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## The Great Arrow Debate (Gads, No More, I'm Getting Airsick!)

That the Arrow wasn't put into large scale production certainly had a short-term effect on employment and Canada's GNP. But serious people, (i.e. grown-ups) soon forgot the whole episode -- they had lives to live. That the Arrow immediately spawned its own publishing industry, however, has helped to offset any of those 1959 cash losses. The buying public has seen to this and, should Canada go on for another thousand years, rest assured that millions of dollars will continue to be generated yearly by the Arrow -- books, videos, plastic models, full size replicas, lapel pins, T-shirts, you name it ... they sell like hot cakes to nostalgia fans, "Arrowmaniacs", unsuspecting victims of Arrow zealots, etc.

The latest Arrow book, *Avro Aircraft and Cold War Aviation*, is a fanatical effort supported closely by Avro engineer James C. Floyd. Any old claim is made in the book to make the Avro side of the Arrow argument shine, no matter the facts. Author Whitcomb, for example, writes on p.76 of how a CF-100, great old fighter that it was for what it was, would soar like a homesick angel past 60,000 feet (he quotes CF-100 pilot Jack Hubbard as taking a CF-100 there without any trouble). Now that's a first, since no CF-100 ever reached 60,000 feet! For the truth of the matter, take a look at *RCAF EO 05-1-1 Pilots Operating Instructions CF-100 Mk.5* published by the Department of National Defence on 1 January 1957. Now turn to one of several charts that list CF-100 performance. Whether you check the combat allowance chart, climb or descent charts, flight operation instruction chart for high altitude, whichever. The service ceiling figure is the same -- 45,000 feet. Period! Yes, it sure is nice to have the best sources handy when writing a book. (CF-100 aircrew who can prove that you flew a CF-100 past 60,000 feet, please let me know the exact details of how you did the impossible.) Well, the facts don't matter much any more. Too bad, but these days all you have to say is 60,000 feet and, guess what, it's the truth!

Naturally, the occasional CF-100 foray into the 50,000s was made for test purposes, or just for fun. Some of this history is noted in my book *The Avro CF-100*. In daily operations, however, the CF-100 was relegated to the mid-40s, along with all its contemporaries. Whitcomb refers to the F-15 (what's it got to do with the CF-100 ... this is like comparing a Neanderthal's club to a 155mm howitzer!) as having a service ceiling barely as good as his imaginary CF-100 and how an F-15 starts "running out of engine and wing at 60,000 feet, even when it is relatively clean and light." Talk about your gobble-di-gook! The fact is that even the awesome F-15 is not expected to serve at 60,000 feet. Author, where do you get your facts? What fairy tale books have you been reading? Your entire Hubbard episode sounds as if it comes straight from a comedy skit. How sad that unsuspecting Canadian school children might come across this page of tom foolery.

On the next page of his book Whitcomb notes how Canada replaced its CF-100s with F-101 Voodoos, "retired from Air National Guard service". Here he wanders into territory about which he seems to know zilch. Firstly, he implies that the Voodoos were past their prime when the RCAF received them in 1961. He calls them "beat up" birds, and that RCAF pilots were "demoralized" when obliged to fly them, compared to the "astronomically superior" Arrow. Such claims are nothing short of pitiful, especially since the Arrow never left the experimental stage, so who knows how good or bad it might have been! To begin, the Voodoos were not being "retired". Check their tail numbers. The first numeral for the first batch of RCAF Voodoos was "9", indicating that the contract to build the RCAF Voodoos wasn't even let until 1959. Hello-oooo ... they were brand new, beautiful airplanes! They were welcomed with total enthusiasm by the RCAF. Whitcomb then lists a series of Voodoo "problems" -- serviceability, low performance, "never fired its limited weapons in anger" -- talk about outrageous stupidity. Help us ... we're looking for serious history here! It seems as if Whitcomb has read no Voodoo history (there are several superb books).

Which RCAF Voodoo pilots or navigators has he interviewed? Author, introduce us to one experienced Voodoo aircrew who didn't have a love affair with his airplane? For starters, go ahead and canvas the members of the All Weather Fighter Association. If you find one Voodoo detractor, you can be sure that he's some kind of a phony impostor who never sat in a Voodoo in his life. Knowledgeable allwx people out there, if you have any comment about the 60,000 foot "controversy", or about the Voodoo being a piece of flying junk that might help the author, contact him through Vanwell in St. Catherines. Now, to put a few historic details straight, I'm reprinting the text from Canada's Air Force at War and Peace that deals with the Arrow, Bomarc and Voodoo. For the CF-100, refer to various books in your public library.

## Of Myth: The CF-105 Arrow

Through the 1950s the West was gathering intelligence about new Soviet bombers. In 1954 the Tu-16 Badger began reaching squadrons, and the Mya-4 Bison, awesome as a B-52, appeared over Moscow for the May Day parade. Two years later the Tu-20 Bear caused another flap. These new Mach 0.8 types shook up the West, forcing new air defence initiatives. The US focused on "Century Series" interceptors like the F-101 Voodoo (Mach 1.84) and F-106 Delta Dart (Mach 2+) with advanced fire control and air-to-air missiles. For insurance it also invested in surface-to-air missiles -- the Bomarc, Hawk, Nike Ajax/Hercules, etc.

Meanwhile, the US was venturing into more exotic turbojet, ramjet and rocket power R&D. The Mach 3 to Mach 4 Republic XF-103, North American XF-108 Rapier and Lockheed A-12 were key projects. North American also began design of a Mach 3 bomber. Canada decided the play at this expensive and risky game. Even as the CF-100 was entering service, the RCAF knew that a replacement soon would be needed. In 1952, adhering to the "self-sufficiency" philosophy advocated by C.D. Howe after WWII, discussions began with Avro. A design was chosen and money went on the table -- Avro was "away to the races". Its fighter would become the 2-seat, Mach 2 CF-105 Arrow.

In spite of getting off the discussion table and onto the drawing boards, the CF-105 worried sharp-minded men in Ottawa. Having witnessed the near collapse of the CF-100, in December 1952 C.D. Howe wrote to the MND, Brooke Claxton: "I must tell you that the design staff at Avro is far from competent to undertake work of this importance." The old arch nationalist, whose drive had led in the first place to the formation of Avro Canada, went so far as to recommend that Ottawa find a *British* firm to design Canada's new fighter. Could this have been the same C.D. Howe who, in 1945, had urged Canada to design its own military aircraft, rather than depend on Britain? It was, and Howe was not easily ruffled. Nonetheless, Claxton and his CAS, Air Marshal Roy Slemon, stuck with Avro.

Kept under wraps for years, the new interceptor finally appeared. What a magnificent sight it was when towed into the open air at Malton on October 4, 1957. The RCAF must have felt reassured, and industry was on a high. In the weeks prior to first flight, *Financial Post* reporter Clive Baxter wrote: "As long as Russia maintains more than 2000 long-range jet bombers in squadron service, many capable of carrying short-range missiles, they remain a serious threat to North American air defence and must be matched." From where did this number come, when there *may* have been 200? From defence department and industry PR hacks -- just what Avro was counting on. Baxter also quoted an Avro subcontractor, who proclaimed the mind-set of the 1950s defence supplier: "If that plane was cancelled, we'd lose our shirts. We spent a great deal getting tooled up for our share of the project. Now it should all pay off." Nothing like getting down to the nitty-gritty!

The Arrow was a mammoth project for a small nation, but Canada, feeling its postwar oats, was into such ventures. With the Americans it was building the St. Lawrence Seaway, one of the world's greatest inland navigation systems. The Trans-Canada Gas Pipeline was being laid across mountains, prairie, forest and bog. Mining and power mega-projects were underway in the North. This certainly was Canada's decade, so the Arrow seemed to fit. It was another grand day when it took flight on March 25, 1958. Jan Zurkowski, the 34-year old test pilot at the controls,



was the man of the hour.

Avro's PR department kept the world informed with a torrent of optimistic news, but all was not well. The Arrow was continued by Ottawa strictly on a yearly basis, with termination always imminent. The MND, George R. Pearkes, VC, reiterated in Parliament on January 23, 1958: "Last year the government authorized another year's development ... The future of that aircraft will depend entirely on the nature of the threat. The matter is constantly under examination." Much earlier (June 28, 1955), C.D. Howe himself had noted: "I can say that now we have started on a program that gives me the shudders, a supersonic plane and a supersonic engine." It was the nightmare of paying for it all, and perhaps of ending up with a white elephant, that gave the creeps to the pragmatic Howe.

Of prime concern in Ottawa were the mounting costs. Hundreds of millions had been spent, enough to build a second Seaway. Yet the Arrow was far from operational and there were questions of costly re-engineering. While five flying Arrows were getting along with their Pratt & Whitney J75s, the engine proposed for service aircraft, Orenda's promising Iroquois, lagged. Worse off was the "Astra" fire control system -- it seemed to be getting nowhere. Naturally, almost any technical glitch could be overcome by pouring in money. But Ottawa was weary of Avro overruns. What had begun as a \$1.5-million fighter had grown in steps to \$4 million, with something like \$7, \$9, even \$12 million forecast for the small RCAF production run (a CF-100 Mk.5 cost about \$700,000).

Somehow Avro couldn't accept that the boom might be lowered, especially since thousands would lose their jobs. Nonetheless, in the fall of 1958 Ottawa announced plans to acquire Bomarc "B" surface to air missiles. Work on Astra and the CF-105's Sparrow missile ceased; and flight testing was reduced. Avro now requested funds to complete the initial run of 37 Arrows. Finally, enough was enough, and on February 20, 1959 Ottawa cancelled the program. Prime Minister John G. Diefenbaker, following the advice of his top men in National Defence, Defence Production, etc. explained: "These outstanding achievements have been overcome by events ... Potential aggressors seem more likely to put their efforts into missile development than into increasing their bomber force." Although often ignorantly described as the hatchet man in the cancellation, Diefenbaker had made the right decision.

### **The Bomber Interceptor: Re-assessment**

In the early 1950s the US approved design of a top-secret spy plane -- the Lockheed U-2, flown in August 1955. The Central Intelligence Agency wasted no time flying the U-2 impudently in Soviet air space, and making astounding discoveries. The first operational flight departed Wiesbaden, West Germany on July 4, 1956, then flew as far as Moscow. In the next four years some 30 overflights, plus others along USSR borders, were made. With the help of these, the then-top secret National Intelligence Estimates for September 18, 1957 was able to report that the USSR had test fired at least 275 short/intermediate range ballistic missiles and, on August 21 and September 7, had fired ICBMs. The launch of "Sputnik" on October 4 caused panic in the Pentagon. More bad news came with the NIE report of December 10, suggesting, in great secrecy, that the Soviets likely would have 100 operational ICBMs as early as mid-1959, perhaps 500 by mid-1960.

Flying as high as 72,000 feet, the U-2 seemed invulnerable -- Soviet fighters could only watch from 50,000. As to Soviet SAMs, their small manoeuvring fins gave little control in the thin air above 60,000. But the Soviets now invested massively in R&D, developing the SAM-2 missile. On May 1, 1960 a U-2 piloted by Francis Gary Powers was shot down by a barrage of these. This phase of CIA spying now ceased, but not before enough data had been assembled about the Soviet bomber threat to sound the death knell for projects like the XF-103, XF-108 and CF-105. In his superb history *Lockheed U-2*, Jay Miller concludes: "The results of the Agency's overflight efforts were indeed impressive. During the first few missions ... U-2 flights quickly revealed that

the long-argued Soviet jet bomber threat, represented by the Myasishchev Mya-4 Bison and Tupolev Tu-95 Bear, was relatively small. They also revealed, however, that Soviet activity in the ICBM field was accelerating, and that forthcoming missile developments would have to be countered, and rapidly."

Herein lies the simple of truth of why the Arrow was scrapped. Thanks to the U-2, Canada could focus on more meaningful priorities. There now was little need for the Arrow, since there was next to no chance of bombers coming over the pole to drop A-bombs in North America. The real threat was ICBMs, against which fighters were useless. Ottawa now could save the taxpayers megabucks. Certainly, some defence was needed in view of the few Soviet bombers, but Canada need not re-invent the wheel to meet requirements. The solution was sensible-- a small number of F-101 Voodoos and Bomarc's.

