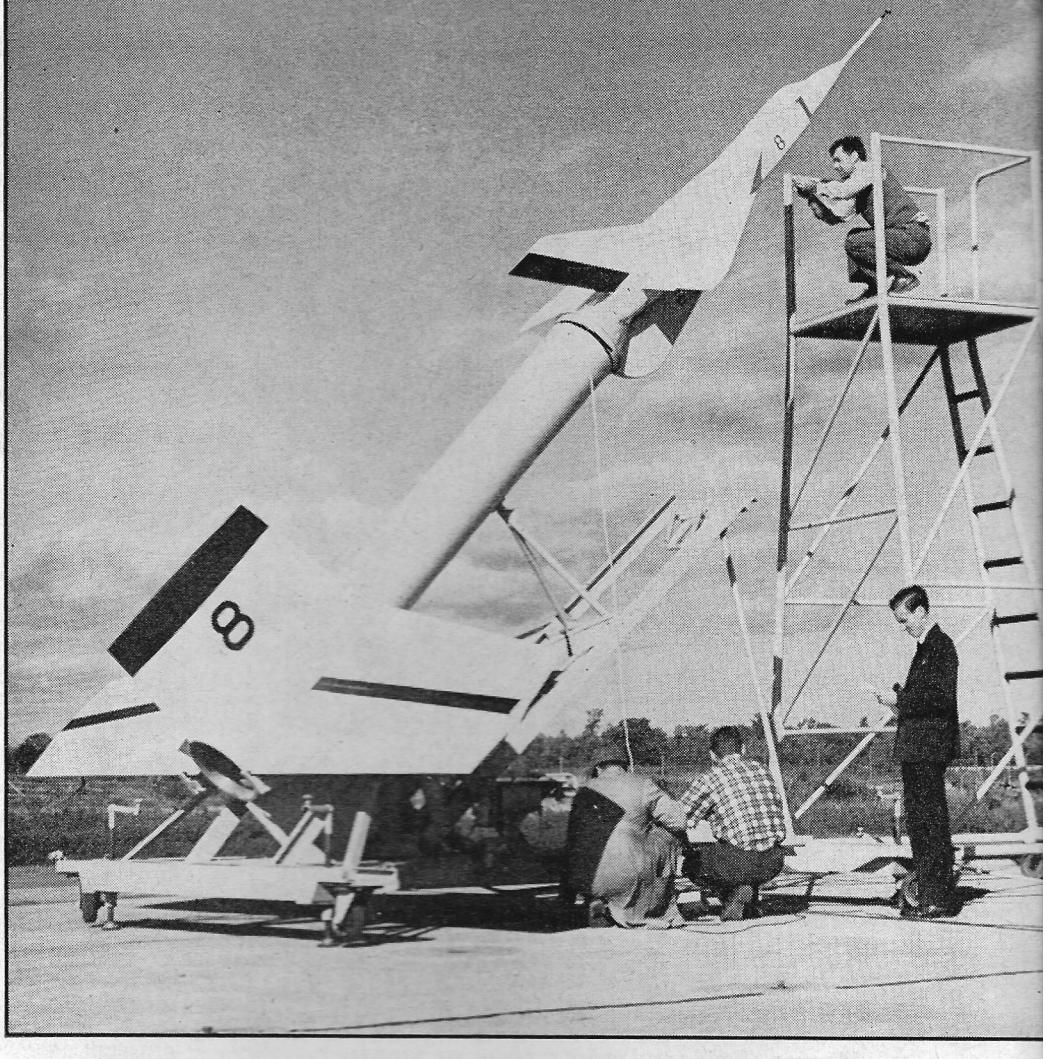


Early research & development on Arrow was aided by the use of large-scale free flight models. Model is shown being readied on launching rig with Nike rocket booster in firing position.

Research & Development

RESEARCH and development in Canada for the aeronautical and allied fields takes many forms and involves many agencies, government and industry.

