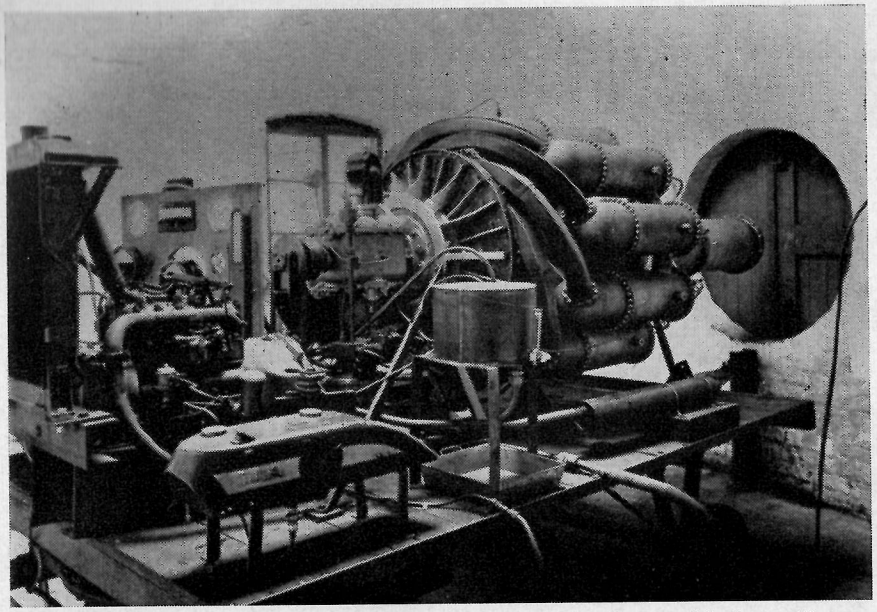


THIRD JET ON TEST. Considerably refined from the first model, but still very crude by present standards, Frank Whittle's third jet engine ran successfully in this test rig—aided apparently by the saddle tank from a BSA motorcycle (in foreground).

From Boxkite to Jet

Birth of the Jet Engine

By A/V/M E. W. Stedman

One of the problems in the expanding use of fixed wing aircraft in Canada was the provision of adequate ground facilities, with suitable landing areas in the remote areas in which we were often called upon to operate. In some cases we were able to overcome this by extensive use of amphibious aircraft. A vertical take-off machine, however, seemed the solution.

I have mentioned seeing the De-Bothezat helicopter at McCook Field in 1923, when we were disappointed in its poor performance. After this I had no information on helicopter development until the war, when in April, 1942, on a visit to Wright Field, I saw a Sikorsky XR-4 helicopter fitted with a 175 hp Warner 'Scarab' engine.

Helicopters Turned Down

At that time I recommended that the RCAF should purchase helicopters for rescue purposes in the north country, a use for which they had not previously been considered. The type recommended, as the result of consultation with the officers at Wright Field, was the Sikorsky XR-6, which had a Pratt and Whitney 450 hp engine. A requisition for six helicopters was put forward, but it was refused by the Treasury Board because the price quoted contained a large charge for development costs.

In October 1943 John Parkin and I visited Wright Field again and saw the Sikorsky YR-4a helicopter with a 180 hp 'Scarab' engine. It had a 38-foot rotor instead of 36-foot blades previously used. Colonel Cooper took me for a demonstration flight in this helicopter, and shortly afterwards I had an opportunity to visit the Sikorsky factory where I saw details of construction and discussed the subject with Igor Sikorsky, whom I had known for some years due to our common interest in flying boats.

In the winter of 1942-43 Lloyd Breadner and I visited the Bell Aircraft Company at Buffalo where Larry Bell showed us a flying model of a helicopter in which he was interested. This was a small model about 15 inches in diameter, driven by an electric motor and operated by remote control. It served to illustrate the principles of the gyroscopic stabilizer bar which was the important new feature being introduced. This later developed into the now familiar Bell helicopter.

It was some years before any helicopters were acquired for use in Canada, due no doubt to the continued high development costs. The first helicopters were received by the RCAF in 1947.

