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The AVRO Canadians

8.1 HISTORY

The AVRO story is best described in the book *Arrows to the Moon* written by Chris Gainor and published in 2001. I shall provide some excerpts along with other information, my interpretation of the events, and where the people worked in the NASA Space Task Group (STG). It is a sad story in a way, illustrating how politics can absolutely destroy an industrial program, impact the lives of thousands of people, and devastate a community and local businesses. Gainor tells that story well. As regards the STG and Project Mercury, the U.S. benefitted greatly from Canada's loss. That can also be said of Gemini, Apollo, Skylab, and the Space Station, since the AVRO Canadians and Brits played a major in those programs as well.

The reader will appreciate the heritage of the company that fostered the great engineers who eventually came to NASA. The A. V. Roe Company was established in 1910 by brothers Alliot Verdon Roe and Humphrey Verdon Roe. Alliot was the aircraft builder and Humphrey was the finance and organizational guy. They built mostly training aircraft for WW-I, although a few saw combat. Financial problems after the war resulted in Crossley Motors buying the majority of the stock. In 1928, Crossley Motors sold the company to Armstrong Siddeley Holdings, Ltd. Alliot Roe resigned and started Saunders-Roe, which then became a subsidiary of Hawker Siddeley in 1935.

During WW-II, AVRO built the famous Manchester, Lancaster, and Lincoln bombers. Some of the more famous Lancasters were built in what was, at the time, the world's largest building, consisting of 1.5 million square feet. Despite its size, the building was disguised to hide it from German planes. The Lancaster is also notable for carrying the largest bomb load of any aircraft during the war, most notably the 22,000 lb. Grand Slam.

After the war, AVRO built the beautiful Vulcan bomber as a nuclear-strike aircraft armed with the Blue Steel missile. It was featured in the 1965 James Bond movie *Thunderball*. Only one restored Vulcan remains. It performed at air shows through to retirement in 2015. AVRO also built a turboprop airliner and four-engine jetliners.

M. von Ehrenfried, *The Birth of NASA*, Springer Praxis Books,
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The Hawker Siddeley Group purchased the former Victory Aircraft firm in Malton, Ontario, Canada and renamed it A. V. Roe Canada Ltd. It employed AVRO as its trading name. During the Cold War period, the Royal Canadian Air Force (RCAF) was worried about Soviet bombers attacking from the north. This led to the design and construction of the CF-100 jet interceptor. AVRO also designed and manufactured the four-engine C-102 Jetliner. As an aside, one of my early supervisors at the STG was C. Frederick Matthews, who worked on this aircraft and later flew in it with Howard Hughes at the controls. See Matthews's biography in Appendix 2.

In 1953 the RCAF issued specifications for the design of a supersonic all-weather fighter to supersede the CF-100. This was designated the CF-105 AVRO Arrow. Several of these design and test engineers later became STG engineers, and even later became quite famous as NASA engineers and managers. Scale models of the CF-105 were launched on top of rockets from the NACA Wallops Island Station by engineers who would later join the STG. AVRO made use of wind tunnels at NACA Langley and Lewis, as well as one in Canada and another at the Cornell Aeronautical Laboratories for aerodynamic research.

In 1957 AVRO gained an IBM 704 computer similar to the one at Langley. See Appendix 3. This was used extensively for stress analysis, aerodynamic stability, as well as for a new CF-105 simulator. Inevitably the cost of the Arrow program started to escalate. There was a new engine, a new missile, a new fire control system, a flight simulator, and associated ground tracking and analysis systems. It was a complex aircraft for its time.

Many in the Liberal Canadian government grew concerned about the increasing costs of the program and it was decided to defer making any program decisions until after the next election, due in 1958. Just a few months prior to the election, the first flight of the CF-105 took place on March 25, posing only minor problems. The aircraft sent telemetry to a control room called the "High Speed Flight Center" where an ex-RAF wing commander talked by radio to the famous test pilot Jan Zurakowski. Later, flight test engineer C. Frederick Matthews likened this to the role of a capsule communicator (CAPCOM) during Project Mercury.

