



FALL OF THE ARROW

Pt II

By D. Murray Peden ©

Editor's Note: In the first installment of this article on the ill-fated Avro Arrow, we learned what high hopes designers and engineers had for the CF-105's advanced airframe and engine. We saw that their expectations appeared to be fully justified. In this portion, it will be shown just how and why the Canadian government chose to throw away what would have been one of the finest combat aircraft ever conceived.

On March 25th, 1958, the great test day arrived for Avro and its chief pilot. Jan Zurakowski finished his cockpit check at 9:30 a.m., and in an atmosphere of tense expectation taxied out for takeoff on Malton's newly lengthened (11,050 feet) Runway 32. Appropriately, Canada's most advanced aircraft was in the hands of one of the world's best pilots.

Jan Zurakowski had already won his spurs as a first rank test pilot. During his World War II service in the R.A.F. Zurakowski had shot down six enemy aircraft. When the fighting was over he had been hired as a test pilot by Gloster Aircraft, and had been chief of testing on the Gloster Meteor. His skill, nerve, and lightning reflexes built him an impressive reputation. Hence when Avro went



The first Avro CF 105 is shown banking over Niagara Falls. At first, cooperation between the U.S. and Canada, particularly in the testing of the Orenda Iroquois engine, was exemplary, but thinly veiled anti-American statements by Canada's then Prime Minister, John Diefenbaker, caused this cordiality to cool. Had U.S. supported project with orders to purchase or manufacture Arrow under license, it undoubtedly would have gone into production. (Gerry Beauchamp)

ARROW

looking for a first class test pilot to display their new CF-100 to best advantage they sent to England and induced "Zura" to come to Malton as their chief test pilot. Now he was being called upon to test fly an aircraft that promised, on paper, to be the most advanced in the western world.

Just before 10:00 a.m. Zura was in position on Runway 32. Potocki and Woodman, in two chase planes, a CF-100 and a Sabre, had been airborne for some time, their expectant circling driving the tension and excitement ever higher. All at once the purposeful thunder of the twin Pratt & Whitney J-75s signaled Zura's initiation of the takeoff run. The gleaming white interceptor accelerated swiftly, surprisingly swiftly considering that its all-up weight exceeded that of many WW II bombers. At 120 knots Zura lifted the nosewheel, and seconds later, at 170 knots, Arrow 25201 lifted cleanly from the concrete and soared effortlessly skyward. Despite the great weight—the average take-off weight in early flights was in the order of 67,000 pounds, i.e., about the weight of a fully loaded Lancaster—Zura lifted the Arrow off easily after a run of only 3,000 feet. The watchers sighed; the first great threshold had been crossed. The all-important finale—a safe landing—still had to be brought off.

After putting the aircraft through its basic paces, with every movement being carefully photographed by Woodman and Potocki from the strategically positioned chase planes, Zura swept back into the circuit. Moments later the Arrow was settling toward the runway on final, about to terminate its 35 minute flight. The spectators, among whom was Air Marshal Curtis, scarcely dared breathe. Triumph or disaster at this point might well be separated by only a few knots of airspeed and the nerve of the man alone in the cockpit. The Delta wing flared gently over the runway, flashed along above it for two or three seconds, then sank gently. A puff of smoke signaled the union of tires and concrete, and the Arrow was down, racing, nose high, along the runway.

As the nosewheel settled firmly onto the concrete Zura streamed the drag chute, and it shortly became obvious that with some positive braking he was going to have enough runway. Although it had been calculated that touchdown could normally be made at 168 knots, Zura had understandably kept several knots in hand on this first test so as to reduce the risk of an unexpected stall. His landing run was therefore fast—the Arrow was a "hot" aircraft at optimum landing speeds—and the brakes had to be employed virtually to full capacity. But this was a trifle.

Five minutes later the Arrow came to a stop on the apron, and Zura's exultant compatriots carried him off in triumph on their shoulders. For five happy minutes everyone around the Arrow was exchanging excited congratulations and posing joyously while the photographers recorded the sweet moment of success.

This happy finale to the morning's tense drama was cut short by an unexpected touch of comic relief. There was a sudden bang, like a cannon shot, as one of the Arrow's tires exploded, and chunks of rubber flew about like bullets. The celebrants scattered at high speed, for the Arrow's tires were inflated to 250 pounds per square inch, and everyone in the immediate area suddenly remembered that significant fact. In quick succession the other three blew out, sending hard rubber shrapnel flying again. The extra speed on the first landing, and the energetic braking to ensure a normal termination of the landing run, had taxed the braking system to the point where the heat transmitted from the brake drums had driven the tire pressure past the blowout point.

