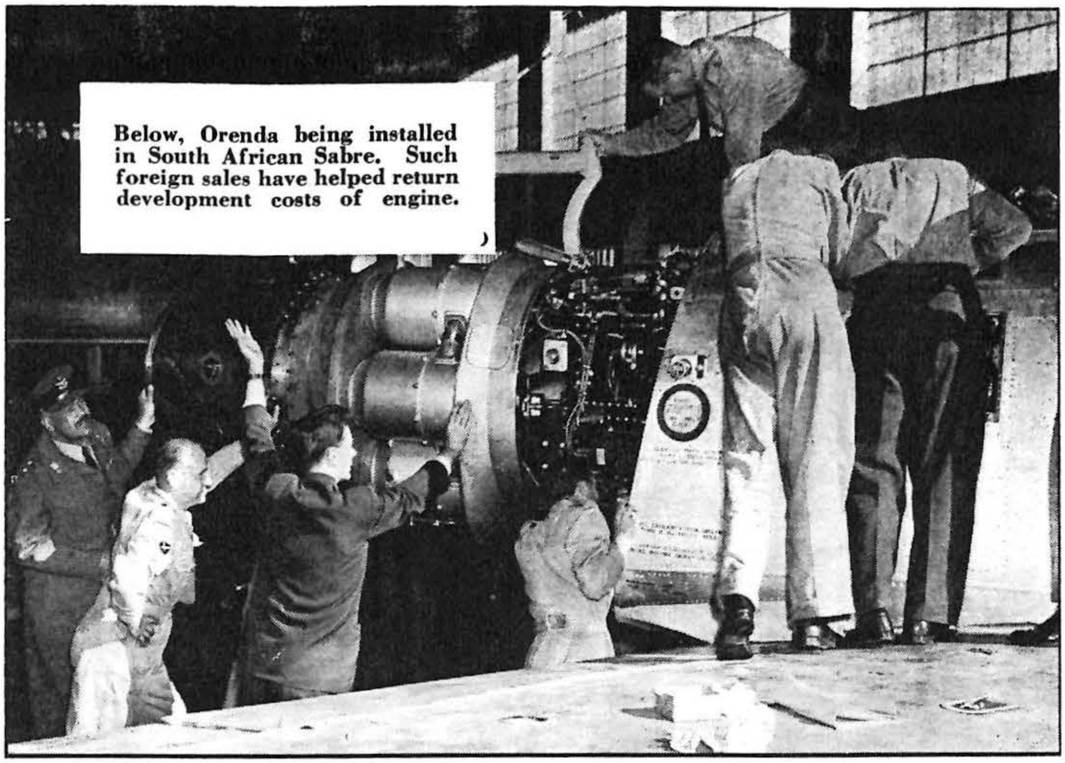

Below, Orenda being installed in South African Sabre. Such foreign sales have helped return development costs of engine.

Dollars from Development

By GROUP CAPTAIN H. R. FOOTTIT

"An important factor . . . has been the stress laid on design and development, which is the heart of a basically sound aircraft industry."
—*Dept. of Labour Pamphlet.*

THE PLANE was down after 16 hours in the air. As it slipped in for a landing the wheels bogged down in the soft earth. Slowly the big biplane went over her nose, her boxkite tail high in the air. In minutes the crew was surrounded by a group of chattering school girls and curious farm workers. This was the unofficial reception committee, the first to witness the end of this record flight. But soon the world would know. Alcock and Brown had made the first non-stop trans-Atlantic crossing by aircraft, from St. Johns, Newfoundland, to Galway, Ireland. The date was June 15, 1919. And their record was to stand for eight years until others would again successfully chance the uncharted airways of the awesome Atlantic.

The aircraft that swept Alcock and Brown into the headlines was a big cumbersome bomber tapped from the vintage of World War I, the Vickers "Vimy". The company that designed and built it, Vickers (Aviation) Limited of England, was a plodding pioneer in the airplane business. They hadn't shown particular promise. Yet they were buttressed by an enviable reputation in the heavy industries, notably in the field of armament. There were Vickers battleships, submarines, torpedo boats, guns of all kinds and calibres, tanks, armoured cars—in fact a complete catalogue for the well equipped service.