At the present, a considerable part of the Canadian research and development dollar is going into programs directed toward turning the Avro Arrow into an operational weapon system. This includes, of course, not only the airplane itself, but such essential hardware as the Iroquois turbojet which will power the operational version, the electronic system of fire control, navigation and communication, and the automatic flight control system.

Private Enterprise: Though all of this work is being financed out of public funds, Canadian aircraft companies, and a number of ancillary firms, are more and more often sinking their own funds into development programs. An outstanding example of such private enterprise is that of the Orenda Iroquois. Orenda Engines Ltd. put several millions of dollars of its own money into this project before the Government started to provide backing.

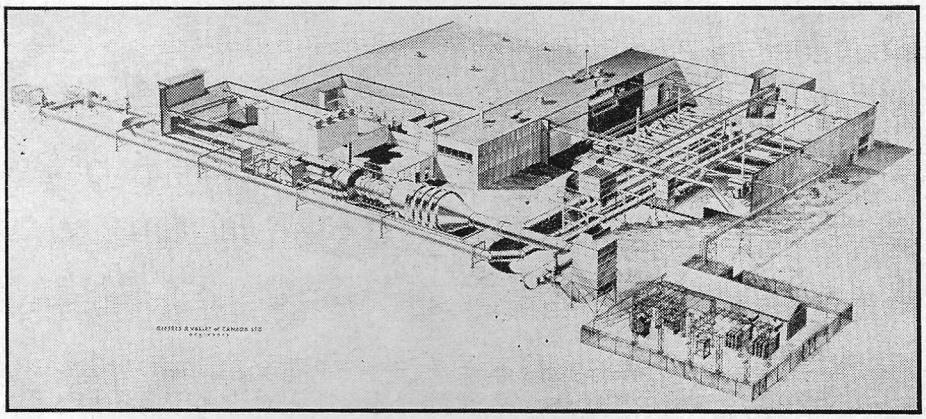
The de Havilland DHC-4 Caribou is also largely a private venture. Design studies were financed originally out of de Havilland's own funds, but assistance has been obtained from the Government to enable construction of a prototype.

The Canadair CL-41 design and development program is going forward strictly as a private venture at this point, with construction going ahead on two prototype machines.

Commendable though these projects are, it must be recognized that they would not be possible—at least not without resort to foreign research and development facilities—if the Canadian Government did not maintain the extensive aeronautical research facilities which are operated, mainly in the Ottawa area, by the National Research Council and the National Aeronautical Establishment. Of course, companies like Canadair and de Havilland pay for the use of these facilities when their own private projects are under investigation, but it is doubtful if any Canadian company could justify establishing and maintaining such comprehensive facilities purely for its own use . . . even if it could afford such a step.

Research Tools: Wind tunnels at the National Research Council's Division of Mechanical Engineering Laboratories on Montreal Road, near Ottawa, include a low speed horizontal wind tunnel which has a 10 ft. by 6 ft. working section and is capable of a maximum airspeed of about 300 mph; a vertical wind tunnel with an open working section some 15 ft. in diameter and a maximum speed of about 60 ft.

At Malton, Orenda is rushing to completion a new high altitude test facility (L), for turbojet engines. Facility will simulate altitudes of up to 100,000 ft.



per sec., usually used for free spinning tests (with models); a high speed tunnel with a 16 in. by 30 in. working section, a running time of about 15 secs., and a speed range from Mach 0.5 to Mach 2.0; a supersonic tunnel with a 10 in. square working section, capable of supersonic operation only at speeds up to approximately Mach 3, and having a running time of one minute or more.

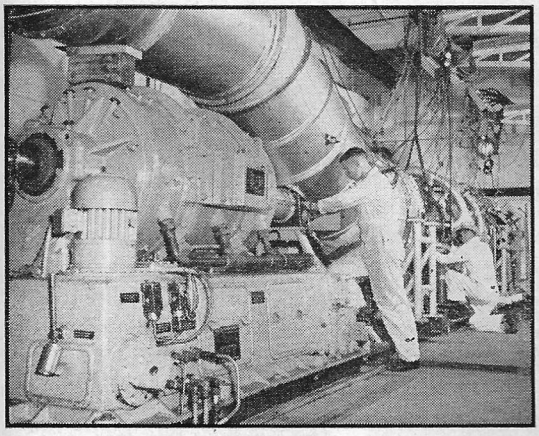
In addition to these tunnels, the NRC has built a 5 in. supersonic tunnel which is actually a one-twelfth scale "pilot" model of the long planned 5 ft. square supersonic tunnel which is eventually to be built at the site of the NAE's Flight Research Section at Uplands Airport.