The Voodoo was available and affordable, and certainly superior to the Arrow as it sat in 1959, i.e. as a big, beautiful, experimental aircraft. The Voodoo was more than fast enough (Mach 1.84 -- faster than the Arrow ever flew except for one flight at Mach 1.96), had range and manoeuvrability superior to the Arrow, and was a pilot's airplane (the Arrow faced costly re-engineering to overcome aerodynamic problems). With nuclear warheads Voodoos and Bomarc's were threat enough to make the USSR think twice about sending manned bombers on suicide missions to North America. After all, deterrent was the name of the Cold War game and there was plenty of that without the Arrow.

### **An Academic View**

As projects like the Arrow were underway, Cold War scientists were seeking better means of prosecuting and defending against nuclear war. These boffins were looking years down the line, studying emerging technologies and their economics. These were the two inseparables -- "how to", and "how much". As the 1950s waned, the boffins, practical fellows that they were, saw that missile technology was booming. In time they had the data they needed, thanks to the U-2. Nuclear warfare practitioners now rushed the ICBM to the forefront. Their new toys offered massive, efficient and cheap first-strike capability, compared to bombers. Life didn't get much better at this stage of the arms race. The media and public knew little of all this, but insiders were on to something big. Specialized publications were discussing the topic. In his paper in the 1958 *Journal* of the RCAF Staff College, F/O D.E. Sharp [that's him on the cover of *CAFWP*, Vol.3] analyzed the manned interceptor in relation to mid-1950s technology. His "North American Defensive Requirements in the Missile Age" was at once illuminating and daring -- here was a CF-100 AI navigator telling it the way it was, challenging "conventional" thought, sticking it to the PR bullshooters. In part Sharp wrote:

*Until quite recently the threat of a bomber attack has been held to be of prime importance in the defence of North America. However, the announcement by the Soviets in the fall of 1957 that they had developed a long-range ballistic missile with a maximum accuracy of plus or minus six miles, coupled with the ... change in Soviet military policy [i.e. from being set for preventative war, to advocating the pre-emptive strike], leads me to believe that the probability of a bomber attack is rapidly decreasing. This ... is proportional to the speed with which the Soviet Union is solving her missile production problems. To launch a bomber force, Russia would have to be prepared to accept a counter-attack of some strength, which is inconsistent with a "first blow" strategy. Stated in terms of the price of a war, this means that a bomber attack no longer provides enough profit to be worthy of consideration.*

The Cold War had much to do with profit, especially with *not* spending dollars. Sharp gave the rough comparison of an ICBM valued at \$2 million in 1958, versus \$10 million for a SAC B-52 and crew: "To state the proposition differently, five missiles can be purchased for the price of one bomber. And we have barely scratched the surface in the manufacturing methods used in missile

construction. More economy is sure to result from improved production methods -- methods we can be sure that Russia is also doing her utmost to develop." Sharp then considered North America's preparedness for a Soviet attack. With all the PR crap floating around about projects like the Arrow, ordinary citizens may have been convinced that they were safe, but Sharp had a more cogent view:

*Equipping our interceptors with air-to-air missiles, despite the fact that these weapons are new and unproven in combat, is a sign that we are at least making an attempt to raise our defensive potential to a point from which we can look at the enemy at eye-level. However, as a defence against offensive missiles, the manned interceptor faces problems which are insurmountable. On the other hand, a ground-to-air missile with its own guidance system and a speed equivalent to or greater than that of the ICBM would certainly provide a solution to many of our present and future defence problems.*

Finally, Sharp addressed the question of Canada re-equipping with a new manned interceptor. He conceded that something like the Arrow offered greater "flexibility" than a missile -- a manned interceptor could be recalled in case of a false alarm, not so a missile (although a missile could be remotely destroyed in flight by its controllers). Yet, the economics of the anti-ICBM missile surely would prevail, especially as missiles became progressively cheaper and more reliable. Some argued the scenario of a Soviet bomber attack following an ICBM attack, so manned interceptors still would be handy. But Sharp's simple point was that the missiles used to intercept ICBMs also could shoot down bombers. In the end Sharp urged:

*These decisive changes must be initiated before, not after, our opponent has obtained sufficient weapons with which to carry out his military objective. We have underestimated his progress before in the field of nuclear development and in other technical fields. It would be a serious error to under-estimate his ability to make similar advances in the missile field... we must strive to shorten the transition period between manned interceptors and missiles, not only for military, but for economic reasons ... plans should be considered immediately to locate US-developed interceptor missiles in Canada's far north as soon as they are available... the useful life of the manned interceptor in the defence of North America will be a function of the time required for the successful development and incorporation of long-range missiles as offensive weapons of war.*

In the end the US developed the Sprint anti-ballistic missile but, by agreement with the Soviets, only a few were deployed. Meanwhile, NORAD operated F-101, F-102, F-106 and F-4 fighters, and SAMs to counter manned bombers. In the 1970s the SAM batteries were decommissioned. In time NORAD upgraded with F-15s, F-16s and CF-18s, even though there was less threat than ever from Soviet bombers. Meanwhile, the ICBM the primary threat to civilization, goes almost unchallenged to this day.

### **American Interceptor Projects**

Since the cancellation of the Arrow, a dedicated group of "Arrowmaniacs" has whined incessantly about the "tragedy" of the decision. How could a nation with the world's "best" fighter terminate the project? To address this it is useful to see what others were doing in fighter R&D in the 1950s, and how they coped with changing times, i.e. before anyone starts spouting off about the Arrow, he'd better get informed about what other projects were under way in the 1950s.

The Soviet bombers of the 1950s had startled the US, which quickly funded interceptor projects more ambitious than the Arrow. Republic, for example, had entered the high stakes supersonic game at the end of WWII with the XF-91 Thunderceptor, powered by a turbojet and a rocket thruster. But the Germans had had trouble with the rocket-powered Me.163 -- the USAF was

twitchy about rocket motors. Curtiss Wright gave up on its large rocket motor for the XF-91. The plane began flying at Edwards AFB in May 1949. With the help of a small Reaction Motors rocket, it exceeded Mach 1 in level flight.

Republic also had the futuristic AP-57 Mach 2 project, using a turbojet at lower, and a ramjet at higher speeds. The AP-57 languished till 1950 (the year the CF-100 first flew), when the USAF requested proposals for a supersonic fighter. Republic offered the AP-57, but Convair won with the YF-102, although funding for the AP-57 (now designated XF-103) continued. The XF-103 had a tubular fuselage with thin delta wing and empennage, and a belly air intake. Specs (1957) included: length -- 81.9 feet, wing span -- 35.8 feet, ceiling - 80,000 feet, speed - Mach 3.7, combat radius - 550 sm, engine -- Curtiss Wright J67 22,000-lb thrust turbo-ramjet, armament -- internal Falcon AAMs. XF-103 specs vastly eclipsed those of its contemporary, the Arrow

The XF-103 pilot would not have conventional forward vision, the canopy being flush, so a periscopic vision system was developed. For landing, a hinged nose was considered, similar to that on the later XB-70 and Concorde. Bausch & Lomb won the periscope contract; its system worked well on more than 200 flights with a modified F-84G. Also proposed was a high-speed pilot ejection capsule. Development came progressively, e.g. weapons system (add nuclear, upgrade FCS, enlarge radar), range (lengthen fuselage, add fuel), expand knowledge of titanium fabrication, devise means of cooling the aircraft surface (max. temperature 675°F). First flight was to be in 1960. By now only \$100 million had been invested in what truly was a world-class interceptor project.

Industry realizes that, for reasons technological, budgetary or political, any hi-tech project is subject to cancellation. In August 1957, as the first example was in final assembly, the XF-103 was axed. This may have been hastened by power plant delays; however, much of the J67 had been proven, even transition to and from turbojet and ramjet power. Also going against the XF-103 were: a squabble between USAF bureaus, a change in philosophy that tomorrow's interceptor should be able to loiter along the DEW Line, and the idea that surface-to-air missiles were more effective and cheaper. "The Trisonic Titanium Republic" by Richard A. DeMeis in *Air Enthusiast*/7 is the best published source of XF-103 history.

Another project that never made it was the two-man North American XF-108 Rapier, to fly early in 1961. Its specs included: length 89'2", span 57'4", height 22'1", gross weight 102,000 lb, speed Mach 3, combat radius 1020 miles. This awesome double-delta originated with the USAF in October 1955. Unlike the short-ranged Arrow, the Rapier was to meet and destroy Soviet bombers in Arctic airspace, long before they reached industrial North America. It would also be an escort for North America's upcoming Mach 3 B-70 Valkyrie, itself an accomplishment far superior to the Arrow. Rapier armament would have been three 115-mile range Hughes GAR-9 Falcon missiles.

In September 1959 the Rapier got the chop, before the prototype was completed. About six weeks later, the XB-70 also was dropped. (Launched in 1955, this project would be resurrected, the XB-70 flying in September 1964. A prototype is in the USAF Museum in Ohio.) The Rapier's Hughes AN/ASG-18 radar and the GAR-9 were transferred to the Lockheed YF-12. Researcher Joe Baugher has noted the reason for the Rapier's sudden demise: "By 1959 the Air Force was already beginning to experience some doubts about the high cost of the Rapier program. The primary strategic threat from the Soviet Union was now perceived to be its battery of ICBMs, instead of its long-range bombers ... the Air Force was increasingly of the opinion that unmanned ICBMs could accomplish the mission of the B-70/F-108 combination much more effectively and at far lower cost."

Lockheed had studied liquid hydrogen-fuelled aircraft in the 1950s, its CL-400 being a Mach 3-4 design. It gave way to the A-12, capable of Mach 3.5+. Also powered by two J75s, it first flew in April 1962. The YF-12A fighter version flew about 15 months later. The result of this work was the SR-71 Blackbird, first flown in December 1964. Of the Arrow era, yet light years ahead of it, this

was the ultimate reconnaissance aircraft, capable of cruising at Mach 3+ at 80,000+ feet. The vintage SR-71 served the CIA and NASA into the mid-1990s.

Although such US designs overshadowed the Arrow, even "old fashioned" US fighters of the 1950s made the Arrow just another contender. Ultimately, all the project showed was that a small power might, a horrendous expense, replicate the technological achievements of far bigger nations. The McDonnell F4H-1 Phantom II, flown on May 27, 1955, was one such US design. In service with the US Navy in 1962, advanced versions still were in flying in 2001. The F-4 is arguably aviation's most successful all-weather, multi-role jet fighter. After preliminary trials, McDonnell developed the F-4C for the USAF. On its first flight it exceeded Mach 2.

The McDonnell F-101B Voodoo flew in March 1957, the same month as the Arrow, yet entered service in 1959, when the Arrow remained highly experimental. This Mach 1.84 fighter was adopted by Canada, where it had an exemplary career to the 1980s. The Mach 2.3+ Convair F-106 was a single-seat all-weather fighter. First flown in December 1956, it entered service in 1959 as the fastest NORAD interceptor. To 2001 it still held the official world speed record for a single-engine jet fighter -- 1525.95 mph. There were many other such designs, e.g. France's Mach 2.3 Mirage III flown in October 1959. Then there was the Soviet's amazing MiG-25, developed in the late 1950s to counter the Lockheed A-12. With a sustained cruise speed around Mach 3, the MiG-25 remained in service in 2001. All these superb concepts were developed, placed in service, or terminated with little fanfare.

### **Flying the Arrow: It Was No Picnic**

Every complex new airplane is a handful for the engineers who design and build it, and for the pilots and other flight test people. In the air anything can go wrong. This was especially true in the 1950s, when new limits were being explored. The Arrow made a spectacular first flight, hitting the headlines that afternoon. But, for the people trying to get the bugs identified and resolved in the first five airplanes, there was no time for headlines. The Arrow was a challenge from the start, and far from a piece of cake to fly. By reviewing flight test reports, it is clear that only a superior test pilot could handle this airplane. Even so, pilots always try to have something favourable to say about their plane, at least when talking to the media. One book claims that Jan Zurakowski described the Arrow as "easy to fly". If he ever did say this, it is fairly certain that the quote is made out of context. Test pilot W.O. "Spud" Potocki once told Arrow historian Les Wilkinson that he was leery about the day when young RCAF pilots might be let loose to fly the Arrow. That is likely a more accurate portrayal -- the Arrow was a handful of an airplane.