Getting a Start: In 1911, after a flyer in airships, the company set up their stocks in the heavier-than-air business. To get under way they bought a license to build the French all steel monoplane, the R.E.P. But they were soon plunging forward at full steam on their own designs. So the 1914-18 War saw the Vickers "Gun-bus", the "Bullet", and several other designs, crisscrossing the front line trenches. But I imagine that it was the old "Vimy", Alcock and Brown's famous flight, and the postwar developments of the Vimy that really set up the Vickers company. Now the name is a household word. Even our children in Canada look up and say "See! A TCA Vickers Viscount!"

There is a lesson in this Vickers venture which we in Canada could well absorb. We've been told too often that the development of aeronautical equipment is "too expensive." We've been fed too long on imported airplanes and build-it-yourself license deals. True, we have developed a few airplanes such as the de Havilland Otter and the Avro CF-100 fighter. But even these have been financed to the tune of fatherly phrases on "industrial maturity" and "solid foundations." Development of all aeronautical equipment certainly gives us all these fine phrases say. But the bed rock truth of the business is the simple fact that design and development is a money making proposition. Let's not forget it. There's dollars from development. So if we want to make money, or save money, we must develop our own aeronautical devices just as Vickers have done.

There's a limit, of course, to what we can do. But this limit is basically an economic one. It hinges on the question, "How many of these products do we want?" If the answer is only "Two", it is obviously not economical to design, develop, and produce this small number. But if the answer is much higher we should automatically

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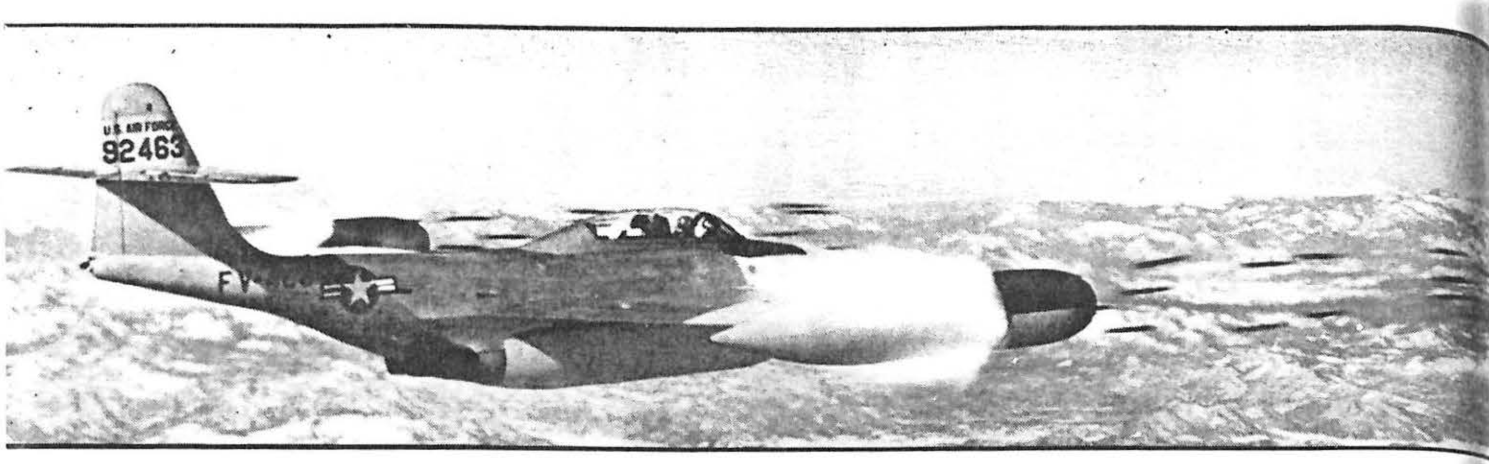


Building home-grown CF-100 has proved more economical than license production of Scorpion (above) would have been.

start deciding on our own development.

Break-Even Point: Take aircraft, for example. We know from our own production records, and those from all over the world, that when the production plans call for the roll-out of some 100 airplanes, the cost of each airplane is getting to a low dollar figure. Moreover, there is only some 10% to 15% drop in price, based on the cost of the first production model from the 100th to the 1,000th. Consequently, any time we're talking about new transports or new fighters, in numbers such as these, we should certainly be talking about developing our own design.