The increasing threat of the Soviet ICBMs made the government question the interceptor; it would be ineffective against such missiles. Mr. Khrushchev claimed the introduction of ICBMs rendered bombers obsolete. Even the Canadian Defense Minister recommended cancelling the Arrow. Cabinet-level meetings of the new Tory government over a period of months achieved a consensus. On February 20, 1959, Prime Minister John G. Diefenbaker informed the House of Commons of the decision to cancel the Arrow development. That day is still considered "Black Friday" in Canadian aviation circles. Approximately 14,000 staff were immediately laid off. It was a tremendous blow not only to the employees but also to the surrounding communities and businesses. The controversy can be seen in a 56 minute YouTube video entitled *CF-105 Arrow Definitive Documentary*.

8.2 THE STG CAPTURES THE TALENT

The cancellation of the Arrow couldn't have been better timed for a new NASA organization in need of aeronautical engineers, flight test engineers, computer engineers, and program managers. At this time there were only about 150 people in the STG. Hundreds more would be needed for Project Mercury.

Consider the sequence:

- March 25, 1958 – First test flight of the CF-105 Arrow.
- March 31, 1958 – John D. Diefenbaker's Tories win the election.
- October 1, 1958 – NASA came into being.
- November 3, 1958 – The STG was formally created.
- December 1958 – The NASA space program was named Project Mercury.
- January 1959 – McDonnell Aircraft was selected to build the spacecraft.
- February 1959 – some 14,000 AVRO engineers were laid off.

AVRO engineers already had a close relationship with NACA Langley, through using their wind tunnels for aerodynamic research. In fact, David D. Ewart was doing wind tunnel tests of an Arrow model at Langley. And Robert Gilruth and Charles Donlan of NASA had a working relationship with Chief Engineer Bob Lindley and Jim Chamberlin, Chief of Technical Design for the Arrow.

At first, Lindley and Chamberlin tried to sell Abe Silverstein of NASA Headquarters on the idea of the Canadian government providing NASA with AVRO engineers. Having Canada share the prestige of developing space travel had a certain appeal to some people. The proposal went around the Canadian Department of Defense and the Canadian Ambassador, earning supporters. But Prime Minister John Deifenbaker rejected it through skepticism over the concept of space travel! Thus the man who killed the CF-105 Arrow, an aircraft more advanced than anything in the U.S., also killed Canada's participation in Project Mercury. In retrospect, he was not a very far sighted individual.

NASA was still interested in acquiring top notch engineers with applicable engineering, flight test, and computer experience. I don't use the term "top notch" lightly. Here are a few examples of their backgrounds up to 1959:

- Peter J. Armitage was a British-born AVRO engineers. He had a master's in aeronautical engineering, had flown with the Royal Air Force, and was trained as a co-pilot and flight engineer. He was a senior flight test engineer on the CF-105 Arrow.
- James A. Chamberlin had mechanical engineering degrees from the University of Toronto and Imperial College of Science and Technology in London. He was chief aerodynamicist on the CF-100 interceptor and the C-102 Jetliner. He was chief of technical design on the CF-105 Arrow.
- C. Frederick Matthews had an aeronautical engineering degree and was also a RCAF pilot during the war. He was a flight test engineer on the C-102 Jetliner and also on the CF-100 twin-engine jet fighter. He also played a role in the redesign of the CF-100 canopy.
- John D. Hodge, a British AVRO engineer, had a degree in engineering from the University of London. He worked on the air loads of the CF-105 and on the flight test program.
- R. Bryan Erb possessed a degree in civil engineering and a master's in fluid mechanics. He conducted aerothermodynamics analysis on the Arrow.

The review team from Langley included Robert Gilruth, Charles Donlan, Charles Mathews, Charles Zimmerman, Paul Purser, and Kemble Johnson. On March 14, 1959 they interviewed about 100 out of 400 who submitted applications. The NASA men soon realized that the AVRO engineers could bring tremendous talent to Project Mercury.

Bob Lindsey and Jim Chamberlin went back to AVRO and explained to their engineers what Mercury was about and the kind of work they might become involved in. NASA was primarily interested in those with flight test and computer experience. Those interested prepared résumés for NASA's consideration.

NASA Administrator T. Keith Glennan approved the hiring of 32 individuals from AVRO, but seven of them declined. Later, more were added. As foreign nationals, they required to be formally processed into the United States, subjected to background investigations and granted necessary security clearances. This process was assigned top priority and cleared in two weeks. The usual time would have been about six months.