Some time in 1958 Potocki roughed out pilot handling notes for the CF-105 Mk.1. These were previewed by his confrere, Peter Cope, who added some margin notes. Potocki's manual reads a bit roughly in places -- like Zurakowski his first language was Polish. He warns persistently about handling problems, e.g. sideslip. Naturally, through cautious, step-by-step testing, most such shortcomings would have been rectified, but others would have caused costly delays. These notes may be compared with the updated pilot operating manual published in 1999 by Boston Mills Press, *The Arrow*.

### **Cockpit Check**

*Do not strap in until leg restraint is fixed in place to satisfaction. Then carry out first preliminary cockpit check. Leave hood open.*

*(1) All damper circuit breakers in. Damper switch to "on". IFF to correct mode. UHF to correct channel, but leave off. Check low pressure cocks as they often are closed and are not very well visible underneath throttles box. Crossfeed central. Damper roll and pitch switching to "Off" (on port side of cockpit, above radio). Check all fire warning and extinguisher buttons for correct setting.*

Check all other switches on port side to "On".

(2)Adjust rudder pedals, counting the amount of notches on each for even alignment.

(3)Check instrument panel. Set Altimeter. See that A/H flap and T/S indicator flap is "Off". Adjust height of seat. Move off to starboard side. Check all switches as per pilot's operating instructions.

(4)Adjust and fit dinghy holes.

(5)Strap in.

(6)Make connections from PG valve [pressure gravity valve for pressure-breathing G-suit] with valve held in hand in this order: PG valve to trousers connector; thick tube of PG valve to rear connector on seat quick disconnect box. Remember that in both cases, locking action is needed and, to achieve this, the locking rings must be initially depressed and turned to "Unlock". Fix the oxygen tube to connector on the quick disconnect panel. Make sure that the bayonet fitting is made. This is the most difficult connection of all. When both tubes fit correctly, check for firm hold and oxygen flow from PG valve, which still should be held in hand. Get helmet.

Connect mask to helmet or hard "top" on left side only, then make mask-microphone connection. Still holding helmet in hand, make a helmet cable connection with quick-disconnect female socket. Check that this seats properly. Connect PG valve to test. As the connection is made, the oxygen should fill the vest and also should flow from the mask audibly. Now put helmet on. Strap mask in place and do some preliminary pre-breathing to check the effort required to breathe. Remove bottom pin from seat and hand over to ground crew. He will show all the pins removed from the back of seat. Proceed with proper cockpit check – visually from left to right. Select "Comm" on mixing box.

### **Starting Up and Taxying the Arrow**

Put master switch to on. Starboard engine first. Close hood. Use some throttle to start going. Check brake response after moving a few yards. Stop and move away. On taxiing, the aircraft oscillates slightly in pitch; the rudder pedals seem very springy. Do not use rudder bar to get differential braking, just gentle, but nevertheless, quite determined pedal displacements. Every time the pedal is depressed more heavily, the aircraft will judder and abruptly change direction. This can be often accompanied by shaking of airframe and general shaking of seat and rudder bar with this. Taxy at moderate speed with practically closed throttles. Even without using brake, airframe shake may be evident. If a chance presents itself during the long taxi run, try deflecting rudder bar without damper to see that some effect can be obtained at speeds as low as 50 knots, particularly if wind is favourable. This will also give some idea of rudder feel, which is springy and rather heavy around the centre. Turning the aircraft around is tricky, even at 200-foot wide runway, and requires good judgment. Engine and brake must be used, but take care not to lock the wheels, as large lumps of rubber will be torn out from the tires, if the bungy rotates without wheels turning.

Align on the runway very carefully by going forward 20 -- 30 yards dead on the straight line of the runway. Slowly apply brakes until aircraft stops without any



tendency to depart from the centre. Apply pedal pressure and hold it there, as parking brake may not be reliable in holding the aircraft correctly. If it slips, it will be necessary to realign the aircraft. Make final cockpit check. Apply throttles against heavy pressure on the rudder pedals, not allowing aircraft to move. At about 90% RPM the nose of aircraft will depress slightly as the effect of thrust is felt. If brakes are good, they will hold max. military thrust. The moment any tendency to depart from centre is felt, apply brake, but only a small amount.

The initial acceleration is not too impressive, unless AB [afterburner] is used. Keep that heading at all cost by small and rapid brake application, until about 80 -- 100 knots is reached. A brake connection has been made at about 110 knots, so don't worry too much about this. Just keep that heading, and watch the ASI [airspeed indicator]. At 130 knots apply very gentle pull on the stick and see that nose comes up. Sometimes a bounce is experienced just after initial elevator movement. The nose of the aircraft has only to rise about 5° to get takeoff attitude. Therefore, only small elevator movement is necessary to obtain this. Once the nose boom comes up to horizon, hold that attitude. Now at this stage without AB the aircraft will ride on the wheels. If there is any tendency to depart from precise heading, rudder bar should be used for corrections, but only with care, as the feel of rudder is such that will give higher responses for the same force as speed increases, which is in opposition to Sabre and CF-100 feel. If the aircraft develops a small deviation from heading, accept this, provided the judgment is made correctly that the wheels will leave the deck before coming off the runway. But this can be done just prior to unstick.

The aircraft unsticks at about 160 -- 170 knots and must not be pulled off the runway, or it will come down again on wheels and lift is lost by elevator deflection. After unstick, climb away, watching the sideslip or ball indication, and correcting accordingly on rudder, to eliminate sideslip. The gear must be raised before 200 knots is attained. This means steepening the attitude up after unstick, or slightly throttling back, prior to gear up selection. As the aircraft unsticks, the airframe will vibrate noticeably. As the gear comes up, marked directional disturbances are felt. If allowed to develop without correction by rudder, some rolling effects may follow, the lateral control being rather heavy at this speed to suppress the roll. The best thing to do after unstick is to select normal gear-down damper on the trigger. This will tend to eliminate yawing tendencies.

After gear is up, vibration ceases and smooth flight begins. The elevator control is somewhat heavy, so is aileron, both break-out forces being about 4 lbs. The elevator, in addition, has a steep feel slope for small control movements. The first thing to do is to trim the aircraft to fly without using force. Then select gear-up mode on the right hand switch. The sideslip elimination is very good and, once gear-up mode is selected, rudder bar can be left alone. The next thing to do is to trim the aircraft with the damper to give zero sideslip either on the ball or the sideslip indicator. Then the aileron and pitch trim should be obtained. If throttling back was necessary before wheels-up selection, the throttles should have been opened right up.

The air conditioning makes lots of noise in the cockpit and, as the oxygen is breathed, this noise level seems to fluctuate. This is normal. Prior to wheels locking up, the automatic brake is applied to stop wheels rotating. This results in brake pedals being depressed away from the pilot's foot. As the pedals come down, there may be some rudder bar motion connected with it. On the

*climb, attain speed of approx. 300 -- 350 knots and establish climb at that speed.*

*The view from the aircraft on the climb is quite good and the attitude in military thrust is not at all excessive. There is noticeable lag in response on both elevators and ailerons, but this is, at present, quite normal. When reaching height of 25,000 feet, aim to hold 0.85M, or thereabouts, or otherwise very slow climb performance will result from this, particularly if speed is allowed to fall below 0.7M.*

### **Subsonic Flight Without Damper**

*The aircraft has less directional stability than long tail arm aircraft such as the Sabre or CF-100. Hence, it is easier to induce sideslip. The rudder, of course, is the primary source of sideslip inducement, but also aileron. The aileron drag of down-going aileron creates an out-of-balance directional condition resulting in yaw (called adverse aileron yaw, as it is, in direction, acting against the intended turn). This is very prominent in this aircraft without the dampers and, if aileron is worked fairly vigorously to maintain level flight, continuous reversed sideslip will appear without actually touching the rudder. In the highly-swept aeroplanes the effect of sideslip always results in strong dihedral effect. That is to say, if the aircraft nose is yawed to starboard, the port wing will have a tendency to come up in a roll. This is magnified at high angles of incidence, or at certain Mach numbers and attitudes. So that sideslip due to any cause will always result in a tendency to roll which, if suppressed by the aileron, will generate more sideslip. The main object in flying the aircraft without the damper is, therefore, to use co-ordination of rudder and aileron at all times, if sideslip is to be kept under control. If the aircraft rolls to port, due to starboard sideslip, starboard rudder and starboard stick movement should be used to regain level flight. The essential thing, however, is to remember that accurate directional trim is essential in this type of flight. So, prior to disengaging the dampers, one should ensure that, directionally, trim is as near as perfect.*

### **Subsonic Flight with the Damper in Yaw Only**

*This is quite straight forward, particularly if the gear-up mode is engaged. Any turn, in this case, is automatically co-ordinated. This results in flight without sideslip. For the damper gear-down mode, the transient directional disturbances are well-damped, but, in a steady turn, some sideslip will be evident to the pilot (normally port sideslip in a turn to port, and vice versa). This must be eliminated by small rudder input, which should be removed once straight flight is achieved.*

### **Supersonic Flight**

*Whilst it is possible at certain altitudes to achieve supersonic flight without afterburning, it is recommended that the AB is used for supersonic flight. The transition from subsonic to supersonic flight is characterized by small disturbances in roll, which might, or might not be detected at about 0.92. Also, pitch may appear a bit touchy. Supersonic penetration occurs at 0.95 and can be detected on instruments by a large jump in height indication (approx. 1500 feet).*

*Once the aircraft settles in supersonic flight, the control in pitch and roll improves markedly due to general reduction in sensitivity in control. The flight is much steadier and easier, provided the damper in yaw is used. Without the*

*damper the sideslip will be generated with ease, and must be eliminated by co-ordination of controls as previously mentioned. Past certain areas, the pilot will experience utmost difficulty to fly the aircraft clean (without dampers). Therefore, no clean mode (without the damper) is allowed, unless specially briefed. As no rolling manoeuvres have been done yet on the aircraft, and no excessive manoeuvring in pitch, this is, at the present, prohibited.*

*The acceleration in supersonic flight is rapid. Although no marked trim changes accompany this, it is difficult to fly aircraft accurately on instruments to any accuracy -- at first. This particularly refers to the Mach number or ASI stabilization. The deceleration from high supersonic flight is rapid if the afterburner is closed. The engine should, however, never be throttled back past 90% RPM until the speed falls off to subsonic value. (The tests on the intake behaviour after rapid closing of throttle have not been completed as yet.) The air brake supersonically does not have much effect. It must be appreciated that any turn gives increased drag, and Mach number may tend to fall. (Special briefing must be obtained before any appreciable g is pulled on aircraft in excess on 1.5 indicated g at high Mach numbers.)*

### **Descent**

*Throttle back to approx. 80% RPM. Extend air brakes and descend at 0.8 -- 0.9 MN [Mach number]. Occasionally, some intake rumble may be experienced, which manifests itself in the form of high frequency vibrational noise coming from sides of cockpit. As the speed is reduced with undercarriage up (at max. landing weight -- 56,000 pounds), towards 185 knots first indication of buffet is felt in the form of some airframe vibration. This will tend to increase in intensity from 170 knots. (The aircraft has been flown at 155 knots ASI just after takeoff, this representing 15° of incidence.) Lateral behaviour becomes progressively heavier as the speed is reduced (characteristic of spring feel), because the aileron movements needed for balanced flight are more pronounced. The control in pitch also becomes more sluggish and much attention is needed to keep accurate height by judicious throttle manipulation (approx. 90% RPM are needed at 160 knots ASI) to maintain altitude. If the power is reduced, very high rates of descent would result. With the gear down, the vibration is felt through the airframe. This is directly dependent on the airspeed. It is severe in some aircraft at 250 knots, moderate at 200 knots and light-to-moderate at speeds around 180 knots. More drag resulting from the gear requires more throttle to hold altitude (160 knots approx. 90% RPM). Provided the damper is used, there is no problem to fly at speeds around 170 knots. Without the damper, conditions are much more difficult, and very careful handling is necessary, particularly directed towards elimination of sideslip.*