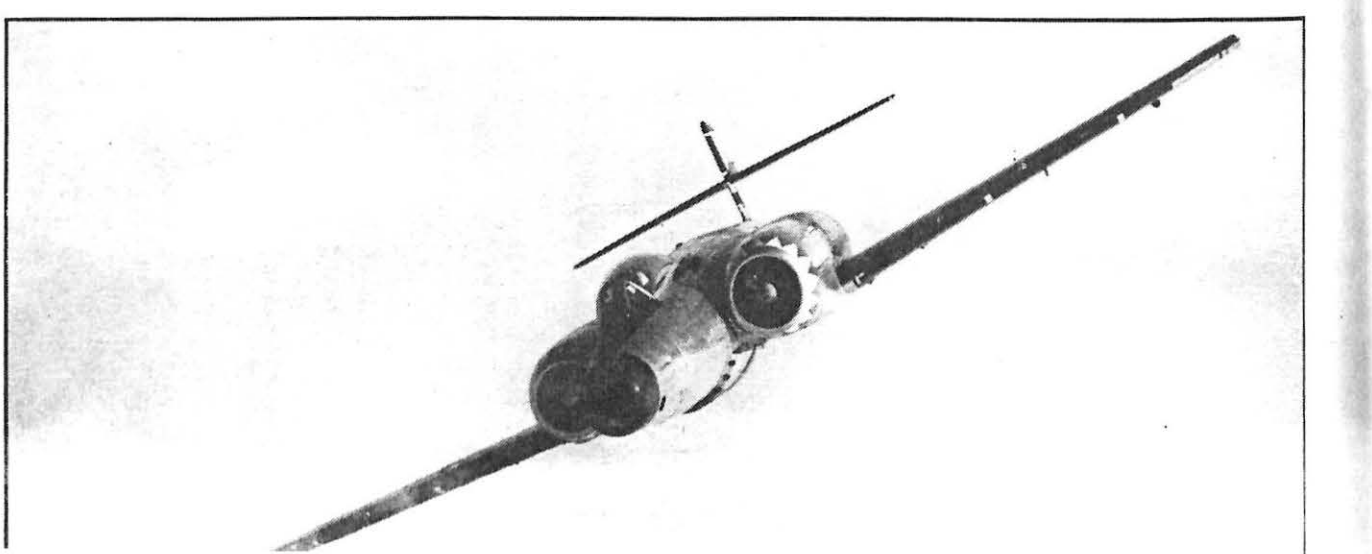
Unfortunately, we Canadians haven't really caught on to this idea of dollars from development. I'd say we're over a century behind our southern neighbors. The U.S. in 1800 had just broken out of the British yoke. There was a great sigh of relief which echoed throughout the Thirteen Colonies. For all during the restrictive days of the War of Independence, the colonists had been primed and cajoled with the democratic ideas of the new nation. They would be free men. They could elect their own government. They could do as they pleased. When George Washington finally led the American Army to victory over George the Third's redcoats, the U.S. peoples had had enough. They merely wanted to exercise this newly won right of doing what they pleased.

With this attitude science, invention, and general progress took a marked slump. Steam engines had been invented in England and were already in use. The Americans wanted none of them. A road was partly built across Rhode Island and money was required to finish it. They voted it down. As one legislative member explained it, roads were built in England, the English were ruled by a king and were nothing but slaves. The Rhode Islanders were free people. They weren't going to do anything the slaves of England were forced to do. Consequently there was no money for the turnpike.

This kind of foolish reasoning went on all through the Atlantic states for a number of years. As Henry Adams wrote in his 1889 edition of the History of the United States, "Until they were satisfied that knowledge was money, they would not insist upon higher education; until they saw with their own eyes stones turned into gold, and vapour into cattle and corn, they would not learn the meaning of science."

Lesson Learned: As we know, the U.S. people did learn the meaning of science. In fact, in the last century they have probably become the most scientific race on the face of the earth. True enough, they have experience and the natural resources to back them up. But we have experience and natural resources, too. And in certain aeronautical areas there's no real reason why Canada shouldn't take the lead. The design and development of Canadian airplanes, for example, is nothing new. How many remember the numerous original designs of Canadian Vickers Limited in the mid-1920's?