Coming when it did this incident was understandably treated as no more than the reflection of an amusing peccadillo. The all-important fact was that the Arrow had made its first flight, and had fully lived up to expectations. Eight years earlier, on January 19th, 1950, Bill Waterton had given the Avro CF-100 its 10-minute virgin flight (also under the gaze of Air Marshal Curtis) and had enthusiastically predicted that it would be a great success. Now the Arrow promised to carry Avro into the forefront again.

To the small group of insiders watching it the Arrow's second flight was even more dramatic than its first. In his capacity as Supervisor of Experimental Flight Test Engineering, Fred Matthews worked closely with Zurakowski throughout the program, and maintained a close scrutiny on operations at every stage, as he recalls:

"When the Arrow took off, it was an awesome sight to stand at the brakes-off point and watch it accelerate down the runway and then

rotate into takeoff attitude. Delta wing aircraft takeoff attitudes are typically very nose high. When viewed from the rear, you have the impression of looking down on the aircraft.

"On the second flight of the first Arrow (25201), I was in the radio truck at the brakes-off point and watched it roll down the runway and rotate. The moment it became airborne, one wing took a sickening drop; I thought it would touch the runway, then it snapped back up and the takeoff continued.

"After the flight, it was discovered that the roll-damping sensors had been hooked up backwards by the Minneapolis-Honeywell crew. So, when there was a roll disturbance, the damping system accentuated it instead of suppressing it. Zura saved the aircraft by realizing immediately what the problem was and switching off the damping system—the switch was by his thumb on the stick. I was thankful Zura was flying it. I'm not sure anyone else would have reacted in time to save the aircraft."

It is interesting to speculate as to what Zura told the ground crew following that flight. He was a quiet man, but very forceful when aroused—and he was a stickler for meticulous performance. Fred Matthews painted an intriguing portrait of him in three short paragraphs:

"All the test pilots at Avro were exceptional. Each had unique and extensive experience, a good rapport with Engineering and Flight Test Engineering, and each had a memorable personality. Of all of them, though, Zura was my favorite. His modesty was exceeded only by his ability. He was seldom, if ever, loquacious, particularly when talking on the radio. I used to joke that the wings could be falling off and he'd report when asked how he was doing . . . "fine" . . . his typical response.

