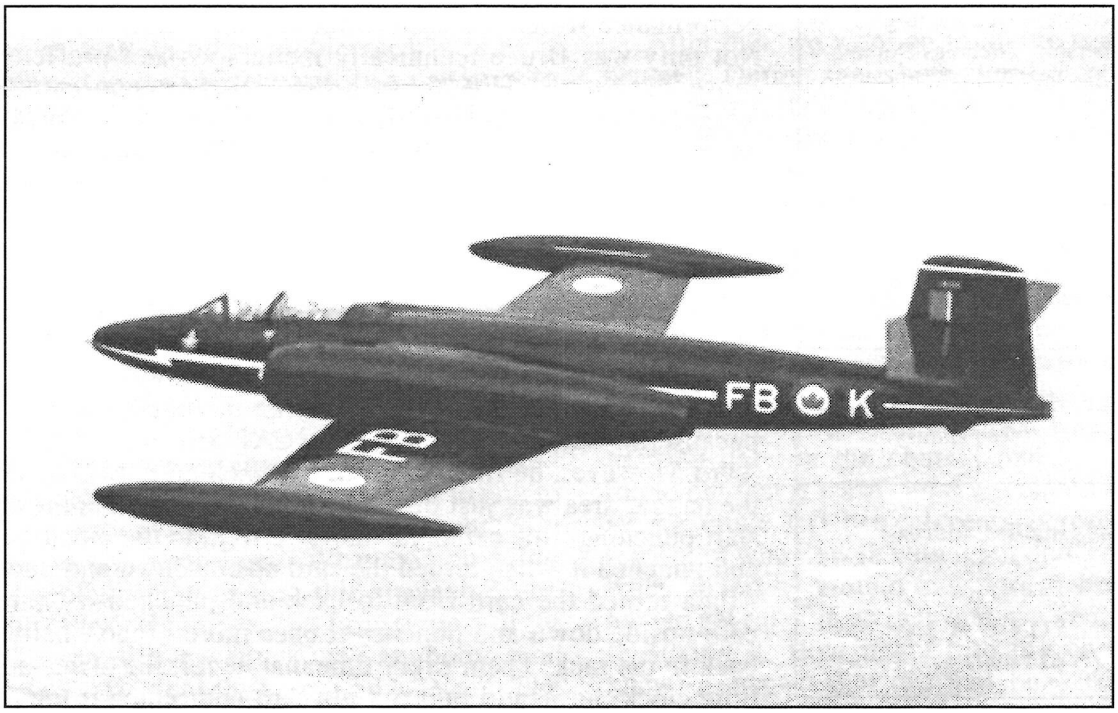
Pre-Flight

A Publication of the Aerospace Heritage Foundation of Canada
P.O. Box 246, Etobicoke "D", Etobicoke ON M9A 4X2

Vol. 24, No. 1 January - February 2013



My Fond Memories of Bruce Warren, CF-100 Test Pilot

by

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"A recent Pre-Flight brought back many fond memories of our all too brief association, over 60 years ago, in Flight Testing, of the prototype CF-100. As I started to recall some of the events we shared, I decided to write them down and I think others would be interested in these memories also."

Founded 1989

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My Fond Memories of Bruce Warren CF-100 Test Pilot

Hangar Office: When I joined the newly formed Flight Test Engineering Department under Mario Pesando, our offices were in the Administration Building. When Bruce Warren arrived on loan from the RCAF for the CF-100 flight test program, he was given an open-walled office between the two bays of the Experimental Flight Test Hangar. Mario arranged for me to share Bruce's office to facilitate co-ordination of the flight test program.

Charts: One of the features of Bruce's office was that, posted everywhere, were large charts and diagrams of CF-100 systems and performance which we used to familiarize ourselves with the aircraft. Not only was Bruce technically meticulous and proficient, he had a sense of humor. Hidden in among these technical charts was a whimsical chart of the love life of one of the other test pilots showing percent seduction against time for several fictional 'cases' - with none ever reaching 100%. The most hilarious one showed an amazingly rapid rise in percent seduction until suddenly at 90% it dropped off to zero with the notation: "Oops - falsies".

Time Cards: Suddenly, one day, we were all notified that everyone would be required to punch a time clock. To show that there was no discrimination, the general manager said he was going to punch one also. When Bruce heard that he was included, he was incredulous because he was on loan from the RCAF and not a direct employee of Avro. However, he finally agreed to punch his card. The time clock for the hangar area was just outside our office. So, when the day arrived to start punching time cards, he dutifully went to the clock, put in his card and punched it - then turned the card upside down and punched it again - then turned the card front to back and punched it - then turned the card upside down and punched it once more - then finally put the card back in the rack. Then, every time that he left the office and passed the time clock, he would pull out his card and punch it the four times all over again.