### **Approach and Landing**

*Downwind should be entered at 250 knots, air brake extended and speed reduced to 200 knots ASI when the gear can be selected down. There is very little trim change connected with gear lowering, but height will be lost unless power is immediately increased for level flight. Check for correct gear indication, as well as external check by the chase plane. A wide circuit is recommended for approach. Before turn on the base leg is made, the damper mode gear switch should be selected to gear down mode. On receiving green light indication, turn commenced on base leg. During the turn it will be necessary to co-ordinate the controls to eliminate sideslip. (In the gear-down mode this is purposefully allowed to enable the pilot to correct for drift prior to*

*touchdown.) Quite large rudder force may be necessary to achieve this sideslip elimination. Once a straight run is achieved, it will be found that the view on approach is quite limited. Therefore, very careful approach must be made. The speed should be gradually reduced to 180 knots and held at that figure. (If higher approach speeds are used, long run results which, in case of parabrake failure, may lead to overrun of the runway.) A cross-check should be made on the incidence indicator which, at that speed and max. landing weight (56,000 lbs), should register approx. 12° -- 13°.*

*The beginning of the runway should be just visible over the nose of the aircraft which, for convenience, may be very slightly moved to one side of the windscreen just outside the divider panel. This is recommended, since it is felt that some familiarization is necessary before one is fully accustomed to the use of divider panel. Up to about 1 mile from the runway beginning, elevator and power adjustments should be made to achieve steady descent of approx. 1000 ft/min, aiming to touch down about 500 feet from beginning of runway. As runway is approached, the thrust setting for the rate of sink should be kept steady and the aircraft allowed to keep sinking until a gradual check is made on sinking rate, as the ground is approached, with the elevator. At this time the attitude will increase and, as the aircraft touches the ground, the throttle should be gradually closed. Beware of closing throttles too early, as the aircraft will sink very rapidly and heavy landing will result.*

*If the speed is excessive after crossing the runway, any elevator manipulation after touchdown may send the aircraft into the air again and heavy porpoise may result. In this case the stick should be immobilized centrally and the aircraft allowed to damp the porpoise by itself. Any tendency to chase the aircraft motion in this case will result only in aggravating the condition.*

*After touchdown the nose wheel should be put gently down on the runway and, once firmly down, the parabrake streamed. It is extremely important that the location of the parabrake handle be checked several times before takeoff, so that there is no need of visual check after landing. The parabrake is very effective, but often erratic in behaviour and has, in the past, given severe swing tendency, which must be instantaneously corrected with brake. Maintain straight run until aircraft slows down, using mainly brakes, as rudder effect is negligible with falling speed and there is no nose wheel steering. The parabrake should be jettisoned when clear of runway.*

### **The Great Debate: Some Excerpts**

After cancellation of the Arrow there was a great gnashing of teeth across the land. In the House of Commons the Progressive Conservative government defended its position, the Liberal opposition roared defiance, but the latter rang hollow. The Liberals, who had launched the Arrow with trepidation, at various times had threatened its cancellation. One of their best arguments was that the PCs should have delayed cancellation until alternate industrial work was found for Avro and its suppliers. Senior Liberal member, the Hon. Lionel Chevrier, stated in the House on March 2, 1959: "I say that the delay between October of 1957 and September of 1958 in reaching a decision [to cancel the Arrow] was completely unjustified. If the government is right now in abandoning the CF-105, it could and should have reached that decision if not a year and a half ago, at least a year ago ... and saved about \$200 million of the taxpayers' money." Chevrier's boss, Hon. Lester B. Pearson, agreed, stating the same day: "In view of what happened in the autumn of 1957 [i.e. the advent of the ICBM and Sputnik I] I suggest that was the time for the government to have come to certain decisions." Pearson then harangued the prime minister about not having tried to sell the Arrow to the US government. In fact, Canada had sought US



partnership, but only the most naive dreamer would expect Washington to invest in such foreign technology. In this regard, Pearson noted in the House of Commons on September 12, 1958: "The aircraft industry down there was not going to allow any interference with its own right to produce its own aircraft for its own government."

Meanwhile, the Opposition cried out against the purchase of Bomarc, suggesting that these were as costly as Arrows. Minister Pearkes addressed the issue on March 2: "May I give the actual figures of the cost. If we had gone ahead ... with the development of the CF-105 ... 100 of these aircraft would have cost us \$781 million and they would have been providing interceptor security between North Bay and Bagotville ... over the approaches of the great industrial centres and a certain number of SAC bomber stations in the eastern states ... we established two Bomarc squadrons ... The cost of those ... is in the neighbourhood of \$100 million, of which Canada is providing \$20 million."

On March 3 the Liberals admitted that, when they were in power, they had considered the Bomarc. Pestered about this by PC member Churchill, Liberal member Hellyer said: "That is correct. If we had truly co-operative continental defence, a point further north would have been the place to put the Bomarc line, and that was being actively considered ..." This is one of many examples showing how both sides were much of one mind -- get rid of the Arrow and replace it with some good, affordable equipment. In realizing this (it's all available for anyone to read in *Hansard*, especially the hefty editions of March 2 and 3, 1959), one can see that the Diefenbaker Conservatives, while vilified by political opportunists and history nincompoops, showed courage and principle by ending the Arrow.

#### **Arrow Expenditure: Avro's Figures in May 1958**

Basic development costs	\$52,402,975
Product improvement and flight test	\$54,013,803
Tooling/tooling improvement	\$30,929,886
Manufacturing: 8 aircraft, spares, publications, ground support equipment	\$64,787,839
Manufacturing: 29 follow-on aircraft	\$148,272,790
<b>Total</b>	<b>\$350,407,293*</b>

\*Exclusive of Iroquois and Astra

#### **Arrow Aftermath**

With cancellation, thousands at Avro and its subcontractors were laid off. For a few weeks the country was in shock, but recovery began immediately. The sharpest of employees quickly found work. A talented cadre "went down river" (as one of them put it) to Canadian Pratt & Whitney. There they joined a team of brainy, eccentric characters developing a small turbine engine -- the PT6. Decades later the PT6 is one of the world's great aeronautical successes, a product immeasurably more valuable to humanity than yet another jet fighter. Others from the Arrow team went to the US to contribute to a host of aerospace projects. Leading Arrow/Iroquois men like Jim Chamberlain and Owen Maynard rose to important positions in NASA, especially on the Apollo program. While Jan Zurkowski retired from aviation, fellow test pilot Spud Potocki joined North American Aviation in the US. Jack Woodman went to Lockheed.

Much was said about this supposed "brain drain", but it was all hot air. Some who went south would return. The "disaster" that awaited Canada, should the Arrow die, was another phony Avro PR come-on. Into the 20th Century Canada's aerospace industry never was in better health, producing a range of sought-after, leading edge products. By 2001 de Havilland/Bombardier had

produced more than 600 world-famous Dash 8 airliners. In regional jets Bombardier led the world, with more than 500 delivered. Bell had rolled out its 2000th Canadian-made helicopter, various contractors were busy upgrading CF-18 fighters, Canada was a leader in flight simulation and in space and satellite technology, in aerial survey products, etc. So much for the great lie that cancelling the Arrow sent Canada into the technological Dark Ages. In truth, that event opened the floodgates for growth and achievement. Consider the results, compared to Canada's industry stagnating in the dead-end world of jet fighters.

### "Demon Dief"

Unfortunately, every Arrow was cut up for scrap. Many blamed this on PM Diefenbaker, alleging that he personally had ordered the hatchet job. This was more Avro bunk. It was the DND, DDP and RCAF that had the Arrows destroyed, according to policy. The prime minister was not involved. Such matters were the responsibility of ministers and their underlings. (This long-understood principle often has been applied, e.g. on September 9, 1999 Prime Minister Jean Chretien, asked if he would help save the Snowbird flight demonstration team from the budgetary axe, replied that it was up to the MND, no matter how much the PM might favour the Snowbirds.)

For years it was a mystery who had allowed the Arrow torching. The task was viewed simply by DND and RCAF people at the time. Mainly, these were Air Marshall Hugh Campbell (Chief of the Air Staff, who would have accepted the CF-105, or, as he put it on August 21, 1958, "another supersonic manned interceptor of comparable performance"), Hon. George Pearkes (MND) and Hon. Raymond O'Hurley (MDP). This is covered in Peter Zuuring's book *The Arrow Scrapbook*, a "must read" for anyone serious about the Arrow story. Zuuring provides an excerpt about the scrapping -- on April 4, 1979 C.R. Nixon, Deputy Minister of National Defence, explained to the Canadian Broadcasting Corporation:

*As a result of an extensive search of our files, we have found some correspondence dealing with the subject. This ... largely substantiates the statements made by Mr. O'Hurley to the effect that, in the opinion of the Department of National Defence, the aircraft should be scrapped. The department was faced with the problem of how to dispose of prototype aircraft whose sophistication and technology were very advanced and quite sensitive from a military point of view... the aircraft had not been sufficiently tested to be put into service ... it would have been too expensive to continue the test program... the prototypes ... were offered firstly to the National Aeronautical Establishment and, later, to the Royal Aeronautical Establishment in the United Kingdom. Both organizations declined ... the only real alternative left was to scrap the aircraft, as there was no question of letting them fall into the wrong hands, whether ... of foreign interests or ... entrepreneurs wishing to acquire a tourist attraction. Furthermore, there is no indication in the documentation that the aircraft were considered to have some heritage value, or that it would be appropriate to display them in an aeronautical collection.*

### Sample Arrow Contracts

Date	Item	Value
March 29, 1955	Production of CF-105 aircraft, spares, ground handling equipment and publications	\$56,056,278
March 30, 1955	Design and development of CF-105	\$29,136,350
August 7, 1956	Publications for CF-105	\$42,637
September 19, 1957	CF-100 engineering ref. Sparrow II for CF-105	\$20,000,000

March 25, 1958	Production of CF-105 Mk.II	\$33,933,894
July 21, 1958	Repair/overhaul CF-105 airframe components	\$400,000
August 7, 1958	Repair/overhaul CF-105 airframe components	\$500,000

### A Last Word

Since 1959 many have commented on the Arrow. Books and articles have appeared. Cult-like fans have concocted goofy conspiracy theories, set up web sites, and formed societies. A full-scale Arrow replica exists, similar near-religious shrines are in the works. A TV "docudrama" has become so popular that its nonsensical interpretation is almost current history. This garbage is promoted by teachers who have never researched the topic.

Few who understood the Arrow objected to its end, only to the scrapping of the six beautifully-crafted flight test aircraft. C.R. Nixon's claim that these had no heritage value is one of the dumbest conclusions ever drawn about the Arrow. Yet, the scrapping of these artifacts is not just a Canadian "thing". After WWII the British government, for example, ordered destruction of amazing code-breaking technology developed at Bletchley Park -- devices that hastened the end of the war. First, 8 of 10 Colossus computers were destroyed; then, years later, the final two. While the Americans kept the sole surviving XB-70 and the British preserved examples of the RAF's TRS-2 strike fighter, the nearly-finished XF-103 was scrapped. Had at least one been saved, the Arrow might be seen in a more rational light, rather than turning into a silly *cause célèbre*.

### Bomarc Days -- 447 (SAM) Squadron

In 1962 the RCAF entered its surface-to-air missile era with two half-squadrons of Boeing Michigan Aeronautical Research Center (Model IM-99B Bomarc) anti-aircraft missiles. The Bomarc had its roots with a 1945 Boeing SAM project. Test models were fired, before the program gave way to the IM-99, which had radar to acquire a target, and a proximity fuse to detonate a nuclear warhead. The IM-99 was intended to destroy Soviet bombers far from urbanized North America (preferably over northern Canada or out to sea). The first prototype flew in 1952, the first launch to test all systems came in 1955, and the first production IM-99A (liquid fuel boosters, 200-mile range, 269 built) was rolled out in December 1957. Next came the IM-99B (solid fuel, 400-mile range, 301 built). Getting the Bomarc B operational proved frustrating -- there were many failures.

