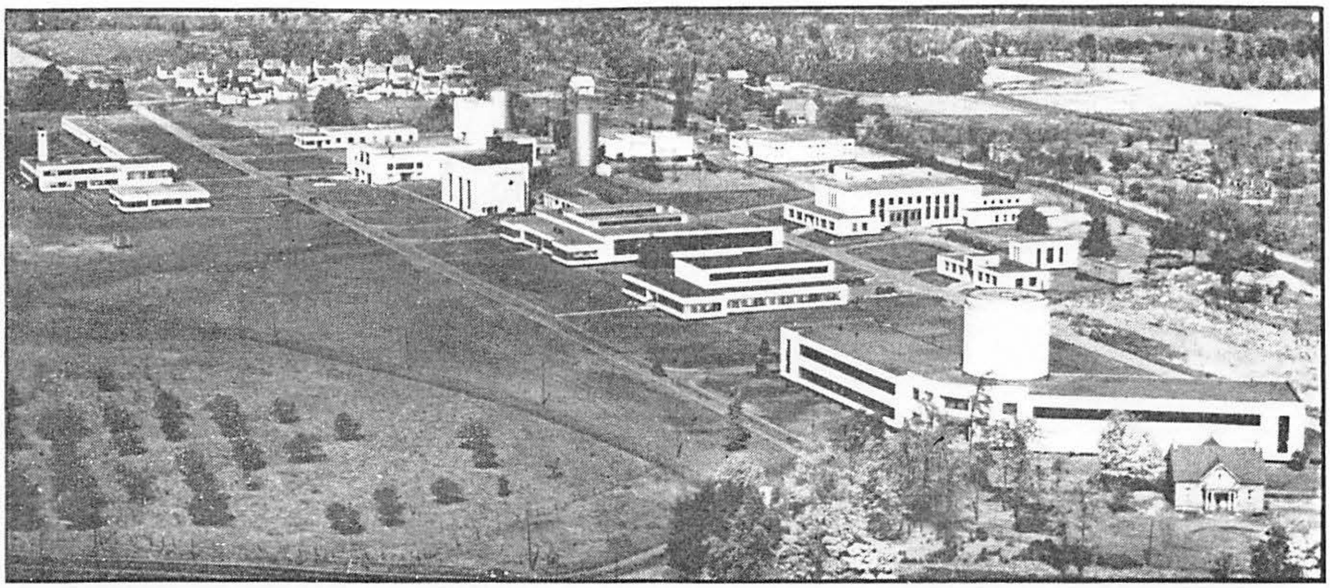


NATIONAL RESEARCH COUNCIL'S . . .

Aeronautical Lab

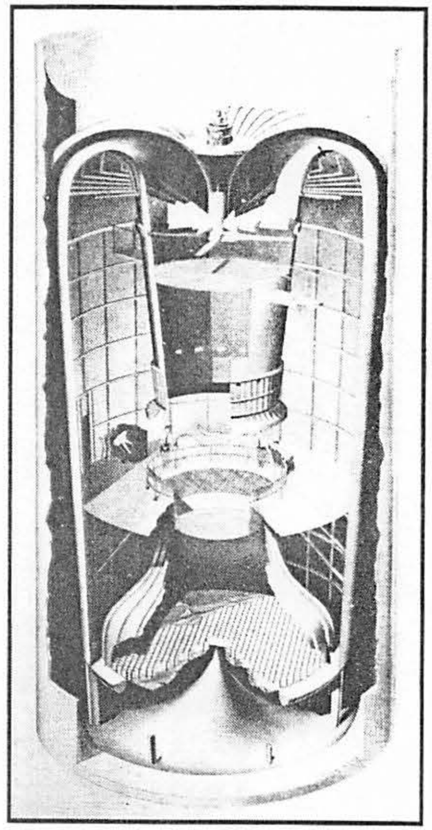
On April 1, 1936, the aeronautical and fire hazard laboratories, formerly part of the Division of Physics and Engineering of the National Research Laboratories at Ottawa and the instrument and model shops, were organized in a separate division designated as the Division of Mechanical Engineering with J. H. Parkin as Director. At that time the laboratories were housed in temporary quarters. Late in 1939, when the need for better aeronautical facilities to assist Canada's aviation industry became urgent because of war requirements, a new 120-acre site was secured just east of Ottawa and there the Montreal Road Laboratories were established. There are now some fourteen separate buildings on this site (See top photo).