Eventually, the ground crew caught on to what Bruce was doing and every time they passed the time clock they would help him out by taking out his card and punching it the four times. By the end of the week, the card looked like an inkpad. At the start of the second week, new cards for all were in the rack and the process of the first week was repeated with Bruce and the ground crew all doing their bit. At the end of the second week his card again looked like an inkpad. At the beginning of the third week, there was no card in the rack for Bruce. Somebody in the front office had gotten the message.

Intercom: On my first flight with Bruce, we were climbing up over 30,000 feet. near North Bay when the intercom quit. For the rest of the flight, we used hand signals or lifted our oxygen masks for a second or two and yelled. When we eventually descended below 30,000 feet, the intercom started working again. The problem turned out to be that the intercom unit was installed outside the pressurized area and would short out above 30,000 feet.

►

Memories ... *cont'd.*

Cockpit Air Temperature Distribution: Another problem we encountered at high altitude was with uneven heat distribution in the cockpit. In spite of the heating system and wearing fleece-lined flight boots, our feet were freezing while our heads were boiling from the heat rising in the cockpit and from the sun beating through the canopy. It was clear that a redesign of the heat distribution system was required.

Green Gremlin: Bruce was upset at the slow-paced response being given by the project office to the design deficiencies he had reported in his flight reports - such as the problems of the intercom and the heat distribution, as well as other problems. It was as if nobody bothered to read his reports. In an attempt to get some action to fix the nagging problems, he decided to write a special flight report. Although I never kept a copy of it, it went essentially as follows:

Page 1 consisted of the usual information about the flight: date, crew, fuel loading, any special configuration, flight objectives, etc. It included notes on engine-start, taxi, takeoff, and climb-out to test altitude. *Page 2* started off: And there I was at 40,000 ft. when I looked out and saw a little green gremlin sitting on my wing tip. When he saw me looking at him, he walked across the wing, up over the engine nacelle, and looked in through the canopy. Somehow he was able to talk to me through the canopy, and he said: "I was sent from Mars to observe you earthlings." What are you doing up here?" I replied: "I'm testing this airplane." The gremlin said: Why?" I replied: "So I can write a flight report." The gremlin asked: "Does anybody read your reports?" To which I replied: "No." The gremlin said: "People on earth are crazy; I'm going back to Mars!" And with that, he disappeared in a flash of light.

I HEREBY REFUSE TO WRITE ANOTHER FLIGHT REPORT UNTIL SOMEBODY READS THIS ONE.

This version of the flight report was never officially published, but somehow the message arrived at the right places and action on fixes started to occur.

General Montgomery: When General Montgomery was visiting in the Toronto area, Avro offered to put on a flight demonstration for him. However, because of prior commitments, he declined. One day as Bruce and I were methodically preparing for a test flight, we were told that Montgomery had unexpectedly arrived and would be down shortly at the rolling gate to the airport for a flight demonstration. We scrambled into our flight suits grabbed our chutes and rushed out to the CF-100 parked outside the hangar. When we taxied past the rolling gate, Montgomery had just arrived and saw us take off. After climbing out to about 1,000 ft., Bruce headed north until we were well out of sight and sound of the group at the gate. Then, he turned back south toward the plant, opened the throttles wide, and dove the aircraft down to just above the roof of the plant so that without warning we suddenly appeared headed toward Montgomery's group. Bruce hauled back and pulled the aircraft into a vertical climb over the group with wide-open engines blasting down toward them. Later, an aide to Montgomery said it was the only time he had ever seen the General visibly shaken.

After that, we went on to do the test flight we had planned. During the whole flight, I was bothered by how uncomfortable my chute was. When we got back to our offices (by then we had moved into offices on the second floor at the back of the hangar) I checked on the chute I had been wearing. In all of my flying in the RCAF and with Avro, I had been meticulous in checking the status and condition of my chute and its packing date. However, this time because of the mad rush to get airborne, I had neglected to do so. I had merely reached into my chute bin in the chute room and picked up what I thought was my chute.

After the flight, I was horrified when I checked the packing date on the chute I had been wearing and found out that it wasn't an Avro chute, but, was an old RCAF chute left behind years before by an RCAF ferry pilot who flew in with it but didn't take it with him when he left by ground transport. Avro hadn't known how to get rid of it, so they had just kept it without ever repacking it. How it got into my chute bin I never knew. I suspect that if I had been forced to use it, nothing would have come out except moths. Later in the day, I was in the design office to check on something when one of the engineers asked if I was in the CF-100 that had flown over the building earlier. When I replied: "Yes", he said: "We thought you were coming through the roof'.