In case you've forgotten the history, it was at the end of World War I when the Canadian Government cancelled the contracts that our embroyo aircraft industry had been working on during hostilities. For a number of years the plants were dark. Finally in 1923 the Government ordered a small batch of British airplanes, to be built in the Canadian Vickeres plant in Montreal. This was the start. The following year Vickers added a small design staff to their personnel. And



they were soon sharpening their pencils ready to draw up a new airplane.

The first order the Canadian company received was for the design of a three place, single engine, flying boat. This was required by the Government for transportation, photography, and forest surveys. The Vickers drawing boards were soon litered with blue prints. In two years the prototype was flying. Then between 1926 and 1930, sixty of these successful airplanes were wheeled out of the Vickers plant, six of them with Chilean insignia—their first foreign sale. This was the Vickers Vedette. Unfortunately the Vedette was the only really succesful airplane of the Canadian Vickers line. However, it was followed by original designs whose names are etched in the annals of Canadian aviation: the Varuna, Vancouver, Vanessa, Vista, Velos, and Vigil. All of these were prototype efforts, although eight Varunas and seven Vancouvers were built and used for forest fire control.

Birth of the Industry: This was the humble birth of industrial aircraft development in Canada. Until 1928, Canadian Vickers was the only company even capable of designing and building airplanes. But the beginning ended in a still birth, and the noble experiment was abandoned. It would be a number of years before Canadians would hesitatingly try again on any scale. Its too bad that we didn't keep the original effort going. Didn't we realize that all industrial beginnings are in the nature of an experiment? We should have. R. D. Prescott, writing in the Journal of the American Statistical Association, as early as 1922, had carefully analyzed the growth of industry in any country and confirmed this early, searching stage. In an article entitled "Law of Growth in Forecasting Demand", he highlighted the four stages of industrial development. In order of their appearance these phases are: (a) Period of Experimentation, (b) Period of Growth into the Social Fabric, (c) Period through which growth increases but at a diminishing rate, and (d) Period of Stability.

It is obvious that Canadian Vickers design efforts were in the industrial "Period of Experimentation." But where are we now in this design world? P. J. Stanley in analyzing aircraft production records after World War II, wrote in his U.K. College of Aeronautics report, "In cases of human populations and manufacturing enterprises, both of which are extremely complex entities, the situation at any one time is the result of an enormous number of complex forces and interactions." Some thirty years after the Canadian Vickers heyday, it is impossible to pin down all these "complex forces and interactions" so we know where we stand. However, in the postwar period we have produced a Canadian-designed trainer, several transports, a fighter, and even a helicopter. On the engine side there was the experimental Chinook, the Orenda, and now the Iroquois. It therefore seems almost safe to say that we have now climbed the industrial ladder to the second phase, the Period of Growth into the Social Fabric.

Of all these industrial hurdles, this is probably the highest. For this is the period where public opinion can play a hand: a period when any of the adverse forces and interactions may be kicked off by a newspaper article and so upset the apple barrel; a period when a political decision, based on insufficient information, may well set us back to the beginning of the race; a period when a Parliamentary enquiry and a misunderstood answer may put a stop order on all development; a period when almost anything may light the fires of public opinion and set us back to the Experimentation Phase.

License-Built: To make matters worse the general public has been fed for years on the idea of building foreign designs of almost anything in Canada. In the aircraft industry alone, we must have built dozens of them. Remember the Vickers Viking, the Avro Avian, the Fokker Super Universal, the de Havilland Moth, the Fairchild 71, the the Blackburn Shark, and all the World War II airplanes? With such a heritage there is always a strong tendency to say that its cheaper and better to just buy a license and start out building someone else's design.

In reality, however, it's not as easy as that. In June, 1954, the Right Hon. C. D. Howe, Minister of Defence Production, explained the selection process to Parliament: "Our aircraft program is a good example of how we utilize all available know-how and developments." He then went on to point out that when we need only a few of a type, we survey the existing designs, select the one that best meets our need, and import the necessary number into Canada. "This latter policy has been followed," he said, "in the case of the Banshees, the Neptunes, and the helicopters which we have ordered from the United States."