Opening Attraction: "Open House" at these laboratories May 31, June 1 and 2, 1950, attracted more than 7,500 visitors, including many industrialists from distant points, as well as representatives of Government departments, including, of course, many Service personnel from the technical sections of the Navy, Army, and Air Force.

The facilities of the aeronautical laboratories are generally of a character and capacity not elsewhere available in Canada. In this way the laboratories fulfil their main function to provide Canada's aviation industry, both contractors and operators, with research, development and testing facilities and also function as the research organization of the Royal Canadian Air Force. Almost all phases of aeronautics are covered — aerodynamics, supersonics and gas dynamics, internal combustion engines and accessories, liquid fuels, lubricants and structures — and the facilities include atmospheric and spinning wind tunnels, model-testing basin, water tunnel, equipment for testing full-scale internal combustion engines and gas turbines, aircraft wings and components and for work on vibration, fatigue, photoelasticity, gasolines, turbine fuels, lubricants and aircraft and allied instruments.

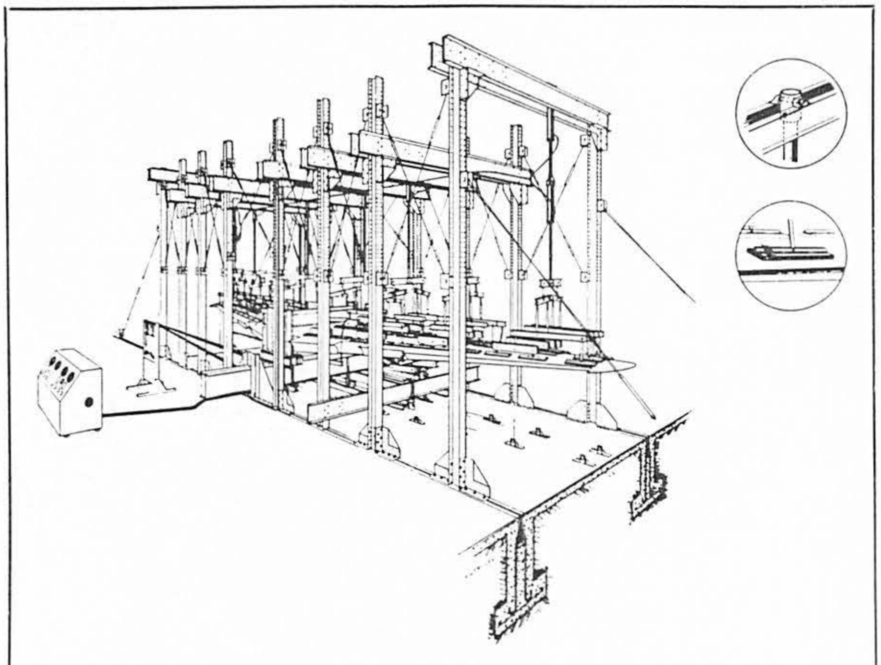
Performance Studies: The performance of newly designed aircraft and the effects of modifications to existing aircraft are studied in the wind tunnel; the effect of variations in attitude, control surface setting and of modifications on the stability and control of an aircraft can be determined and its performance predicted.

The vertical spinning tunnel provides a safe medium for studying the spinning characteristics of an aircraft. Motion pictures are taken of the freely spinning model and from the study and analysis of the films the spinning characteristics of the full-scale aircraft can be predicted. At the present time correlation tests are being carried out in this tunnel to determine how results here compare with the results in other spinning tunnels (i.e. the RAE tunnel at Farnborough and the NACA tunnel at Langley Field).



Vertical Spinning Tunnel

Structures Lab: In addition to the aerodynamic qualities of aircraft designs the properties of the structures must also be examined. The structures laboratory is equipped with a variety of testing apparatus and instrumenta-



Wing in Static Test Apparatus.

tion for indicating the effects of loading on various components of an aircraft under different flight conditions. The most recent addition to the facilities of the laboratory is the equipment for the static testing of full-scale aircraft components such as wings and tailplanes.

The Avro jet transport, C-102, designed and built by A. V. Roe Canada Limited, is at present under test in the structures laboratory. This is an example of the kind of service rendered by the laboratories to the aviation industry. Tests on the jet fighter, CF-100, designed by the same company, are also in progress.

Other Studies: An experimental study of curved plates subjected to end-wise compressive loading is being continued. Wing-flutter tests are also being made to obtain design data in regard to the thickness of skin required in aircraft wings. Another investigation is concerned with ground shaking tests and vibration measurements in flight. In addition to 600,000 lb. and 60,000 lb. machines, a 2 000-lb. Universal testing machine has recently been installed for tests of small specimens and for accurate calibration work.