The status of this tunnel, an intermittent blowdown type with a speed range from Mach 0.3 to Mach 4.5, is obscure at the moment. At this time last year, it appeared that a start would be made within in a matter of months on construction of the $6,000,000 research tool. It appears quite likely that the change in Government was at least temporarily delayed when the new Conservative Government clamped down on defence and associated spending while it looked for ways and means to finance its promised tax cuts. No further action on the tunnel may be expected until after the Government gets sorted out by this month's election.

Essential Aid: Most scientific and aeronautical authorities in this country are agreed on one thing: that if Canada is going to stay in the aircraft manufacturing game—whether home-developed or license-built aircraft—this tunnel is essential. The projected tunnel will take care of manned aircraft requirements for as far as it is possible to look into the future. And with its Mach 4.5 capability, it will also play a role in the development of missiles.

Several Government agencies have been associated with the planning and designing of this tunnel, and at one time the plans called for it to be operated by the Defence Research Board on completion. There is now a possibility that some other agency will be made responsible for the tunnel.

One private company which has built up and operates a substantial research and development facility is Orenda Engines Ltd. At Nobel, Ont., the firm has for some years had a comprehensive full-scale engine test establishment where Orenda engineers seek solutions to basic problems associated with compressors, combustion systems, control systems, turbines and exhaust systems. It is at Nobel that aerodynamic and thermodynamic tests are conducted to prove the theoretical basis of design and to determine practical limitations of both engines and components.



This rotating blade cooling rig at Orenda's Nobel establishment is used to develop various types of cooled turbine blades for jet engines.

At Malton, Orenda's Sir Thomas Sopwith Laboratory operates five major laboratories which engage in research and development work on mechanical matters, aerodynamics, materials, fuel systems, and instrumentation. Also at Malton, an advanced high altitude test facility for turbojet engines is nearing completion. The facility will be able to simulate high altitude conditions up to 100,000 ft. and speeds in the nature of Mach 2.0, for development testing of complete Iroquois engines. In the last couple of years, Orenda has invested nearly $8,000,000 in the construction of new engine test and development facilities.

Purists: So far, most of the research and development activity mentioned has been of the "applied" type. More fundamental or "pure" is the type of work carried on by the University of Toronto's Institute of Aerophysics, where the projects tackled could lead to the solution of many of the anticipated problems of space travel. It should be emphasized that the Institute is not particularly thinking of space travel in carrying out its research projects, it is just that the nature of its work is such that much of what it learns is applicable to this field.

Specifically, the Institute's researchers cover most aspects of modern fluid dynamics as it concerns flight. Their dealings are with the mechanics of rarefied gases. The tools they use are the shock tube, the shock wind tunnel, and the low density wind tunnel.

The operation of the Institute is financed by the University of Toronto,

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over Toronto shortly after 9.30 a.m. Ten minutes later the pilot radioed the ATC Centre that a runaway propeller had developed on one engine.

ATC Controller D. Finlay, who was being trained in the operation of the new surveillance radar, informed the pilot that his aircraft was positively identified on the radar screen and could be directed to a landing at nearby Downsview Airport.

Though the pilot was flying above cloud and over unfamiliar territory, with the Malton radar aid it was possible to direct him in a straight line to Downsview. This he elected to do and, receiving landing instructions from the Malton radar crew, he brought the aircraft down safely. Though the cabin of the aircraft was filled with smoke, the aircraft's crew had succeeded in putting out the fire in the engine.