Mr. Howe then told the members that when the Government needs a considerable number of airplanes of one

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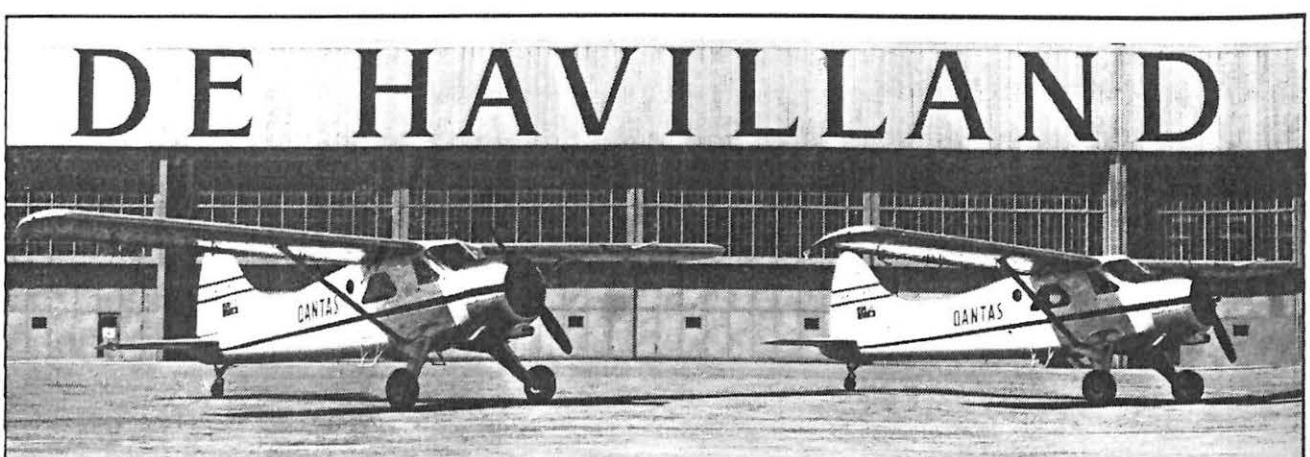


Canadian-developed Beavers are now operating in 50 different countries on seven continents, from pole to pole.

DOLLARS FROM DEVELOPMENT

(Continued from page 60)

type, his Department has two choices: either they can arrange to produce an existing airplane in Canada . . . "on a license agreement from another manufacturer, or design and development by a Canadian company." After discussing some of the U.S. aircraft that have been built in our plants Mr. Howe stated, "It is true that by following this practice we eliminate development costs. On the other hand, we are faced with license fees that are in reality payment in support of the development staff of an aircraft industry in another country."

Here, of course, is the crux of the matter. These license fees and royalty payments can run into millions of dollars. And these all pour into the coffers of the company that designed the airplane. I have no figures available, but I would venture to guess that North American Aviation has already reaped a handsome profit from the production of the F-86 Sabres in Canada and Italy.

Hidden Dividends: When we design and develop our own airplanes, we pay for the development but we save on the license and royalties. And even if we don't sell our own designs outside of our own borders, there are still domestic dividends. I would think, for example, that the CF-100 jet fighter, and its Orenda engine, both designed and built in Canada, cost us less today, with the numbers we have produced, than if we had bought a similar product from the U.S. or U.K. Even if we had decided to build a comparable design, such as the Northrop F-89 Scorpion, I'm sure it would have cost us far more with license and royalty payments than our present CF-100 does.

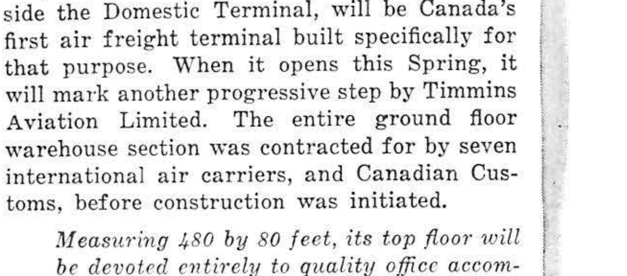
To determine exactly where we stand is a most torturous task. The bare selling price of a Canadian-designed and built airplane is no true indication of its cost to the Government. We must figure on the corporation taxes and the individual income taxes—since these, in effect, are monies returned to the Treasury and are the same as a refund on the aircraft's selling price. We must calculate the impact of the aircraft worker's pay envelope on the Canadian economy. His dollars pay hidden taxes on food and drink. He supports the local car dealer, the butcher and the baker. And each in turn pays taxes which roll back into the Government and so reduce the real cost of the airplane.