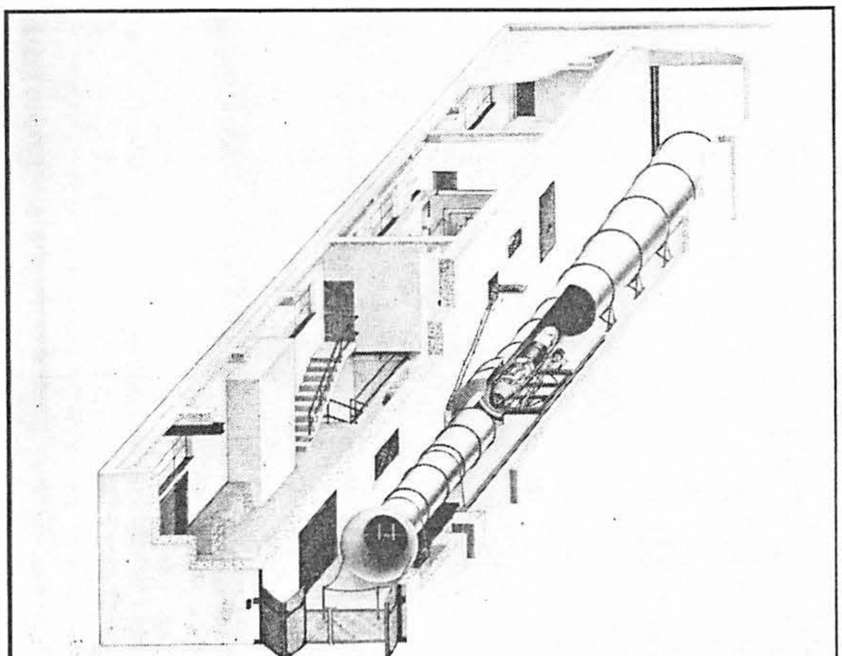
Problems peculiar to aviation in Canada are associated with cold weather and consequently a large amount of the work done in the laboratories is concentrated on the improvement of the low temperature operation of aircraft. The recently completed low temperature laboratory equipped with large cold chambers and an icing wind tunnel permits work on aircraft components, engines, fuels, structures, and many items of equipment. Icing, one of the great flying hazards, is also studied in flight by laboratory crews using a specially equipped North Star aircraft, provided by the RCAF

Low Temperatures: During a recent three-month period the cold chambers of the low temperature laboratory were in operation for a total of 507 hours on eight different projects. Three chambers are available one 50 by 15 by 15 ft. and two others, each 10 ft. cube. Temperatures as low as −85°F. can be attained readily.

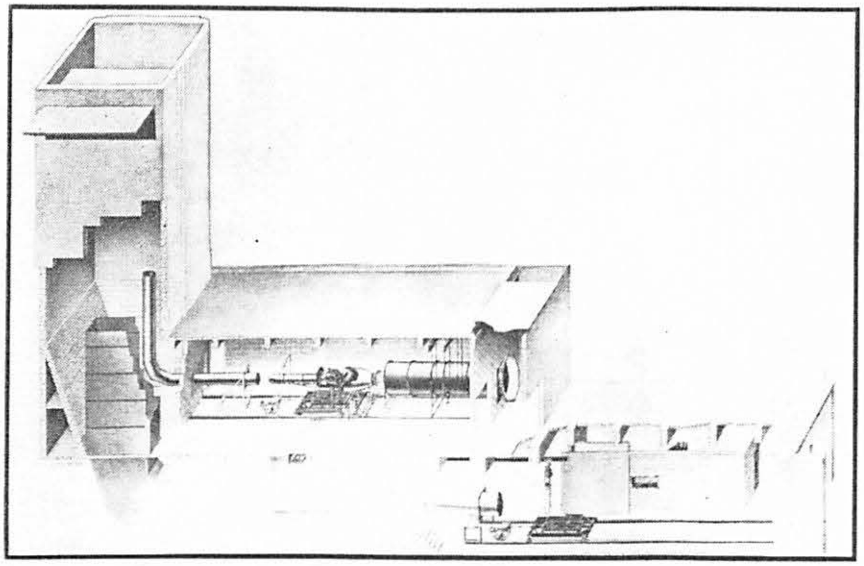
An icing wind tunnel has just been completed and put into operation driven by a 1,000 h.p. motor and having a working section 4½ ft. square in which an air speed of 260 m.p.h. at −40°F. can be attained.