Barnes in Production

First deliveries of precision mechanical springs from the new Montreal branch plant of The Wallace Barnes Co. Ltd., were made in the latter part of January. The new plant is located in the Pointe Claire industrial district, about 13 miles southwest of Montreal. Established in 1921, and having its main plant in Hamilton, the company is a subsidiary of Associated Spring Corp., Bristol, Conn.

Non-Spinnable F-104

Attempts to spin the USAF's supersonic F-104 Starfighter have led Lockheed to the conclusion that the aircraft is almost spinproof. The conclusion was reached after 50 attempts, with engineering test pilot Jake Holloman deliberately trying to induce a spin.

Holloman took the F-104, equipped with spin chute, to altitudes between 36,000 and 39,000 feet and stalled the aircraft 36 times. It refused to spin. He attempted to spin coming out of a turn. The Starfighter snap-rolled but it wouldn't spin. He tried zoom entries with the nose as high as 110 degrees; he attempted an acceleration entry. No spin.

In 50 tries, he managed to spin eight times by a combination of a deliberate stall with crossed controls. Holloman recovered from all of them easily, without using the spin chute.

"A pilot has to go through intense buffet, stick shaker, lateral instability, then apply cross control after pitching up to spin the F-104," Holloman said. "It is virtually impossible to achieve that set of circumstances."

Wheeler Moves

Transfer of close to 100 employees, in addition to maintenance and overhaul equipment, from Mont Joli, Que., to Montreal Airport was recently completed by Wheeler airlines. Until the time of the move, the airline had carried out its maintenance at Mont Joli, with light aircraft being serviced at its home base at St. Jovite.

The new hangar, 150 feet wide by 270 feet deep, will serve to house and service the larger members of the Wheeler fleet, including Douglas DC4's, C-46's, and DC3's. In addition to the long range Dew Line resupply in the eastern Arctic and trans-Atlantic operations, the company also flies a regular ski service from Montreal to St. Jovite, and numerous charter operations.

WEATHERHEAD

(Continued from page 99)

refrigerator, an oven, or a hot oil bath. Parts undergoing test are not subjected to all three of these aging processes, but specimens are first aged by one of the above means, and then checked for effects of usage.

The hot oil age tank utilizes any suitable fluid, oil or hydraulic fluid, and has an ambient temperature range to 180°F.

The hot air age oven is 18″ x 34″ x 24″ and has a recording graph incorporated with the temperature range 100°F. to 250°F. electrically recorded. The oven will go to 400°F. non-recording.

The cold air age box has a similar recording device, and a temperature range from 0°F. to —80°F.

Pressure Impulse: After the test specimen hose assemblies have undergone the age treatments, they are tested on the fluid pressure impulse machines, square wave and sine wave. The first of these operates in the pressure range of 75 psi to 3000 psi with peak pressure of 4500 psi, at a cycling rate of 36 per minute. Specimens under test are subjected to 100,000 cyclings of pressure before removal from the test machine.

On the sine wave pressure impulse machine which has a pressure range of 0 to 10,000 psi, the rate of cycling is 575 per minute. Here, as with the square wave test, pressure is monitored on oscilloscope and pressure gauge.

Another testing device which was built by Weatherhead of Canada from an NRC design, is the environmental chamber. This insulated box is 48″ x 36″ x 36″. It has a controlled temperature range between 65°F. to 300°F., and a max of 1000°F. Installed equipment in this chamber permits simultaneous thermo cycle, pressure cycle (static or dynamic), and fatigue cycle (vibration), to be carried out.

Other testing facilities in the weatherhead test lab included a volumetric expansion test machine, with a pressure range of 0 to 2500 psi; a tensile tester capable of 2000 lbs. pull; a hardness tester and metallurgical microscope.

RESEARCH

(Continued from page 87)

and through grants-in-aid from the Defence Research Board. Income is also derived through research contracts from the USAF, the USN, and investigations for such aircraft manufacturers as Avro Aircraft, Orenda Engines, and de Havilland Canada.