We have been far too glib in the past in trying to compare one simple selling price against another. We have tried to assess our developments by such simple comparisons as the cost of a CF-100 against the cost of a U.S. Scorpion, or a U.K. Meteor. This indeed is a false yardstick. Moreover, in some cases our decision for development has hinged on the possibility of foreign sales, completely neglecting the effect on our domestic market and our domestic economy. If we choose the right product to develop, it is almost certain that we can compete in the air marts of the world. South Africa and Germany have bought our Orenda engine in the Canadair-built Sabre aircraft.

TAL it's new in '57

The Timmins Aviation Building at Montreal Airport, presently under construction alongside the Domestic Terminal, will be Canada's first air freight terminal built specifically for that purpose. When it opens this Spring, it will mark another progressive step by Timmins Aviation Limited. The entire ground floor warehouse section was contracted for by seven international air carriers, and Canadian Customs, before construction was initiated.

Measuring 480 by 80 feet, its top floor will be devoted entirely to quality office accommodation, and a number of well designed office suites are still available for rental to companies associated with the aviation industry. For information, inquire:



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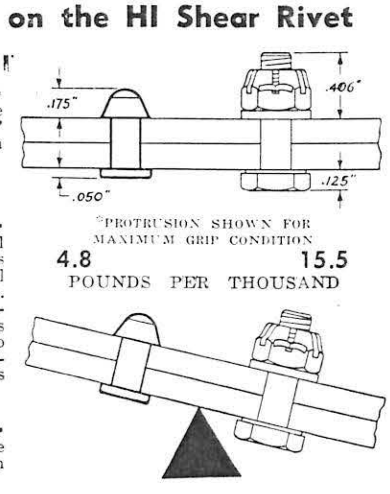
SIMMONDS

One-two-three on the HI Shear Rivet

1 minimum protrusion . . . . Hi-Shear rivets have the smallest "Headed Ends" of any high strength fastener.

2 maximum smoothness . . . . The smooth spherical rivet end eliminates chafing of adjacent fuel cells or other equipment. Hi-Shears eliminate hazards in aircraft areas which are accessible to the flight crew, passengers, maintenance crews and cargo.

3 less weight . . . . Hi-Shear rivets are the lightest high strength fasteners available.



note . . . . Comparisons of size and weight shown above based on Hi-Shear HS48-6-5 pin and HS15-6 collar; AN3-5 bolt, AN310-3 nut and AN960-10 washer.

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And I noticed in last month's *Aircraft* Magazine that de Havilland of Canada are advertising that their Beaver aircraft are "operating in 50 different countries on 7 continents, from Pole to Pole." This is an impressive record. It's impressive, too, to see that at the foot of the advertisement is the note, "Designed and built by The de Havilland Aircraft of Canada Limited."

Other Facets: There are many other facets to this do-it-yourself diamond. I asked L. H. Kottmeier, vice president, Sales, for the Aircraft Division of Canadian Car & Foundry Co. Limited, about them. Les Kottmeier has had a wide and varied career in all aspects of airplane design, production, inspection, and sales, in both the U.S. and Canada. Said he, "First and foremost, any license agreement is usually restrictive in territory, which cuts down your scope of action. Moreover, in the past many such deals have been of the 'one shot' variety. This means that the licensee is in a difficult position to supply continuing spares, since the spares market is based on the number of aircraft produced in the single run. Spares are a continuing and important part of any aircraft company's business, and in well established firms often account for 50% of the gross profit."

On the development side he points out an interesting sidelight: there are always "by-products of designing aircraft, as there are in all development fields. The Hi-shear rivets, the chemmill process, and many other ideas are real money makers for their owners."

If we're going to reap dollars from our own developments, both from the major products and the side lines, we must have a preparedness program that leaves no point in doubt. Even the old Vickers Vedette depended on the University of Toronto's new, 1924 model, wind tunnel to establish its aerodynamic characteristics. So we, in this age of complexity, must have modern wind tunnels, static test rigs, and research facilities. We must also be prepared in the economic field.

Commercial Sales: I was talking to W. Stanley Haggett, Director of the Bristol Aeroplane Company of Canada, recently. He was telling me about some aspects of selling airplanes on the commercial market. One airplane may be technically better than another. But it the manufacturer making the better airplane doesn't have an easy payment plan to finance the sale, he may lose out to the firm that has the poorer plane, but the better payment plan.

