

Paul B. Dilworth

Pioneering Canadian Aero Jet Engine Technology

In addition to playing a major role in bringing jet aircraft engine technology to Canada in the '40s by his work with the National Research Council (NRC) and at the Turbo Research crown corporation, Paul Dilworth went on to become manager and chief engineer of the Gas Turbine Division of A.V. Roe Canada at Malton, Ontario. He later founded the engineering consulting firm of Dilworth, Secord, Meagher and Associates (DSMA) in Islington, Ontario. DSMA became a major design and development company for aviation wind tunnels and automotive environmental test facilities for international clientele. It was also instrumental in bringing to Canada the NASA Space Shuttle manipulating arm project and played an important role in its development as the famous Spar Aerospace "Canadarm" used with outstanding success on all Shuttle flights.



A pioneer in jet engine technology, Paul B. Dilworth was the first manager and chief engineer of Avro Gas Turbine Division and founder of DSMA Ltd. [Photo, courtesy Sylvia H. Brown]

Upon graduating in mechanical engineering at the University of Toronto in 1939, Toronto-born Dilworth joined the engine laboratory of the National Research Council in Ottawa. In 1942, his boss, M.S. (Mac) Kuhring and Dr. J.J. Green, head of the NRC aerodynamics laboratories, were assigned to carry out an extensive survey of aeronautical research activities in the United Kingdom. Included in their report was reference to a new gas turbine (jet) engine being developed for jet propulsion of aircraft by Wing Commander Frank Whittle at Power Jets Ltd. in the United Kingdom.

At the same time, the RCAF was seeking ways to relieve Canada of dependence on the U.K. and U.S.A. for supply of engines for military aircraft produced in Canada. This new development in aero-engine technology appeared to open up possibilities for Canada to become involved in the design and building of new power plants, and thereby end dependence on foreign sources of supply.

As a result of the Kuhring-Green report and ensuing meetings and exchanges between senior RCAF and Canadian government officials and those of the British Ministry of Aircraft Production, it was decided to send a team to the U.K. to make an exhaustive survey of British jet engine development. The team was instructed to report on how Canada might best assist in Britain's wartime jet engine development and on what would be entailed in Canadian development and manufacture of that type of engine. Their mission was classified "Top Secret."

The team appointed for this task was led by Charles A. Banks, then senior representative of the Canadian Department of Munitions and Supply in England. (Banks, a native of New Zealand, was subsequently appointed Lieutenant Governor of British Columbia, 1946-50). The other members of the team were Ken Tupper, head of the NRC Hydraulics Laboratories, and Paul Dilworth. Under Banks' aegis, they carried out an extensive survey of all jet engine research, development, and manufacturing being carried out in the U.K., including work by suppliers and government research laboratories. Their survey lasted almost five months.

The final report by C.A. Banks, K.F. Tupper, and P.B. Dilworth was issued in May 1943, entitled *Report on Development of Jet Propulsion in the United Kingdom* (but was better known simply as "The Banks Report"). Aided by Banks' persistent representations, the Banks Report laid the foundation for Canada's entry and rapid rise to become one of the world leaders in the development of gas turbine technology.

Among the recommendations in the report was establishment of a cold weather test station in Canada (where cold winter temperatures can be guaranteed). Its purpose was to verify performance and compressibility limitations of jet engines at the low temperatures encountered in high-altitude flight. A high-priority meeting at the National Research Council headquarters was held in June 1943 to discuss the Banks Report. Among others in attendance were Ralph Bell, the Director General of the Aircraft Branch of the Department of Munitions and Supply, his assistant Fred Smye (later to play a major role in the whole A.V. Roe-Orenda-Avro saga), and senior representatives from the RCAF and NRC. Tupper and Dilworth were assigned to set up the cold weather test station (CWTS). Stevenson Field in Winnipeg was chosen as the site.



F.H. (Harry) Keast was a brilliant young engineering disciple of Frank Whittle. Upon immigrating to Canada, he performed the superb aerodynamic design of the Chinook and Orenda compressors. Later, he played a lead role in the design and development of the famous Iroquois engine for the Avro Arrow. [Photo, courtesy David Keast]

In just over four months, the CWTS was built and equipped. Staff were trained in England and returned to Winnipeg. The first engine test was performed on January 4, 1944. The engine, a Whittle type Rolls Royce W2B, had been flown to Edmonton by USAAF military transport via Senegal and Brazil. The engine ran without a hitch. That was the first time the roar and whine of a jet engine was heard in Canada.

In March 1944, following Banks's urgent representations, Turbo Research Ltd., a crown corporation, was formed at a facility in Toronto to undertake research, design, and development of gas turbine engines. Tupper was appointed chief engineer and Dilworth stayed on in charge of the CWTS in Winnipeg. Winnett Boyd and Douglas Knowles, along with their advanced design work on a major plant for testing gas turbine compressor units, were transferred to Toronto from Ottawa with a number of other engineers and technicians, some from the CWTS and some directly back from training in England. Apart from their short period of training in the U.K. and at the CWTS, none of this Turbo team had any prior experience in design or development of engines, let alone aero jet engines.