Engine Lab: The engine laboratory is studying the low temperature operation of aircraft gas turbines and, in co-operation with the low temperature laboratory and the gas dynamics section, is investigating the icing of gas turbines and means of preventing ice formation, and ice removal.

Icing and anti-icing tests were carried on almost continuously in all five test cells during the winter season. In these tests natural icing conditions were simulated by spraying water into the inlet of a large duct mounted in front of the engine under test. Droplets of the required cloud particle size, about twenty microns diameter, were produced and allowed to supercool to the temperature of the air stream without freezing. When these particles impinge on any forward facing projection of the engine, they immediately freeze resulting in an icing condition very similar to that encountered in flight in icing cloud.



Jet Engine Test Stand.



Jet Engine Test Stand.

Four of Five: The trend towards the adoption of jet engines in aircraft made it necessary to reorganize the engine laboratory and this has been done. Four of the five engine hanger stands have now been converted to permit the testing of jet aircraft leaving only one stand for the older type of reciprocating engines.

Fuels and lubricants laboratory work is also following the modern trends. Low temperature lubricants are being developed for special purpose such as their use in rock drills employed in the mining and construction industries. Ignition limits of aviation gas-turbine fuels have been studied because the reduced pressures and low temperatures existing at altitude produce conditions which make re-lighting difficult in gas-turbine combustion chambers. Research on other fuel problems has produced little information that is of value under these new conditions and a basic study therefore has to be made.

Winter Flying: Aircraft skis and other features of winter flying are being studied in the engineering and structures laboratory sections with the flight research section co-operating on flight trials. The structures laboratory is studying the skis from a strength aspect to assemble data on which to base loading requirements for aircraft skis. The engineering section is continuing work begun prior to the second world war on ski-surfacing materials.

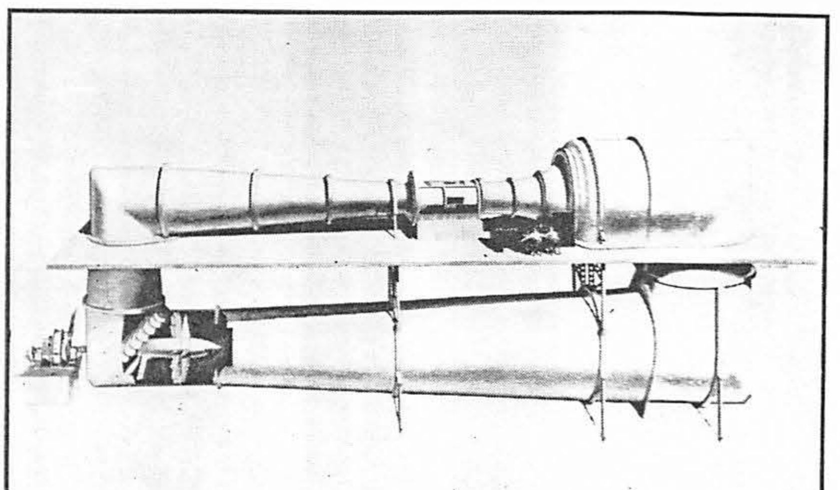
A flight research section is operated at Arnprior, Ont., in co-operation with the RCAF, for the investigation, in free flight, of problems in aircraft control and stability, transonic aerodynamics, ski undercarriages and artificial precipitation. The National Research Laboratories tailless glider, designed and constructed in the structures laboratory and based on studies in the atmospheric and spinning tunnels, is now based at the flight research section.

Two Mustangs: Two Mustang aircraft provided by the RCAF, have been equipped to test small models in the transonic region lying above prepared test sections on the wings. The present equipment is capable of testing these models, wind-tunnel style, up to a Mach number of 1.2, or speeds up to 20 per cent in excess of the speed of sound. Most of the measurements normally made in a wind tunnel are possible with this equipment, and information from some fifty measuring channels are recorded in flight.

The development, calibration and maintenance of the instrumental equipment required for the research projects in the aeronautical laboratories is the function of the instrument laboratory. The complete instrumentation of the National Research Laboratories tailless glider was developed in the instrument laboratory as well as many instruments for the study of the meteorological conditions associated with the icing of aircraft. The instrument laboratory is also equipped to undertake the calibration of airspeed indicators, altimeters, tachometers, pressure gauges, gyro attitude direction and rate-of-turn indicators and many electric-type instruments. These calibrations can be made at normal and low temperatures. The behavior under vibration can also be investigated.