8.3 THE AVRO CONTRIBUTION TO THE STG

Initially 25 AVRO people accepted the offers by NASA and the STG, and more came over time. Later, some returned to Canada or England, or moved elsewhere in the U.S. The following is an alphabetical list with just a few remarks about their contributions to the STG. More is available in their biographies in Appendix 2 of this book and, in some cases, also in the NASA JSC Oral Histories. The list doesn't do justice to their unique contributions to spaceflight. Many went on to support Gemini, Apollo, Shuttle, Skylab, Space Shuttle, and the International Space Station, either with NASA or the Canadian Space Agency. Chris Gainers' book gives details through to 2001.

- Bruce Alexander Aikenhead – Worked in the astronaut training group. Returned to Canada in 1962.
- Peter J. Armitage – Worked in the Recovery Operations Branch. See Appendix 2.
- David Brown – Worked in the Structures Branch. Left in 1970.
- Richard R. Carley – Worked in the Flight Dynamics Branch.
- Frank J. Chalmers – Worked in the Flight Control Branch on MCC development, but left after only a few months.
- James A. Chamberlin – Became Chief of the Engineering and Contract Administration Division.
- Thomas V. Chambers – Worked in the Flight Systems Division Dynamics Branch.
- Jack Cohen – Worked in the Mission Analysis Branch developing simulations.
- Stanley H. Cohn – Worked in the Mission Analysis Branch Mathematical Analysis Section. Returned to Canada in 1962.
- Burton G. Cour-Palais – Worked in the Structures Branch.
- Eugene L. Duret – Worked in the Flight System Division Heat Transfer Section and was a remote site flight controller.
- R. Bryan Erb – Worked in the Flight Systems Division Heat Transfer Section. Became Assistant Director of the Canadian Space Station Program. See Appendix 2
- Donna M. Erb – Bryan's wife. She taught school and later went into computer science and worked for Lockheed and MITRE in Houston.
- David D. Ewart – Worked in the Flight Systems Division Flight Dynamics Branch.
- Joseph E. Farbridge – Left after only a few months.
- Norman B. Farmer – Worked in the Flight Systems Division as head of the Electrical Systems Section.

- Dennis E. Fielder – Worked in the Flight Control Branch, Control Central and Flight Safety Section. See Appendix 2.
- Stanley H. Galezowski – Worked in the Flight Systems Division, Dynamics Branch. Left in 1962.
- George Harris Jr. – Did not join STG but worked on NASA's Mercury Space Flight Network.
- John Dennis Hodge – Worked in the Operations Division. Became a Flight Director. See Appendix 2.
- John K. Hughes – Worked in the Flight Control Branch, Control Central and Flight Safety Section.
- Morris V. Jenkins – Worked in the Flight Systems Division Dynamics Branch.
- Robert N. Lindley – He helped to organize the hiring of AVRO engineers by NASA but joined McDonnell Aircraft instead.
- C. Frederick Matthews – Worked for the Flight Control Branch, Control Central and Flight Safety Section training flight controllers. See Appendix 2.
- Owen Eugene Maynard. Worked for the Flight Systems Division, Onboard Systems Branch.
- John K Meson – Did not join the STG. Worked at NASA Headquarters.
- Leonard E. Packman – Worked for the Flight Control Branch, Control Central and Flight Safety Section.
- Tecwyn Roberts – Worked for the Flight Control Branch, Control Central and Flight Safety Section. Was the first Mercury Flight Dynamics Officer (FIDO). Later moved to Goddard.
- Rodney G. Rose – Worked for the Flight Systems Division, Systems Test Branch.
- Leslie G. St. Leger. Did not join the STG. Joined General Dynamics and later joined NASA JSC.
- John N. Shoosmith – Worked for the Operations Division, Mathematical Analysis Branch. Youngest to leave AVRO and last to leave NASA after 36 years.
- Robert E. Vale. Worked for the Engineering and Contract Administration Division, Engineering Branch.
- George A. Watts – Worked for the Flight Systems Division on structural loads.

In summary, the addition of the AVRO engineers to the STG was a brilliant management decision and had a beneficial impact on the entire U.S. space program for many decades and many missions.