A mining engineer with an international reputation, Charles A. Banks persuaded the Government of Canada, in 1944, to undertake research into jet engine technology. He was Lieutenant Governor of British Columbia, 1946-1950. [Photo, courtesy British Columbia Archives and Records Services/C-08131]

Several design studies were carried out by Turbo Research on a straight-through centrifugal engine similar to the Rolls Royce/Whittle designs and also on axial flow units. These projects, the brain children of Winnett Boyd, were designated TRI for the centrifugal and TR2, TR3, and TR4, for the axial flow engines. (As the Chinook, TR4 was later finalized and built as a development and learning project.) The Chinook and its successor, the TR5 Orenda, included a number of innovative design features that formed a solid foundation for later success.

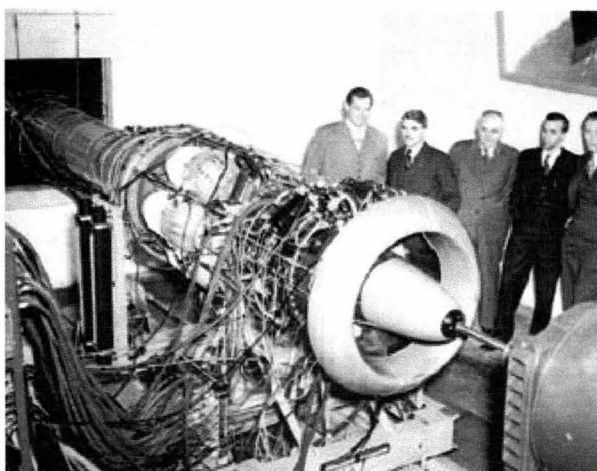
In the spring of 1946, the Canadian government decided to transfer all work on gas turbines to private industry. A.V. Roe Canada Ltd. had been established in late 1945 to set up a unique aircraft design and manufacturing facility in the former Victory Aircraft plant at Malton, near Toronto, and its chairman, Sir Roy Dobson, and Fred Smye, Avro's first employee and the motivator behind all activities at Malton, arranged for Avro to take over and transfer the entire Turbo operation to Malton. This included a major test facility which was acquired later at Nobel, Ontario. The CWTS facility was, however, turned back to the NRC. Ken Tupper also returned to the NRC and Paul Dilworth was appointed manager and chief engineer of the newly formed Gas Turbine Division of A.V. Roe Canada Ltd. (Avro).



Orenda/Lancaster Flying Test Bed and Supporting Staff, 1950. L/R, Douglas Knowles, Dave Parker; Paul Dilworth and Winnett Boyd. [Photo, courtesy, Sylvia H. Brown]

Dilworth was supported by a remarkable team of innovative young engineers, including his old classmate Winnett Boyd as chief designer, Douglas Knowles as head of development and test, and Harry Keast, a brilliant young aerodynamicist and former disciple of Whittle at Power Jets in the U.K. They had their first engine (the axial flow Chinook rated at 2600lb thrust) running on the test bed by March 1948. It had been

approved as a project to confirm the soundness of the basic design approach and as a tooth-cutting exercise for the manufacturing and test organizations. Its success in both objectives also played a vital part in building the confidence of senior management and government. In the summer of 1946 Avro received a contract to develop an engine of 6500lb thrust to power the *Avro CF 100* twin-engine jet fighter. This was certainly a daunting task for a neophyte organization, but the result, the Orenda engine, originally designated TR5, which ran a record total of nearly 1000 hours during its initial test program in February 1949 through to the late fall, became one of the three most powerful jet engines of its era. It was used in the *CF 100* and the *Canadair CF 86 Sabre* jet fighters, taking the latter to world speed records. Almost 4000 Orendas were produced at Malton between 1949 and 1956 and saw service in the air forces of Canada, the Netherlands, Belgium, and South Africa.



L/R: Winnett Boyd, Frank Whittle (famous British scientist responsible for the world's first successful jet engine for aircraft), Walter Deisher, Paul Dilworth, and Fred T. Smye, the true founder and father of A.V. Roe Canada, examine the Chinook engine on test, 1948. The design of both the Chinook and its famous successor, the Orenda engine, was the product of chief designer Winnett Boyd's creative genius. [Photo, courtesy A.V. Roe via Ian Farrar/Orenda Aerospace Corp.]

In a reorganization at Avro in 1955, A.V. Roe Canada Ltd. became the parent company of two autonomous companies: Avro Aircraft Ltd. and Orenda Engines Ltd. Orenda's team later went on to develop the famous Iroquois engine for the Avro supersonic Arrow. Both projects were considered to be beyond the state of the art at the time, but both perished as a result of the still controversial cancellation of the complete program by the Diefenbaker government in February 1959. Regrettably, Avro did not survive, but Team Orenda went on to provide other contributions to Canadian aerospace technology. Ownership of the Orenda company changed hands several times and it continues in operation today as Orenda Aerospace, a wholly owned division of the Canadian Fleet Aerospace Corporation. The company recently celebrated its fiftieth anniversary.

Paul Dilworth left A.V. Roe in 1952 when he established DSMA. He will however best be remembered for his influence and inspirational leadership in the pioneering days of jet engine development that were instrumental in establishing Canada as one of the leading nations in aero-engine technology. Under Dilworth's guidance, the famous Orenda engine became one of the most successful engineering projects ever undertaken in Canada. Upon that foundation, the Orenda company was built. Almost 50 years after the original Orenda jet engine design was developed at Malton, the industrial version of the Orenda is still in use today.

Jim Floyd

[Back](#)