Wing Tip Fuel Tank Tests: To provide for long-range ferry, removable wing-tip fuel tanks were designed to provide 300 gals. Each. The initial trial installation was done on the second prototype - CF-100 Mk. 1, 18102 (FB-K). The first flight was without tail fins on the tanks. However, strain gauges on the tank-wing interface showed that the tanks were acting as lifting bodies and twisting the wings. Therefore, fins were added to the tanks to counter the lift. They were painted black like the tanks and the rest of the aircraft. At the end of the day after we flew the first flight with the fins, I walked through the hangar to get to my car. As I passed the aircraft, I ran into the protruding fin.

on one of the tanks. It hit me just above the eyes and almost knocked me out. I hadn't seen the fin because it was black. The next morning I issued a shop order to have the fins painted red so they could be seen. Subsequently, most of the tip tank fins were painted red. I'm probably the only one who knows the original reason why.

Roll rate with tip tanks: To determine what the effect of the tanks had on maximum roll rate, we did a series of rather violent roll tests. Because the aircraft-tip tank configuration was for long-range ferry operations, it was not stressed for inverted flight. Therefore, the tests consisted of rolling, with stick hard over, from 90° port to 90° starboard and then back again. A series of such tests was done at various speeds and altitudes. All in all, a wild ride - not recommended for anyone with a queasy stomach.

Position Error Tests on the Mk 1 Prototypes, 18101/18102: All new aircraft designs require the airspeed/altimeter system to be calibrated for what is known as position error - the errors in speed and altitude due to the chosen position of the static pressure source which, for zero error, would read the exact free stream static pressure at all speeds and altitudes. One efficient method of conducting this calibration is by pacing an aircraft specially calibrated for such tests. We were fortunate to obtain the services of such an aircraft - a specially calibrated USAF F 86 from Wright Patterson Air Base.

The F86 was piloted by Major Dick Johnson who had set the world speed record in an F-86. The pacing tests were conducted on both of the Mk 1. prototypes, 18101 and 18102. On the tests of the second aircraft, after we had finished a series of pacing checks at 30,000 ft. with the next series scheduled for 10,000 ft., Major Johnson called over the radio: "I'll race you down". Bruce rolled the CF-100 on its back and opened its huge dive brakes and down we went. Only then did I realize that I had a cold coming on as my ears became plugged. I was in agony but didn't want to call the race off as we were winning. After leveling off, we completed the tests and my ears started to clear. But, by the next morning, I was again in pain so much so that they sent me to an aero medical specialist who treated me and grounded me for a month.

18102 High-Altitude Fuel Consumption Tests and Crash: The next series of tests was to determine high-altitude cruise fuel consumption to prepare18102, with its long-range ferry tip fuel tanks, for a trans-Atlantic flight for display at the 1951 air show at Farnborough. The tests were conducted as a series of constant ratio W/p (aircraft to weight/atmospheric pressure) cruise-climbs to determine the best cruise conditions for maximum range. That is, as the weight of the aircraft decreases with fuel consumed, the ratio is kept constant by climbing. Because I was grounded by my ear problem, Bob Ostrander took my place in the program.

On a cruise-climb fuel-consumption test on June 23, 1951, 18102 was above 40,000 ft. when something happened and it was seen in a steep dive, crashing into the ground, killing both Bruce and Bob. Although not official, the reason for the crash is surmised to be an improperly configured pilot's oxygen mask, which did not provide sufficient oxygen for the altitudes they were flying at. If I had not been grounded because of an ear infection, I would have been in it when it crashed - fate! Although Major Johnson doesn't know it, he saved my life by challenging us to a race down from 30,000 feet. The CF-100 did not perform at Farnborough until Jan Zurakowski performed in the CF-100 at the 1955 show.

Canopy Tests: After the accident, I had a nagging feeling about what had happened - if Bruce was unconscious, why hadn't Bob bailed out. Because there was no evidence that the canopy had been jettisoned, I started to wonder if perhaps Bob had tried to jettison it and nothing had happened. One day on a visit to the aerodynamics department, I started asking if any wind tunnel tests had been done on canopy jettison. There had been, but, when I looked at photos of the model, it was apparent that the canopy shape in the tests was not that of the canopies on the aircraft. When I asked if any jettison tests had been done on the production configuration, no one could recall. However, one aerodynamicist rummaged through his desk and found a forgotten test report showing the pressure distribution over the production configuration canopy. When I saw it, I became suspicious that there wasn't enough suction at the front end to lift the front of the canopy up so that it would fly off into the air stream. My analysis of the distribution confirmed my suspicion. The only thing left then was to determine if the pressure distribution over the aircraft canopy was like that of the wind tunnel model.

*The **conclusion** of this article will be in our next issue. It offers us a closer look not only at the complexity of aircraft but also the inherent dangers in the rigorous testing of the various stages of their development. It demanded flying expertise, courage. and dedication of test pilots like Bruce Warren..*