The Institute is presently adding to its facilities by constructing a new 16,000 sq. ft. research building near the Connaught Laboratories in north Toronto. Initially, the building will house a new low-density wind tunnel and hypersonic shock tubes.

Anti-ICBM: A project connected with anti-ICBM development, on which the Defence Research Board is currently working, is of prime interest to the aircraft industry.

Working with U.S. and U.K. scientists, the DRB is engaged in a program which involves the study of a scale model ICBM passing through a simulated atmosphere, research in upper atmospheric physics, infrared detection and guidance, and the development of new propellants for large rockets.

To assist in obtaining vital scientific information about the upper atmosphere, the DRB and the USAF are constructing a large radar installation near Prince Albert, Sask. Aimed at studying the aurora borealis and its

likely effect upon ICBM detection, the joint project will begin this summer.

INDUSTRY CROSS SECTION

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specialty firm provides sales, service and installation of airborne electronic equipment. In addition, company handles engineering design and installation of custom executive aircraft communication, navigation and radar systems.

•**Thompson Products Ltd.:** Chief role of Thompson Products' aviation div. lies in forging of aluminum, titanium, and alloy steel blades for gas turbines. Although the bulk of its work is for U.S. manufacturers, Thompson also sells to Rolls-Royce of Canada, Orenda Engines, and Canadian P & W.

•**Radium Dial Corp.:** A Montreal firm, this company employs 20 on the manufacture and refinishing of instrument dials. It is also agent for U.S. Radium Corp. Lackon edge-lit panels.

•**Cannon Electric Canada Ltd.:** Located in Toronto, Cannon of Canada manufactures a variety of electrical connectors for use in several aircraft applications, including powerplant, communications, landing gear, radar, lighting, etc.

•**Timmins Aviation Ltd.:** Located at Montreal Airport, Timmins Business Aviation Centre caters to the executive aircraft trade. With 68,000 sq. ft. of space devoted to aircraft repair, overhaul and conversion to executive standards, Timmins is the largest operation of its type in Canada. Company is also engaged in the sale of parts, materials, aviation fuel and such aircraft as used and new Beechcraft, Grumman Gulfstream and Trecker Royal Gull. Conversion activities centre principally around DC-3, Lodestar and PBY aircraft. Employees number 105.

•**United Aviation Ltd.:** This firm is situated at Edmonton Municipal Airport. United's 21 employees are engaged on major overhaul work on airframes and engines. Company also handles aircraft sales, and provides for maintenance, accessory overhaul, and aircraft storage.

•**Western Airmotive:** Formerly known as Vancouver Aircraft Sales, this Vancouver company deals in aircraft service and repairs mainly (90%) for the civil market. Western Airmotive is also a supplier of spares, and sells new and used aircraft. Other activities include instrument and radio overhaul, repair and sales. Company does limited repairs on rotary wing aircraft. Plant area is 45,000 sq. ft.; employees number 20.

•**Vertol Aircraft Co. (Canada) Ltd.:** This Arnprior, Ont., company was originally known as Piasecki Helicopter Co. of Canada Ltd., and is a subsidiary of Vertol Aircraft Corp., Morton, Penn. Company is active in repair, overhaul and modification of Vertol helicopters for the RCAF and the RCN. It manufactures spare parts, and runs service trials for Vertol helicopters.

•**The Weatherhead Co. of Canada Ltd.:** Although only 15% of Weatherhead's St. Thomas, Ont., factory is devoted to aviation production, firm is well-known in Canada's aviation industry. Chief items are fittings and house connections; the parent U.S. Weatherhead organization pioneered flareless fittings on this continent. The Canadian company boasts a completely equipped environmental test lab in its aviation division.

•**York Gears Ltd.:** One of the largest companies of its type in Canada, Toronto's York Gears employs some 250 men (down 50 since last year) in an 80,000 sq. ft. plant. Working entirely on military contracts, 80% of the company's effort is in design, development and manufacture of gearboxes, universal shafts, gears, and precision components. It is a major supplier to Orenda Engines, Avro Aircraft, Canadair, Canadian P & W, Rolls-Royce of