Later development of the helicopter confirmed my early conviction that it would be invaluable for rescue and similar work in inaccessible areas in the north.

First Efforts at JATO

From 1942 until the end of the war John Parkin and I saw the work being done in California on jet-assisted take-off. We discussed this with Dr. F. J. Malina of the California Institute of Technology and subsequently saw demonstrations of this type of equipment.

At one time quite early in the war we considered the possibility of launching fighters in winter by attaching releasable skis provided with rockets to the wheels. The rockets would propel the skis and aeroplane until take-off speed was reached, then the aeroplane would lift off the chocks on the skis. The idea was never developed.

Problems on Propellers

By 1945 propellers were becoming very large and heavy. The Curtiss-Wright Propeller Co. developed a method of manufacture from steel sheet. The first process was to take a sheet of steel approximately the shape of one face of the blade and about half an inch thick. This was then placed in a press to put a bulge in it and the blade was milled, leaving a plate of tapered thickness.

To relieve the shortage of propellers during the Second War, local manufacture was undertaken. Mr. James Young, chairman of the board of Canadian Pratt & Whitney Aircraft Co. Ltd., wrote:

"In World War II when the Canadian Government decided to manufacture propellers in Canada, we obtained for the government the license for the whole range of Hamilton Standard Propellers for nothing—all the Government paid was the actual cost of getting out the technical information. That was part of United Aircraft Corporation's and Canadian Pratt & Whitney Aircraft Co., Limited's con-

This is the last in a series of articles from the memoirs of the late Air Vice-Marshal Ernest W. Stedman, CB, OBE, M.I.C.E., F.R.Ae.S., F.I.A.S., Hon. F.C.A.I. Born in England, AVM Stedman came to live in Canada in 1920, served as Director of the Technical Branch of the Air Board and entered the RCAF on its organization. He retired from the RCAF in 1946, his last post being Air Member for Research and Development. For two years he was Air Adviser to the Chairman of the Defence Research Board, and for seven years Assistant Professor of Engineering at Carleton College, Ottawa. He died in 1957.

tribution to Canada's war effort. We started Canadian Propellers and finished it as a non-profit organization; we delivered over 13,500 propellers without profit."

The Hoover constant speed propeller was type-tested and approved for use in Canada and then manufactured by the Canadian Car and Foundry Co. in Montreal. This propeller later used wooden blades made by the Singer Mfg. Co.

Birth of the Turbine

My first recollection of the efforts made to apply the gas turbine to the propulsion of the aeroplane was when I was in college in 1910. We were told about the work being done by Holzwarth in Germany on the design of a 1,000 hp gas turbine. In fact, the engine developed only about 200 hp.

The use of the turbine as a prime mover developed slowly, but there was a commercial turbine, made by the Brown Boveri and Company, for use with the Houdry Oil-Refining process that came into use about 1936.

Frank Whittle (Air Commodore Sir Frank Whittle, KBE CB FRS) had been working on the idea of using a gas turbine to provide jet propulsion for an aeroplane for many years. In 1936 Power Jets Ltd. was formed by Whittle and some friends to develop the patents he held on jet propulsion. There were reports of Italian made jet propelled aeroplanes in Italy in August, 1940, and in November, 1941.

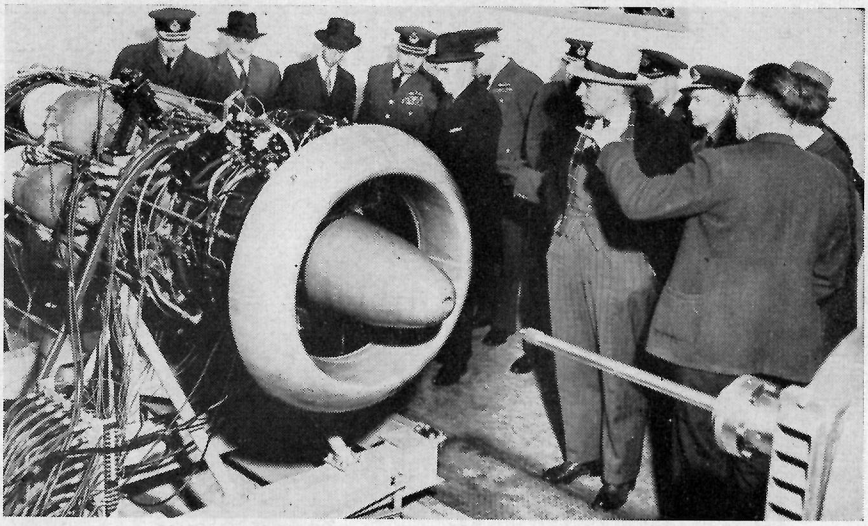
The first aeroplane designed for jet propulsion in England was the Gloster E 28/39. This machine was completed in April 1941 and flew in May, 1941, with very satisfactory results.