Along with 66 CF-101 Voodoos, the RCAF's 56 nuclear-armed Bomarc Bs constituted a viable air defence package. They were adopted almost immediately upon the demise of the Avro Arrow in February 1959, although political wrangling over nuclear weapons in Canada delayed proper arming of the Bomarc until January 1963, and of the Voodoos until September 1965. Training for RCAF Bomarc personnel began at Chanute AFB in Illinois. Technicians, posted from fighter squadrons, viewed this as a strange new world, until they found that the Bomarc was just another flying machine. Although some aspects of the Bomarc required a considerable technological jump, compared to a CF-100 or Sabre, staff soon mastered them. RCAF Bomarc squadrons -- 446 at North Bay and 447 at La Macaza, Quebec, set enviable serviceability records (there also were eight USAF squadrons). La Macaza was the only self-sufficient Bomarc base, all others being co-located on USAF or RCAF bases.

The first CO of 447 Squadron was W/C J.E.A. Laflamme, DFC. He and five other operations officers trained at Chanute, finishing with a thorough knowledge of the Bomarc, its computer-operated SAGE Direction Centre, and every type of war scenario. During a course at Hurlbert AFB, Florida, RCAF technicians showed such skill assembling a Bomarc that, when launched by the SAGE DC at Gunter AFB, Alabama, it destroyed a new QB-47 drone. This was a no-no, since



the missile was only to make a near-miss, thus saving the expensive drone (there were only 14 Boeing QB-47s, operated by the 3205th Drome Group).

La Macaza opened in September 1962. Personnel, who numbered about 200 (plus dependents), occupied 114 double-trailer PMQs in a trailer park just off base. Otherwise, accommodation was sparse, distant and often undesirable. The Bomarcs were housed in 28 shelters resembling big garages. The initial cadre, including senior NCOs such as FSgts Floyd Smith, Sonny Aumais, Len Goertzen and Don Hynes under S/L Elmer McGinnis, accomplished much in the early days. A key task was control of the Bomarcs. This was based at the SAGE DC in North Bay, and linked to La Macaza's ops centre, headed by F/L Terry Lyons. F/Os Merv Eagleson, Herb Karras, Gerry Maguire and Bob Merrick worked in ops, one always being on duty. Boeing tech reps Dick Kachel, Tom Russell, Dick Shafer, Ray Sloronski and Keith Svendby also contributed to operational effectiveness and to the quality of station life.

On New Year's Eve 1963 a USAF C-124 landed on the runway adjacent to La Macaza. Everyone watched as an aircraft, larger than most buildings for 50 miles around, disgorged "stuff" into the closely-guarded trucks. The "stuff" was Canada's first nuclear warhead. In May 1963 W/C J.L.A. "Joe" Rousell, DFC, succeeded W/C Laflamme. In these days "ban the bomb" demonstrators were a feature of Canadian life. As 447 was reputed to have nuclear warheads, La Macaza was targeted by activists, who camped on the roads around such ADC bases. W/C Rousell had a knack of defusing these demonstrations.

Canada's Bomarc warheads became the province of a USAF detachment, the 425th Munitions Maintenance Squadron, under Maj Dan Chisa and his small staff. They did an excellent job. As Bob Merrick later noted, "No one ever succeeded in stealing one of our Bomarcs." Even so, when an Air Canada DC-8 crashed north of Dorval, a Montreal reporter called La Macaza enquiring as to whether or not a Bomarc might have been launched accidentally. He was assured by the ops officer that all were still in their hangars and that someone would have noticed if one had been launched.

Two major tests periodically assured NORAD that the Bomarcs would respond to SAGE commands. The first was the Partial Squadron Demonstration that involved the SAGE controller, 447 ops officer, and maintenance control. The SAGE controller sent a launch message to the site, and a Bomarc "would leap smartly to attention", showing that it was ready for flight. The check list included positive measures to disconnect the fuse to the solid boost rocket that launched the Bomarc. A more complex test involved a Mobile Inspection Unit. The same three elements co-operated in sending a launch message to the Bomarc, but this was routed through the MIU, and technicians measured the missile's response to the various commands imbedded in the message. Such messages were sent over ordinary phone lines, until the local phone lines were brought down one day by a road accident.

Had WWII broken out, 447's ops centre had to take certain action. Thereafter, the Intercept Director's switch actions would cause Bomarcs to take flight, climbing to either 40,000 or 71,000 feet, according to his judgment. On lift-off, two ramjets fired, accelerating the Bomarc to M 1.3 or 2.1 (depending on the threat). From there, the Intercept Director used data link to control the Bomarc, much as a CF-101 was controlled.

In time the original 447 cadre broke up. Of this, Bob Merrick recalled in 1999, "As the charter members left, they could look back with pride on their achievement in putting a new weapon system, and a new station into a proud place in RCAF history." Eventually, the fear of Soviet manned bomber attacking North America faded. Canada's squadrons were disbanded in 1972 and the sites sold. The warheads returned to the US and most Bomarcs ended as USAF target drones in Florida. The 446 site became the campus of Canadore Community College, 447 became a prison. Later, 447 was re-activated at CFB Edmonton as a Chinook squadron. Readers wishing to know more about Canada's Bomarcs ought to read John Clearwater's *Canadian Nuclear Weapons: The Untold Story of Canada's Cold War Arsenal*.



## The Voodoo

When Canada freed itself from the Arrow, it chose the McDonnell F-101 Voodoo as the RCAF's new all-weather fighter. History shows this to have been the smart thing to do. The idea for what became the Voodoo first surfaced in the autumn of 1945. At that time McDonnell was responding to a USAAF request for a single seat, long range, bomber escort (day) fighter. The St. Louis company quickly offered its "Model 36 Voodoo", which the air force then labelled "XF-88". McDonnell's offering featured a 35-degree wing sweep, based on German wartime research. The air force ordered two XF-88s. The first flew on October 20, 1948, and exceeded Mach 1 on May 12, 1949, using 3000-lb thrust J34 engines.

In spite of a good flight test record the XF-88 drew little reaction from the air force, which now was favouring less exotic designs like the F-84 and F-86. In June 1950 the XF-88 flew off at Edwards AFB against the Lockheed XF-90 and North American XF-93 experimental escort fighters. It won handily, but no order ensued. Instead, the Pentagon decided to focus on all-weather fighters like the F-89. The XF-88s gathered dust, then ended on the scrap heap at Langley AFB. Nonetheless, McDonnell remained convinced that its design was "a natural". SAC still wanted an escort fighter and, in 1951, the XF-88 was revived as the F-101A. As such it flew on September 29, 1954 (four years before the Arrow), becoming the first airplane to exceed Mach 1 on its first flight. The F-101A was powered by J57s each of 10,200 lb thrust. Armament was basic -- four 20-mm cannons.

Testing the F-101A showed a fundamentally good design, but with one very bad feature. In certain attitudes the horizontal tail could be blanked out by the wing and cease responding to control inputs. The nose would pitch up and the airplane would fall into a flat spin. If this occurred at low altitude, the pilot had no time to recover and usually became a statistic. From high altitude there was time to recover, or eject. This quirk would plague the Voodoo to its last days, the only attempt to rectify the problem being a stall warning horn and an enunciator light on the instrument panel (these to warn you that you were about to die!) and a stick pusher. The latter would shove the stick forward when the system sensed the onset of pitch-up. For the best commentary about flying the Voodoo, refer to the pilot's notes written in 1957 by McDonnell's chief pilot Robert C. Little, and reprinted in Robert F. Dorr's fine excellent book, *McDonnell F-101 Voodoo*.

Regardless of progress with the F-101A, McDonnell still had an orphan on its hands. The air force wasn't buying, since SAC had lost interest in escort fighters. Then, in 1955 came a breakthrough. In those pre-U-2 days, rumours of a large Soviet bomber force were rampant. The idea of a long-range interceptor came into the limelight, and the Pentagon ordered the 2-seat F-101B for NORAD. Bob Little flew the first on March 27, 1957. Meanwhile, McDonnell had an order for a few RF-101A "recce birds", and Tactical Air Command adopted the orphaned F-101A, converting them to nuclear strike F-101Cs. The F-101B was armed with the Hughes MG-13 fire control system, two GAR-8 Falcon AAMs and two MB-1 Genie AAMs, the latter with 1.5 kiloton nuclear warheads. All systems were proven during 1959 trials with the 60th FIS at Otis AFB. In less than two years 17 Voodoo squadrons were on the line. The 479th and final F-101B rolled out in March 1961. As to costs, Dorr quotes some 1956 dollar figures for the Voodoo -- \$2.90 million per airframe, plus \$2.79 million for engines and electronics, i.e. a basic cost of some \$5.69 million per aircraft. One wonders how Avro could ever have delivered an Arrow for the price it was touting -- about half that of McDonnell! Clearly, Avro was having the people on about costs, but not everyone was as dumb as Avro assumed.

## Canada and the Voodoo

As early as August 1958 Chief of the Air Staff A/M Hugh Campbell was stating, privately, that if the Arrow was cancelled, this should be offset by procuring something else. From his post as Deputy Commander of NORAD A/M Roy Slemon made the same point in public. At a Chiefs of

Staff Committee meeting in February 1959 Campbell repeated that, even if Bomarc were based in Canada, the RCAF still would need 100 -- 115 fighters for six NORAD squadrons. When Ottawa did cancel the Arrow, however, its decision did not address the matter of a substitute. Prime Minister Diefenbaker explained this in Cabinet on February 6, 1960, the day his government approved purchase of the Voodoo. Notes from that meeting include the following ambivalent statement. They illustrate how politics colours any major issue -- politicians care first about getting re-elected. Genuine thoughts around the table are secondary -- politicians rarely even care to hear anything that might make good sense

*If the [Chiefs of Staff Committee] reported that security demanded the acquisition of these aircraft, then that would have to be the decision. To purchase them, however, would place him [Diefenbaker] and the Minister of National Defence in impossible positions. On the other hand, failure to re-equip would be bad for the morale of the RCAF. He thought the public had been convinced of the wisdom of the government's decision to cancel the Arrow. To obtain other aircraft now, in the face of statements that the threat of the manned bomber was diminishing and that the day of the interceptor would soon be over, would be most embarrassing unless a reasonable explanation could be given.*

The United States was prepared to make an outright gift of Voodoos to Canada. This was rejected in Cabinet as being too much like foreign aid. Acquiring fighters at little direct cost eventually was negotiated in a deal wherein Canada assumed the manning, operation and maintenance of certain radar sites. Announcement of the agreement came in July 1961. The decision made to acquire 66 Voodoos, practically the first event was a formal handover at Uplands on July 24, 1961. There, US Ambassador Livingstone T. Merchant ceremoniously turned over a Voodoo to MND Douglas Harkness. Transfers of the remaining aircraft were to begin on October 1, 1961 and be completed by April 26, 1962. The USAF name for this was Project "Queen's Row"; the term Project "Kitty Car" was applied to a program to upgrade the Voodoos before handover to the RCAF. This was complicated when Ottawa initially refused to authorize nuclear weapons on Canadian soil. It was not until 1965 that the RCAF received the nuclear-armed Genie for its Voodoos. The fascinating details of this episode are well explained in John Clearwater's book, *Canadian Nuclear Weapons*. Besides political history, the book includes the specifications for such weapons and details of their control.

First in Canada with Voodoos was 425 "Alouette" Squadron, commanded by W/C R.D. "Joe" Schultz, DFC and Bar. A well-known wartime night fighter ace (see *CAFWP*, Vol.2), Schultz had been CO of 413 Squadron (CF-100s). During the Arrow era he had been Air Defence Command's designated Arrow liaison pilot. In that capacity he frequently visited Avro and other Arrow contractors, then kept ADC HQ informed of developments. It was presumed that Schultz would command the first RCAF Arrows, to be known unofficially as the "Arrow Proving Unit", stationed at Uplands. When the Arrow was cancelled, it was natural that Schultz be offered the first Voodoo squadron.