Associated Projects: The model-testing basin undertakes work for naval architects and ship builders as well as for the aircraft industry. Facilities are available in the hydraulics laboratory for work with river and harbor models and models of hydraulic structures.

An initial study of silting in the Fraser river in which a laboratory model of a five-mile section near New Westminster, B.C., was used, has been completed and useful results on how to keep the channel open have been secured. It is now proposed to make an overall study of the possible



Main Aircraft Model Tunnel.

development and maintenance of navigation channels in the Fraser river and to this end a movable-bed hydraulic model is being constructed at the University of British Columbia in Vancouver, B.C.

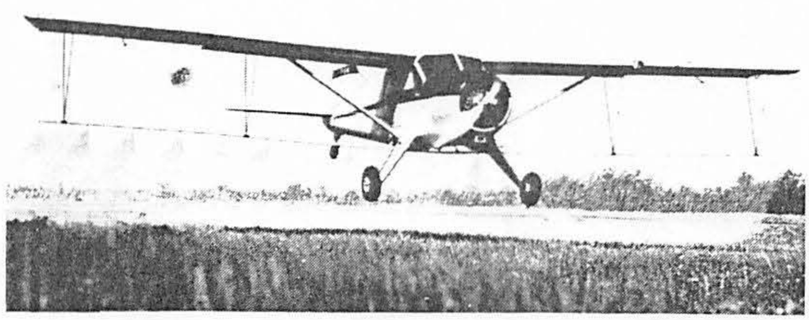
Semi-Permanent: In view of the scope of the problems involved and the continued usefulness of such a model for solving future difficulties the project is being organized on a semi-permanent basis. The construction of the open-air model began with the clearing and levelling of the site and the provision of proper drainage works. The asphalt channels and concrete reservoirs have been completed and suitable housing for pumps and auxiliary equipment is now being erected. Work is under way on the installation of pumps, water distribution system, and the concrete footings for the datum poles.

Work in general engineering includes the design of special mechanical equipment and investigation of snow preliminary to study of snow removal equipment and snow vehicles.

Keeping Abreast: The facilities of the laboratories are continuously under review and modification in order to keep abreast of the ever changing requirements in the field of aviation. The current emphasis on high-speed flight has resulted in a need for supersonic wind tunnels and equipment for work on combustion, compressors and turbines.

A ten-inch square supersonic wind tunnel of the intermittent type has been designed and is being built which will permit test work up to a Mach number of four (or an air speed of 3,000 miles per hour) to be done.

Nearing Completion: A new high-speed aerodynamics building is nearing completion. The corner stone of this laboratory was laid during "Open House" by His Excellency, the Governor General, Viscount Alexander of Tunis. In an address delivered on that occasion, Lord Alexander noted that the opening of this new building was symbolic, because . . . "it marks the crossing of a boundary between aviation research as we have known it in the past, and the new field of engineering and scientific endeavor on which we are about to enter".



A Farm Machine

THE SPRAYING BEAVER

The latest thing in Beavers is this utility model equipped for aerial spraying for weed and/or pest control. Before making the decision to adapt the Beaver as an aerial sprayer, de Havilland noted that in past years a wide variety of aircraft had been used as aerial sprayers, for the most part surplus training aircraft with little to recommend them but low initial cost.

Says R. D. Hiscocks in de Havilland's New Letter: "The importance of using the proper type of equipment cannot be over-emphasized. During a recent six year interval in the U.S., nearly 100 experienced pilots were killed in a total of 700 accidents. The record is not quite so dark in many other countries but there has been a growing demand for better aircraft from private operators and government agencies.

"To many it appeared that the Beaver was ideally suited for aerial spraying, and design work was initiated. . . . In the first demonstration 80 acres were sprayed with DDT solution in less than ten minutes. In subsequent tests the Beaver sprayed 400 acres in a single flight and took off and landed with a full load from summer fallow, which was sufficiently soft to bog down most other aircraft.

"Business was brisk, farmers found that aerial spraying is far cheaper than ground methods. Moreover, the modern highly toxic chemicals are extremely dangerous to handle with ground spraying equipment and several farmers have been serious injured, with the result that they are sold on the aerial method. Possibly even more important is the rapidity of application. The period during which certain pests and weeds are most vulnerable to the chemicals is often quite short, and prompt action is essential."

The Beaver can carry 240 U.S. gallons spray fluid, which is sprayed by a 48 foot boom (see cut). It can cover 240 acres in about 20 minutes at a rate of one gallon per acre. It carries two hours of fuel for spraying operations.