The Gloster jet demonstrated a much better performance than that of the 'Spitfire', and convinced me that here was something of the greatest interest to Canada. This aeroplane is now in the Science Museum in London, England.

The application of the turbine engine to aircraft propulsion was a long, wearisome struggle. The pre-war work of Frank Whittle and his associates attracted little attention until the struggle for air superiority provided the spur.

The first British fighter with jet propulsion was the Gloster F9/40 Meteor, powered by two Whittle engines. First proposed in April 1940, it was subsequently used for the destruction of V1 flying bombs.

The U. S. government was interested in the Whittle engine and decided to build a Whittle type engine at the General Electric Company works at Lynn, Mass. The USAAF arranged for the Bell Aircraft Corporation to design a fighter aircraft using two of the engines to be produced by G. E.



CANADIAN JET. First run of the Chinook engine at A. V. Roe Canada's Malton facility was an important milestone in Canadian aviation history. The engine is inspected here by RCAF officers and government and company officials.

A Whittle WIX engine had been flown to the United States at the end of Sept. 1941, to be used as a sample from which the G. E. design could be made. This historic engine was returned to England, but in 1949 it was presented to the Smithsonian Institute.

I reported to the Air Council, early in Oct., 1942, advocating that Canada enter the jet propulsion field. The Air Council passed this recommendation on to the Department of Munitions and Supply.

Acting on our recommendation, R. P. Bell, director general of aircraft production, suggested sending a team to England to investigate the question of the design and manufacture of jet engines in Canada.

Crown company formed

At a meeting held in Canada in May, 1944, the proposal was made that a Crown company be set up. This proposal was approved by the Minister of Munitions and Supply and in July, 1944, Turbo Research Ltd. was incorporated.

By March, 1945, the engineering staff of Turbo Research Ltd. had drawn up the preliminary details of two possible engines — one having a centrifugal compressor and the other having an axial flow compressor. The technical advisory committee met to consider these two proposals, presented by Ken Tupper.

The centrifugal compressor would undoubtedly have been easier to produce, but much work had been done on this type of engine in England by Power Jets Ltd., Rolls Royce Ltd., and de Havilland, putting us behind in experience. Another consideration was that the centrifugal compressor seemed to have limited possibilities for obtaining the required higher compression ratios for future development.

The axial flow type engine involved many unknowns. All engines produced to that time seemed to be capable of considerable improvement. It was felt that the number of stages for a given compression ratio could be reduced, i.e. it should be possible to obtain a greater compression ratio per stage. Also there were fewer limitations on the possible over-all compression ratio.

Axial flow decision

We, therefore, recommended that our first engine should have an axial flow compressor. This recommendation, which has since proved of the greatest importance, was accepted and the company was authorized to proceed with the design and construction of this engine.

At this time I retired from the RCAF and I was no longer associated with this work. Although I was re-elected to the Board of Directors of Turbo Research Ltd., this company, shortly afterward, ceased to exist and the gas turbine work was transferred to A. V. Roe Canada Ltd. Later I was invited to witness the initial runs of the first "Chinook" engine.

Service requirements, as recognized by A/V/M James, now called for an engine of much greater thrust and the "Chinook" engine did not go into production; work began on the more powerful Orenda engine. This success of this project demonstrated Canada's ability to pace leading Western nations in aviation development.