The Alouettes received their first aircraft at Namao in October 1961. The story of how the original 425 cadre trained is covered in such books as *Sixty Years*. Once the OTU began at Namao, it was natural that some problems would surface. RCAF files suggest that introduction of the Voodoo was a prolonged headache (people seldom write a memo when things are going well). In one case, delivery of ground handling and servicing equipment did not keep pace with Voodoo arrivals. The US strove to make up deficiencies, and McDonnell helped in training RCAF technicians. A joint RCAF/USAF meeting in Ottawa on January 8-9, 1962 addressed the matter of insufficient ground support equipment. Other difficulties could only be handled by Canadians, e.g. runway and tarmac improvements. Writing on June 8, 1962, S/L G.H. Hielihy, an AFHQ engineering officer, described one dilemma in context:

*The simultaneous entry of the Bomarc, CF-104 and CF-101B to service has caused a*

*serious shortage of trained Armament Systems Technicians. The shortage is due to the formidable skilled labour needs of the new systems, aggravated by the lengthy conversion training necessary. In all, a shortage in excess of 100 technicians exists with little prospect of making up the shortage until at least the third quarter of 1963. The availability of technicians for the CF-101B program has been further restricted by the assignment of first priority to the CF-104 program.*

Whatever challenges the Voodoo presented, the overall program went according to plan, with all targets reached by June 1962. That month A/C M.P. "Max" Martyn visited Namao, home to '101 and '104 conversion. There he found the one humming along, the other beset by low serviceability and a shortage of specialist trades. Meanwhile, the coming of the Voodoo was heralded in Flight Comment, which wrote ("warned" might be a better word!) in November 1961: "You are handling more thrust per pound of aircraft than you have ever felt before, so it is especially important that you stay ahead of the aircraft ... There's a tremendous amount of thrust available, and plenty of control, but you can't expect to cowboy this aircraft with gay abandon at low airspeeds." Flight Comment observed that the USAF was pleased with the Voodoo -- when introduced, it achieved a relatively low accident rate, regardless of its quirky pitch-up habit. This was serious enough that McDonnell produced a film, "The Word on Pitch-Up", which was supplied to the RCAF. In March 1962 Flight Comment also reported some early Voodoo drama involving F/L J.W. "Dutch" Stants. The end results were happy and Stants, then with only 11:35 hours on type, received a Good Show:

*On takeoff from Cold Lake in a CF-101, F/L Stants was notified by the tower that his nose gear was still hanging. As he throttled back, the engine fire warning light illuminated and smoke filled the cockpit. F/L Stants immediately selected 100% oxygen, flamed out the affected engine, told the navigator to prepare for ejection, and declared an emergency. Shortly after the flameout, the fire warning light went out and the smoke began to clear from the cockpit; F/L Stants then proceeded with a single-engine circuit and landed without further incident.*

On January 14, 1963 Stants had another emergency. When his cockpit filled with smoke, he aborted takeoff and tried to deploy the drag chute. This failed, but he managed to engage the barrier available for such emergencies. The number of things that could go wrong in such a modern aircraft seemed staggering, e.g. installation of a tail hook for high speed landings meant that a cockpit warning device was needed, lest the hook fail. An incident at Uplands on March 19, 1962 showed another hazard. Preparing for an astern snap-up attack, a Voodoo pilot lowered his seat to view his scope. Almost immediately he found his breathing restricted, so descended rapidly to base. Investigation revealed that the oxygen hose under the seat was pinched. On raising the seat, normal flow resumed. Pilots were advised to ensure that hoses always were clear.

Beyond pitch-up, other Voodoo flight safety matters arose as time passed. A minor issue was rain dispersal from the windscreen, whether speed was high or low. The Americans were familiar with this problem, and recommended water-repellent sprays. These were tested at 409, half of a windscreen being coated, the other not. The conclusion was that the a spray would help. Something more serious was noted in May 1962 -- cases of RCAF Voodoo altimeters giving inaccurate readings, being as much as 3150 feet in error! The biggest worry was that a Voodoo might level off at an altitude used by commercial airliners. As an interim "fix" pilots carried compensation index cards to convert indicated to actual altitude. A/V/M W.R. "Iron Bill" MacBrien, AOC ADC, considered cards inadequate. Permanent corrective measures were delayed into 1964 by the need to keep aircraft as close to USAF standards as possible, and by the fear of both users adopting different solutions. Problems with altimeters or other components usually were resolved by working closely with the McDonnell and other suppliers.

### Squadron Life

documents usually are less informative than wartime Operational Record Books, but help to flesh out the Air Defence Command story. The typical squadron had 12 Voodoos, some T-33s, about 55 officers and 290 Other Ranks. As of 1962 the CO (a W/C) was assisted by a Senior Technical Officer and a Personnel Administration Officer (S/Ls), plus two Flight Commanders (F/Ls), an AI Navigation Leader (S/L), and four F/L specialists serving as Senior Operations Officer, Electronic Support Officer, Mechanical Support Officer and Aircraft Repair Officer. These arrangements changed with circumstances, particularly after nuclear weapons were acquired. When 425 Squadron drew up its Organization Chart for December 1967, it showed the CO having four officers reporting directly to him (Training Officer, Operations Officer, Executive Officer, Weapons and Tactics Officer); the Flight Commanders reported through the "OpsO". Because it operated at Bagotville and Val d'Or, 425 had four flights with roughly seven crews each. This also meant that, in terms of personnel, 425 was larger than usual -- 33 pilots, 32 navs.

#### RCAF Voodoo Squadrons

Squadron Name	Commencing	Base
409 Blackhawk	March 2, 1962	Comox
410 Cougar	November 11, 1961	Uplands
414 Black Knight	February 1962	Namao
416 Black Lynx	January 1, 1962	Bagotville
425 Alouette	October 15, 1961	Namao

Documents from 416 Squadron give an overview of conversion training. On January 2, 1962 the squadron moved from Bagotville to Namao for the Voodoo course. The first four days were spent on lectures, followed by familiarization trips. "It was with some apprehension that the pilots approached the Voodoo for the first flight", wrote 416's diarist. "First trips were best described by a slight smile and a dazed look worn by all pilots and navigators after landing." By January 9 all 416 pilots had completed solo trips and joined the 1000-Mile-per-Hour Club. The only difficulties had been slippery taxiways, with S/L Johnstone and F/O Delong becoming founders and first members of the "Boondocks Club". The second part of the course consisted of instrument checks for pilots, and AI training. There were two near misses on January 14, with one pilot making a wheels-up approach, until warned by an alert tower operator; and another pilot flew between two Voodoos without noticing either, until he was passing them! Advanced AI training and combat checks completed the course. On February 1, 416 returned to Bagotville to commence operations, then moved to Chatham in November.

The first Voodoos for 409 Squadron (17445 and '446) reached Comox on March 2, 1962. By March 13 the squadron had 12 crews posted in from OTU at Namao. Six days later Voodoos relieved CF-100s at readiness. On March 23, 409 reported its first Identification Scramble by two Voodoos (F/Os P.C. Yorke/V.H. Wheeler, S/L C.W. Moore/F/O R.M. McGimpsey). On April 19, 1962 the last 409 CF-100 (18474) flew to Lethbridge for storage. (Comox may have thought it was seeing the last of "the Clunk", but on September 15, 1962 it returned with the Electronic Warfare Unit (3 CF-100s, 8 aircrew, 15 groundcrew).)

The 409 Historical Report tersely noted that at 1731 hours (Zulu) on October 24, 1962, its readiness rose to DEFCON 3C (i.e. a high level anticipating war). As of 1648 on November 3, then at 0006 on the 28th, this was reduced progressively. Thus did 409 spend the Cuban Missile Crisis. 425 Squadron, operational on Voodoos since October 1, made no mention of such events. The only comment from 416 was that normal routine had been followed until October 24, "when additional crews were called in following the US move against Cuba." The only 410 reference to the emergency was on October 24: "All crews of 410, including the new crews, were considered to be combat ready in the face of the Cuban crisis." Such operations seldom were described in detail -- another shortcoming of record keeping at the time. For 1962, 409 simply listed the following exercises with no embellishment:



Date	Exercise	No. Sorties
June 15	"Right Cross 16"	15
June 17	"Turkey Shoot"	17
July 25	"Right Cross 17"	6
August 2	"Right Cross 18"	10
September 19	"Beardown"	4
September 26	"Right Cross 19"	8
October 22	"Beardown"	20
December 11	"Turkey Shoot"	25
December 16	"Turkey Shoot"	25

Besides exercises, however, there were non-operational taskings. On July 28, 1962 the Blackhawks despatched seven CF-101Bs to Colorado Springs for a flypast honouring retiring NORAD Commander, General Lawrence Kuter. Reports note numerous flypasts through the summer of 1963, e.g. 2 aircraft for a flypast at Texada Island (June 30), 2 for Campbell River (July 1, Canada Day), 2 for Port Hardy (July 19, opening of new air terminal), 2 for Kamloops (August 7, local airshow), 1 for Powell River (August 10, local Sea Fair), 3 for Victoria (August 16, Air Force Day), 3 for Comox (August 17, Comox Day), and 3 for Nanaimo (September 26, opening of the Vancouver Island Exhibition). When not flying, unit personnel were on hand to show off their aircraft and facilities to visitors ranging from the Associate MND, to a delegation of school principals.

In one report 409 briefly described a Voodoo prang: "On 14 Jan 1978, Captains F. Martin and R. Littler touched down short causing a failure of the starboard main landing gear. During the subsequent deceleration and roll of the aircraft Captain Littler ejected. The aircrew received only minor injuries; however aircraft 101023 was damaged beyond repair." *Flight Comment* of January 1978 offered a detailed pictorial spread of this incident. Although it named no names, the article's tone was a touch sarcastic:

*It wasn't long after man invented runways until he invented what we have come to refer to as "short landing" - in fact, while historical data are not available, we would be willing to bet that the two inventions were almost simultaneous.*

*In the old days of course, the after-effects were not always critical. In many cases the runway was just a frill anyway, the aircraft of the day being generally capable of grass field operation. Sometimes, however, the approach to premature touchdown presented its own hazards in the form of telephone or power lines, fences and even herds of animals grazing on the perimeter grass.*

*Recently one of our Voodoos touched down short. It might have been capable of grass field operation, had one of the main landing gears not been damaged by the snowbank which covered the grass. Be that as it may, the aircraft made it to the runway and proceeded up it, gradually veering to the right and leaving the paved and cleared surface.*

*One of the crew members ejected and, although his parachute did not have time to inflate and drop him to safety, his trajectory, plus the snow present in the infield, combined in saving his life. The other crew member rode the aircraft to its inverted halt and was removed from the machine in reasonably undamaged condition.*

*Without going into the whys and wherefores of the whole thing - which remain pretty*

*much of a mystery at any rate - we will simply quote again the old saying which indicates that "If they built a runway around the world at the equator, inevitably someone would manage to land short and someone else would run off the far end."*

On December 11, 1962 the 425 diarist recorded a curious incident:

*KO53, F/O Jensen and F/O Walker, had a bit of excitement last night; a SAC crew flying a KC-97 ran into problems. Their aircraft developed an electrical fire and the crew elected to bail out, but after bailout the aircraft continued to fly. It flew through the Montreal control zone and continued on up towards the Bagotville area. KO53 and F-101 were scrambled. GCI vectored them on to the KC-97. F-101 got a contact on the KC-97 and flew into position expecting they would have to shoot it down. But apparently one of the crew members was missing and it was not sure if he was still in the aircraft. F-101 maintained surveillance till their fuel was low, then they returned to base. The KC-97 continued up north, nobody knows where.*

In its 1963 Historical Report 425 complained that 416 had "bent" one of its Voodoos. This was the horrendous incident of October 10, 1962, which 416's historical officer described as "Black Wednesday". :

*Whalley/Jeffries were rolling down runway 11 on take off when Stu's aircraft struck a TCA Viscount "mysteriously" on the live runway. The Voodoo tore the rudder off the Viscount and split open the top of the fuselage, then miraculously continued flying. Ray, on orders, ejected, while Stu fought to keep the burning aircraft in the air, then ejected himself as the 101 rolled on its back and started down. Results of the prang: two dead and eight injured passengers, one demolished Viscount, a hole in the field opposite the button of 29 where a 101 went in, a nav with a broken ankle, plus a fine war story, and a pilot shaken up but deserving of credit for the fine job he did to keep the tragedy as low as possible.*

[*Sixty Years* provides further details of this story.]