All in all, then, we need to be prepared technically and economically, if we are going to get dollars from our own developments. I firmly believe that we are. However, there are many that are not so sure. As R. H. Guthrie, Engineering Manager for Canadian Pratt & Whitney, once told H. C. Luttman, Secretary of the Canadian Aeronautical Institute, as the latter reported it in an issue of the *C.A.I. Log*, "The trouble in Canada is that we don't know what we know.

"Dick Guthrie is right. But it's time we found out. For there are dollars in development. As an editorial in the *Montreal Gazette* put it, "All these sales mean that Canadian design and workmanship are becoming recognized throughout the world as first rate. There is no reason why Canada should not develop aircraft production as a major national industry; the Swiss, after all, did not invent the watch."

COMING EVENTS

April 8-12—Welding Show & Annual Meeting American Welding Soc., Convention Hall & Hotel Sheraton, Philadelphia, Pa.

April 22-24—Vickers Inc. Annual Jet Engine Hydraulic Symposium, Hotel Statler, Detroit.

April 25-26 — AITA Semi-annual Meeting, Empress Hotel, Victoria, B.C.

May 6-10—Industrial Tool & Production Show, Exhibition Park, Toronto.

May 22-24—Annual Convention, American Society for Quality Control, Masonic Temple, Detroit.

June 8 — Air Force Day across Canada.

June 24-25—29th Meeting, Aviation Distributors & Manufacturers Assoc., Grove Park Inn, Colorado Springs, Colo.

September 9-13—IATA Annual General Meeting, Madrid, Spain.

Sept. 30-Oct. 4—Canadian National Materials Handling Show, Show Mart, Montreal.

October 2-4—Annual Meeting and Forum, National Business Aircraft Assoc., Cosmopolitan Hotel, Denver, Colorado.

NATIONAL RESEARCH COUNCIL

(Continued from page 37)

Simulated Ice: In the Division's Low Temperature Laboratory is an icing tunnel in which models or full-scale components (e.g., jet engine air intake) may be subjected to conditions existing in flight through icing clouds. This tunnel is a closed circuit facility with a 4½ ft. square working section and a maximum airspeed of 200 mph. Refrigeration equipment can lower the temperature in the tunnel to 40°F. at maximum speed. Water injected through an array of nozzles and atomized to controlled droplet diameters duplicates the conditions of icing cloud.

In this same laboratory is a smaller icing tunnel, having a working section of only 8 in. by 10 in., but capable of speeds up to 500 mph. This is mainly used for work on instruments and other small equipment.

There are as well, three cold chambers where equipment under test can be subjected to temperatures ranging from as low as — 85° F. to +167°F., at winds up to 40 mph. The largest chamber, which is big enough to be used for cold soaking of large equipment such as fire trucks, tanks, etc., is 50 ft. long, 15 ft. wide and 15 ft. high. The two small chambers are 10 ft. square by 8 ft. high.

The helicopter spray rig located at Uplands, though regarded as part of the Low Temperature Laboratory, is operated by the NAE Flight Research Section. It is used for testing helicopters in free flight in simulated icing conditions. The spray rig is 70 ft. high and produces a large icing cloud 15 ft. by 30 ft. by atomizing water with steam in spray nozzles. It is useable during the winter months only, being located outdoors.

Structures: The Division of Mechanical Engineering's Structures Laboratory has well equipped facilities for work in the areas of statics, dynamics, aeroelasticity, and aircraft hydraulics.

Statics includes research on aircraft structures, civil and marine structures and a wide variety of structural components, as well as work on structural and plastic materials. The most imposing single piece of equipment used in connection with this phase of the laboratory's work is a testing machine which can apply tension, compression, or bending loads of up to 600,000 lbs.

Dynamics work includes investigations on aircraft landing gear, the determination of dynamic loads on military equipment, a variety of structural vibration problems and fatigue investigations and research. Fixed fatigue testing equipment provides facilities for flexure, direct stress and torsion fatigue tests. The load capacity of this equipment is slated to be increased to 130,000 lbs. Ancillary equipment includes a range of accelerometers up to 200 G's.

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