The early routine for CF-101 crews was described ably by 425 Squadron in its 1963 Historical Report. This began by reporting 425 as having 12 Voodoos and 17 crews. On average, it received a new crew every six weeks. Pilots fresh from OTU had about 30 hours on type, navigators -- 18. Three or four weeks familiarized the newcomers with local procedures. Ground training accompanied flying, each aircrew taking about 150 hours of such instruction. The Navigation Radar Leader was chief instructor, subjects including aircraft engineering, armament, intelligence and current events. Under the heading "Flying - Day to Day", 425's historian noted:

*The squadron worked the day on, day off system, working Monday, Wednesday, Friday and week-end alert; or Tuesday, Thursday, weekend off. Days "on" were spent flying the Voodoo or on alert. The simulator and T-33 time were scheduled for days off. The crews spent about 65 hours a week "on the job". The alert requirement was for two aircraft on 5-minute and one aircraft on "one hour". The number two alert was flown as long as a combat ready team manned it. A desirable 16, minimum 12, trips were flown in a month and most crews managed to get between 16 and 20 hours...*

*To keep the squadron on its toes and to test its effectiveness, many exercises were held through the year. These included six station-run exercises spaced through the year, and two Tactical Evaluation visits, as well as approximately 16 assorted Sector and Region efforts.*

*The station exercise on the 23 October was especially noteworthy as it was run as a competition. The experiment was so successful that it was decided to schedule more in the future. The Tac Eval visits were in February and December and both could be considered successful. The second was marred to a certain extent by unfavourable weather.*

Squadron diarists, given more to brevity than detail, made things tough for historians down the road. 416's description of April 10, 1963 hardly sounds like a dramatic day: "This was Tac-Eval Day. The exercise started at 0400 when both alerts were scrambled; between then and 1600 the squadron flew 58 missions and had a 48 percent MA [mission accomplished] rate. A potentially dangerous situation occurred in the morning when [F/O] Hyslop suffered orientation problems. Thanks to cool determination on the pilot's part, and some excellent help from [F/O Donald F. Parker] in the back seat, the aircraft was safely landed. Alert aircraft were again scrambled late tonight by the Tac-Eval team." The entry barely hints at what transpired in Voodoo 17463. On May 7, 1963 the CO, W/C E.D. Kelly, recommended Parker for a rare award. It went right through all command levels and was announced on January 4, 1964. The citation to Parker's "gong" (an Air Force Cross) reads:

*On the morning of 10 April 1963, Flying Officer Parker was the navigator of a CF-101B aircraft of No.416 All-Weather Fighter Squadron participating in a tactical exercise. During the second mission in which he and his pilot participated, while making an attack on a target aircraft at 20,000 feet, Flying Officer Parker was surprised to observe his aircraft turning in the wrong direction for the intercept manoeuvre which was underway. Upon querying the pilot, Flying Officer Parker deduced from the replies that the pilot was in difficulty and suspected that a malfunction of oxygen equipment was the cause. He calmly, but emphatically, directed the pilot to descend and follow emergency oxygen procedures. When this action produced no tangible results, and from further remarks made by the pilot, Flying Officer Parker realized that the pilot was seriously ill. He then commenced to direct the pilot to return to base and prepare to land the aircraft. Although the situation was obviously hazardous, Flying Officer Parker did not even declare an emergency in his radio transmissions, since he had reasoned that this would unnerve the pilot completely. Nevertheless he elected to remain with the aircraft and to attempt to save it and the pilot. Handling all radio transmissions himself, he soothed, persuaded and encouraged the pilot through the approach and landing in less than ideal weather conditions, in spite of the pilot's uncertain and often incorrect reactions which caused the aircraft to repeatedly approach critical performance limits. Following the landing, the pilot collapsed almost completely and was helpless. Flying Officer Parker climbed forward to shut down the engines and assist groundcrew and medical personnel in removing the almost unconscious pilot from the cockpit. Throughout a dangerous situation, Flying Officer Parker demonstrated exceptional courage, devotion to duty and loyalty to his pilot, in hazarding his own life when he might have safely ejected from the aircraft. His cool and skillful direction, which made full use of the pilot's severely limited ability, was instrumental in saving both their lives and a valuable aircraft.*

One of rare Voodoo squadrons to describe a few exercises in any detail was 410. On May 9, 1963 it reported Ex. Big Shot Papa, involving 10 scrambles and 16 attacks on participating SAC targets coming in two waves. Thirteen were considered successful, three were failures attributed one each to crew, evasive action and AWC. Turn-around time had been 11 minutes following the first scramble, 26 after the second.

Ex. Cold Wave of May 14, 1963 involved 31 scrambles. Crews reported 42 attacks (36 successful). Failures were attributable to radar malfunctions (2), GCI failure (1), ECM jamming (1)

and safety concerns (2). Equally important was that average turn-around time (from touchdown until an aircraft was ready to scramble again) was 9.5 minutes. This reflected well on 410's armourers and refuellers. On May 21 came Ex. Cats Eye 7/63. This was much less satisfactory: 17 scrambles and 29 attacks, but this time MIs (missed intercepts) totalled 11. Of these, 3 were attributed to GCI failures, 4 to radar malfunctions, 1 to crew error, 2 related to safety, and 1 was obscure. Ironically, 410 had to cease flying for the last two days of May because it had exceeded its monthly quotas of sorties and flying hours.

A Voodoo squadron could succeed well when operating from home base, but 410's experience suggests that success might slip when aircraft were deployed, and as operations intensified. Between September 18 -- 23, 1963 the squadron participated in three "Cats Eye" exercises from North Bay and Val d'Or. First, they had an 84% success rate, then 58%, finally 52%. However, after several weeks of debriefing, 410 attained 72% in its next "Cats Eye" (October 17). It had an exceptional run on October 30 during a "no notice" practice -- 83% on seven intercepts

In wartime an 83% success rate still represented a 17% failure rate - and atomic weapons were terribly unforgiving. Just how dangerous things could be was shown in January 1964, when more than half the sorties had to be cancelled due to ice-covered runways. Of course, in a shooting war, safety would have been thrown aside to ensure maximum effort. Everybody understood the odds and the stakes. Occasionally a scramble intercepted an real bandit. For the night of January 20-21, 1981 416 noted that two of its Voodoos intercepted and photographed two Soviet Bear "D" bombers playing around in the Coastal Air Defence Identification Zone. The crews on this occasion were Maj H.J. Henwood/Capt S.C. Peach and Capts E.E. Boyd/F.D. Robinson. Peach got one picture showing Henwood forming on a Bear. On April 24, 1982, 416 reported that two aircraft (Maj J.A. Hall/Lt J.M. Forbes, and Lt D.W. Dolan/Capt J.R. Seel) operating from Gander on a "Coldshaft" exercise had intercepted two Bears. The incident was typical of Cold War operations. One side would test the other's defences to see how fast it could scramble and what tactics were used. Not all scrambles resulted in contacts, e.g. for June 1978, 416 made three without result, then caught up with two Bears on the 25th.

Many intercepts involved friendly aircraft. SAC tankers deviating from flight plans might find a Voodoo making inquisitive passes. There were several false alarms in August 1981, when US air traffic controllers went on strike (and were promptly fired by President Reagen). On July 30, 1982 two 416 Voodoos (Martin/Burton and Black/Robinson) scrambled to find their target an Iberian Airlines DC-8. The squadron diarist noted: "The airliner's flight plan had been lost somewhere in the ATC system".

After each mission a Voodoo crew debriefed in detail. A standard form included the navigator's log, flying time, weather at various altitudes, even the time that engines were shut down. The target was described under several headings - type of aircraft, altitude, heading, and Mach number. The crew had to report its tactics, speed, weapons mode, ranges from turning onto vector through to lock-on, then subsequent action. Electronic countermeasures were noted, as were any malfunctions. Even routine training flights generated their share of paperwork.

Through the Cold War, US and Canadian fighters faced off with the most formidable of all "opponents" - their own air forces. It was assumed that USSR bombers would be crewed by elite personnel and equipped with the most effective defensive measures. In fact, the Soviet equivalent of SAC was a decade or more behind in almost every respect, from bomber design to defensive measures to strategic concepts. When Voodoos and Delta Darts scrambled after B-52s, B-57s, and Vulcans, they faced "chaff" and electronic jamming far more sophisticated than anything the enemy might have.

In one period 416 Squadron was blessed with a diarist who blended wit with detail. One instance of his talents involved a mixed flying exercise and party dubbed "Survival" at Chatham August 26 to 28, 1982. The event attracted 300 personnel and 83 aircraft visiting Chatham. Types included F-5, A-4, A-7, A-10, CF-5, T-33, Tutor, C-130, F-111, CF-101, P-3, KC-135, F-106, Tracker and

Buffalo. The writer described the non-flying merry-making (beer and oysters, a "sumptuous seafood feast", entertainment, at least one champagne breakfast), but he was most eloquent when recounting one arrival:

*Part of the festivities included an arrival competition where visitors were graded on the aesthetic appeal of their initial pass over the Base. An F-111 from Plattsburg Air Force Base, with a 416 Voodoo clamped on each wing, claimed first place. As the tight Vic formation crossed the field at 400+ knots the F-111 simultaneously dumped fuel and selected afterburner, igniting a 70-foot stream of flame behind the formation. At centre stage the 101's executed simultaneous vertical breaks from the Vic formation. The 416 boys showed good airmanship by avoiding a line astern position on this guy !*

Running down and disbandment of squadrons could be sad and frustrating. However, 410's departure at Uplands on March 31, 1964 was a class act. The unit held a Farewell Formal on March 6, attended by its first wartime CO, G/C Paul Davoud. A wake held on March 20 was a more casual affair. On the 31st the AOC ADC, A/V/M Max Hendricks, and an official party, presided over the event. Included were a parade, flypast, and handing over of the squadron badge to the chaplains for safekeeping. At 1430 hours, eight Voodoos flew over Ottawa City Hall and at midnight the squadron officially died. A few days later the Hon. Walter Dinsdale (ex-410 member and a sitting MP in 1964) expressed his regrets and asked the MND why one of the RCAF's most historic squadrons had been disbanded, while more junior units survived. Minister Hellyer had no reply, but 410 reappeared some time later as the Voodoo OTU.

For 409 Squadron the stand-down process began in 1982. Over a period of two years no new aircrew were posted in. In May 1984 Voodoo 101010 returned to Comox from Bristol Aerospace in Winnipeg, the last 409 aircraft to receive off-base maintenance. Although making do with shrinking resources, 409 operated almost to the end, e.g. with practice scrambles and SPADEs (Simulated Penetration Air Defence Exercises). The last detachment saw two 409 Voodoos deployed to Ex. Maple Flag XIII at Cold Lake in May 1984. The squadron diarist observed, "Over the years the Voodoo has contributed greatly to the exercise, simulating Soviet aircraft, providing the other participants with a realistic adversary".

As if to show that it would go out with a bang, 409 lost a Voodoo in its final days, 101007 crashing on Texada Island soon after takeoff on June 22, 1984. Capts Tom Chester and Bernie Hughes ejected and suffered minor injuries on landing. 442 Squadron executed a speedy rescue. After medical checks the men returned to squadron where they were celebrated as "conscientious ejectors". Investigation revealed that a catastrophic failure of the left engine had cut fuel lines and control cables to the empennage.

On July 1, 1984, when 409 (AW) Fighter Squadron closed, 28 officers, 120 Other Ranks and 10 Voodoos remained on strength. The Voodoos left for Cold Lake on July 6 to be present for the formation of 409 (Tactical) Fighter Squadron with CF-18s. From there the Voodoos dispersed, four to 416, one each (for heritage purposes) to McChord AFB, Colorado Springs and CFB Edmonton. Two others returned to Comox as Aircraft Battle Damage Repair training aids.

### **RCAF Voodoo Pioneer**

Thomas W. Murray, born in Scotland in April 1933, joined the RAF in 1951 to fly the Meteor and Vampire, then the Hunter. One day in 1956, while in London following a survival course in the south of England, Murray noticed the RCAF recruiting office. Out of curiosity he went in and soon learned that the RCAF was paying \$500 a month, far more than the RAF rate. He wasted no time signing on and soon was instructing on T-birds at Gimli. There he got to know such renowned characters as Bill Bliss, Pete Griffiths, Ken Lett and Howie Tetlock. Murray next was posted to CF-100 OTU at Cold Lake, flying there first on June 5, 1960. On October 17 he made his first sortie



with 409 at Comox. In 2001 he recalled how he first became involved with the Voodoo.

*On July 6, 1961 my nav, Rob McGimpsey, and I were on an early morning scramble at Comox in CF-100 18566. On landing, I got word that "the Boss", W/C Hal Bridges, wanted to see me. Having completed our sortie with some very tight circuits and low go-arounds, I thought, "Uh-oh, you've pressed it too far this time, Murray!"*

*But the word was good ... with a big smile Hal told me that I would be leaving 409 Squadron to join the initial cadre of RCAF Voodoo crews. Our job would be to check out the five squadrons soon to convert to Voodoos. Along with 425 Squadron navigator Dave Mitton I'd be preceding everyone. Our job would be to indoctrinate all crews, using a simulator at 410 Squadron at Uplands; then do acceptance flying there on Voodoos as they were delivered.*

*After a brief technical ground school at Otis AFB in Massachusetts, Dave and I travelled (first class on the airlines) to Hamilton AFB, California to join the 83rd FIS. This posed a problem -- how were the 83rd's pilots to keep current with Canadian visitors using their planes? This was resolved by having us fly Tuesday to Thursday. We stayed out of the way for the rest of the week. This allowed us plenty of time to handle the two cases per month of duty-free booze to which we each were entitled!*

*Our first flight was in Voodoo 59-460 on July 27. We soon became good at the job, finishing with a final trip in the same aircraft on September 14 (Voodoo '460 later came to the RCAF). We each had 34:40 hours on type -- no wonder we knew it all! Now we returned to Ottawa to begin an intense period in the simulator and at flying -- squadron personnel now were pouring through the course.*

*Early summer of 1962 found Dave and I transferred to 410. Again we found our way south of the border. This time we were off to the prestigious Interceptor Weapons School at Tyndall AFB in Florida. Again we were obliged to uphold the great RCAF traditions of superior airmanship and dishing out lots of duty-free booze! My first Tyndall trip was on May 15 with Capt Bob Goad. For that occasion my logbook reads: "A/C 273. Fire, flash to steady, one engine out. Landing with fuel load 9500 lbs."*

*Yes, my first trip included an engine fire right over Florida's alligator-infested swamps! First the fire warning light flashed, indicating a possible fire. Then it glowed steadily -- confirmation that something was burning! Trying to keep cool, I transmitted emergency calls and was turning back towards base, when a voice with a strong Southern accent drawled from behind, "You just say the word and I'll go." I figured that if that was as fast as Bob could talk, this couldn't be a real emergency. Nevertheless, we streaked back to Tyndall for the fastest landing of my life. Let's see ... 175 knots minimum, add 5 knots for single engine out, add 5 for every 1500 pounds above 3000 pounds of fuel. Sounds like 205 - 210 KIAS. Spike it on, drag chute holds, get out ASAP. We soon appreciated our problem -- a burner can had failed, blowing a hole in the fuselage. After all that fun, the rest of the course was a snap! Things wrapped up on June 29 with a trip in the TF-102. In all the course totalled 25 flights: 26:00 hours in the F-101B, 7:10 in the TF-102. The latter flights were to familiarize us with a different type of fire control system and to intercepts without the benefit of a navigator.*

*Back at 410 I was fortunate to be designated 1962 airshow pilot, so got to tear up*

*places like Trenton, Val d'Or and Toronto's CNE waterfront -- low, fast and noisy. My back-seaters for these shows were Dave Milton at Val d'Or and Trenton, and Jeff Bingham (RAF) at the CNE. The Voodoo was a good airshow performer, especially as fuel burnt off and the thrust-v-weight ratio approached one to one. Unfortunately, with all those courses I had made myself "invaluable" and in March 1963 was transferred to ADC HQ at St. Hubert. There we set up the original CF-101 TACEVAL Team.*

On the airshow circuit Tom Murray discovered that 450-500 knots was the best range for most manoeuvres. Putting it another way, "Dead slow for that airplane was 300 knots. The secret was to keep your speed up, then you could do as you pleased. We only had one scary airshow moment in 1962. Our yaw damper kicked out during a high-g turn over the Bay of Quinte at Trenton. Fortunately, it kick up, not down, it that would have been it!"

For the CNE show the Golden Hawks were the final act, preceded by a pair each of Starfighters and Voodoos doing slow and fast runs. Murray recalled: "The go as fast as possible, yet not go supersonic, required going in and out of burner. I had my routine down until the last day, when the high-speed 104 (Clive Loabster of CEPE) got into some very rapid yo-yo oscillations right in front of me. It was so fascinating to watch that I left the second burner in a fraction too long. We came within 5-10 knots of going supersonic right in front of stage centre. Clive went up and I came out of burner so fast that I almost broke my wrist -- can you image trying to explain that one to a Board of Enquiry!"

Murray enjoyed many a further Voodoo adventure. One winter's day at Cold Lake the challenge was on -- a "104" honcho wanted to "drag" Murray in his Voodoo. Out they taxied and roared away in a 2-ship takeoff. As Murray put it, "the Voodoo was nothing but thrust" -- he left his challenger behind. The unofficial numbers indicated that Murray levelled at 35,000 in 1:19 minutes, his challenger in 1:22. In 1965 the RCAF sent its first team to the USAF William Tell fighter competition at Tyndall AFB. A squadron-wide competition was held, which 425 won. Tom Murray recalled in 2001:

*The Alouettes won the right to represent Canada and they cut a wide swathe through Tyndall. An RCAF trait in those days was holding the Voodoo low on takeoff. The base flight safety officer attended one of our "Willy Tell" briefings to inform the troops that such a practice was unsafe and he would be at the end of the runway next day to check altitudes. Unfazed and nonchalant as always, W/C Mike Dooher of 425 queried in reply, "Are you going to be sitting or standing?"*

*In the end 425 placed second. This was only because the heat-seeking missiles allocated to them failed to guide -- "sand seekers" we called them. Paul Dzulinsky of 425 was the youngest pilot at the meet, so a dual F-106 with a TV camera man was sent up as chase for one of Paul's missions. Clancy, a USAF pilot whom I knew well, did his best, but Pete didn't want to be caught that day. All they got was his takeoff and landing, and a few shot of Pete disappearing ahead. Clancy later wondered, "What on earth is it that they feed those guys?"*

In 1966 Murray was still at ADC HQ, but there were signs of change in the wind. There was a lot of the talk about "unification" and the Army was moving into St. Hubert. This did not auger well for anyone in air force blue. At Friday beer call one afternoon some Army general made an announcement to the effect that the fly-boys at the bar were getting a bit rowdy! Aircrew just couldn't understand a fellow like that! Oh well, the airlines were hiring and a flight lieutenant could double his pay by making the move. That's what Tom Murray did. In 1966 he joined United Airlines on the DC-6. Over the years he flew other types, finally retiring off the DC-10 in 1994.

### **First Bear Intercept**

RCAF Voodoos were tasked to intercept unknown aircraft entering Canadian airspace. Targets

would be acquired and tracked by DEW Line or other radar sites; data would be analyzed by NORAD, e.g. checked against airline flight plans. Voodoos might be scrambled to investigate. Beginning in the 1960s "unknowns" often turned out to be Soviet Bear bombers testing NORAD readiness and/or doing electronic snooping. This was a cat and mouse game that both Cold War protagonists had been playing since the early 1950s. The USSR proved to be a sticky customer regarding such incursions. While it would have taken great umbrage had one of its aircraft been attacked for nosing around, say off the New England coast, the USSR had no compunction about attacking American "spy" aircraft -- B-50s, B-47s, P2Vs, etc. As recently as 2001 China still was playing tough with US aircraft in international airspace off its shores. That April PRC fighters buzzed a USN EP-3 patrol plane so aggressively that a mid-air collision occurred. One fighter crashed and the EP-3, severely damaged, had to seek haven in China. Naturally, China, having caused the trouble in the first place, made a huge and idiotic fuss.

RCAF/CF Voodoos made numerous Bear intercepts over the years. In a typical case, on June 26, 1968, 416 Squadron was on alert at Chatham with two Voodoos on 5- and two others on 15-minute readiness. Lead for the latter pair was F/L R.D. "Pat" Pattison (his AI nav was S/L Ron Neeves). Pattison recalls:

*It was a clear summer day and we on alert were busy getting bored by sitting and reading, watching TV, or playing cards to pass the time. As we lazed about just after lunch, the scramble horn sounded and away dashed the 5-minute crews, strapping in, firing up and taxiing out of the barn for takeoff. With burners lit, they lifted off Runway 27, carved around to the east and disappeared from sight in their A/B climb.*

*This was a "hot" scramble. Now the 15-minute crews came up to 5-minute status. We got the information that Northern NORAD radar had picked up a trio of unidentified aircraft coming down between Iceland and Greenland, heading for Newfoundland. The GCI radar operators were certain that these were Russian bombers, which had radar of their own -- they soon picked up the incoming blips of our Voodoos. To confound our efforts, they set up an enormous 100-mile holding pattern over international Atlantic waters. This caused the Voodoos to burn excessive fuel, forcing them to set course for Gander.*

*Having shaken off the first pursuers, the Russians completed their holding pattern and returned to their original track of 235° at 35,000 feet. Now GCI decided to scramble the new 5-minute alert birds to see if they could catch the Russians with their pants down. The horn sounded and off we scrambled. Ron and I donned our Mae West and parachutes, sprang up the ladder and into the cockpit, hooked up the seat pack connections, Mae West and oxygen, then I hit the start switches to bring the engines to life. In 2 1/2 minutes we were taxiing and closing the canopy. I plugged in the burners and quickly lifted off, climbed and bent around to the right onto the initial vector of 090°, then came out of burner. No.2 was a bit slower getting airborne, but he caught me in the climb.*

*We torqued eastbound at Mach .85 at 35,000 feet -- GCI wanted us to get there ASAP. They called "Gate", we stroked the burners and were rocketing along at Mach 1.3 over the Gulf of St. Lawrence. Ron soon had a radar contact with three aircraft flying line astern each about five miles apart. Now cruising at .85, we picked their leader as our target, called that we were taking over from GCI, then heard our wingman declare Bingo fuel. He was breaking off and heading for Gander for fuel. We had more than enough fuel to complete the intercept, so wondered about this. But, rather than argue, I told him to get lost. Now we rolled in two miles behind the lead bogie, so we could*

*make a visual ident. To protect against possible Bear retaliation (i.e. cannon fire from the tail turret), I had my missiles timed out and armed, ready to launch with the squeeze of the trigger. As we closed to minimum launch range, I noticed that the tail stinger was locked up in the caged position, so wasn't ready to track and fire. My heart beat slowed, I let the missiles revert to passive mode, and we continued with our vis-ident.*

*We had intercepted a Tu-20 Bear "D", a huge, swept-wing bomber with giant counter-rotating propellers. As we came abreast of its tail, we noted a large perspex bubble. Sitting there were three crewmen waving at us. Then they hauled out a copy of "Playboy" and showed us the centerfold! They gave us the thumbs-up and we returned the gesture. We now moved along to the cockpit, where the co-pilot was eyeing us. We signalled that they were in Canadian airspace and should follow our orders. We positioned ourselves at their 1 o'clock, waggled our wings and turned seaward. Lead followed, as did the other two Bears. Once they were over international waters, they headed south (probably to Cuba) and we set course for Gander. We landed with 2000 pounds of fuel, enough for a couple of overshoots and close-patterns. We taxied in, shut down, then debriefed the NORAD guys as our Voodoo was refuelled. On reaching Chatham later that day, I executed a victory roll over the field, pitched out and landed to be welcomed by the CO.*

*Over the years I've been asked about pictures of this exciting intercept. The first 2-ship that had scrambled carried hand-held 35-mm cameras. They missed the chance for photos, and we were not equipped with cameras. Later, a Canadian general, quizzing us about photos, reamed us out for not coming home with any. His USAF counterpart sent us each a Certificate of Recognition for our good show. Makes you think, doesn't it!*

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