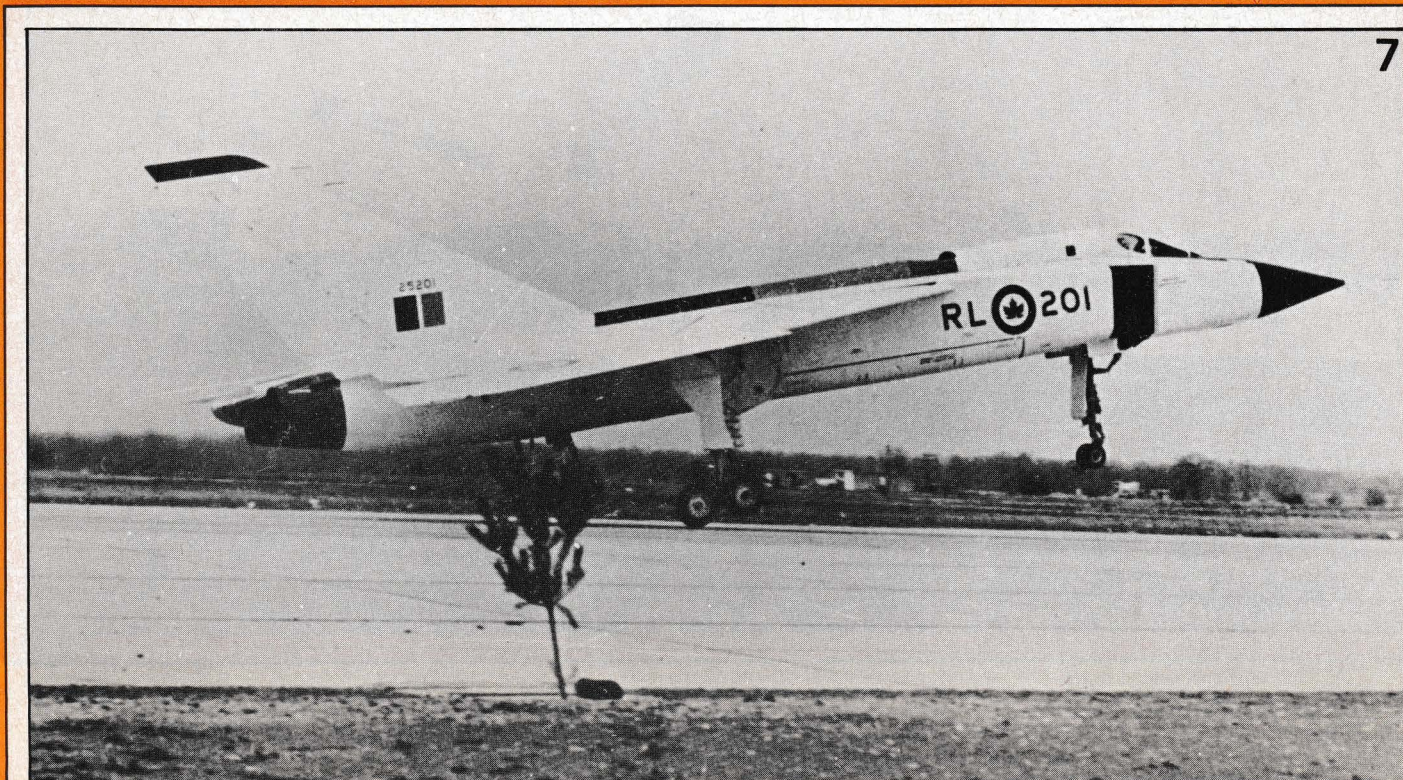
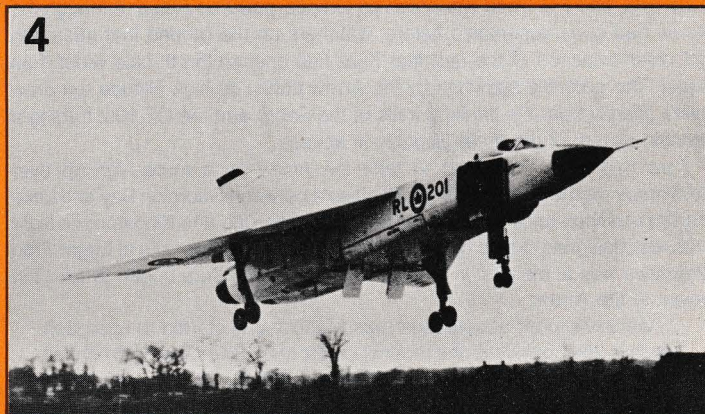
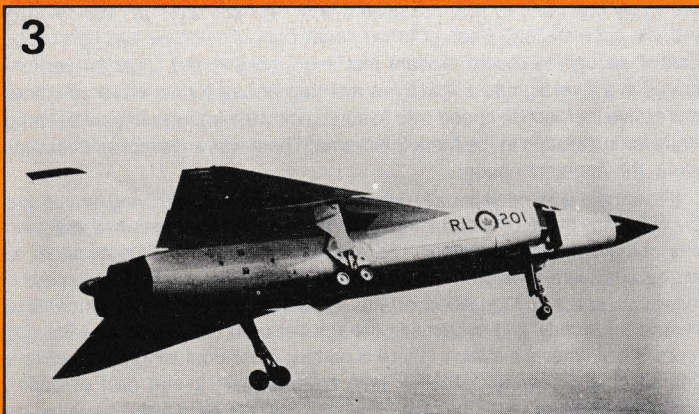
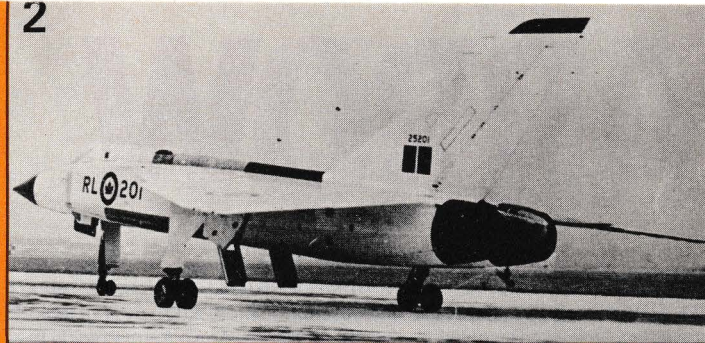
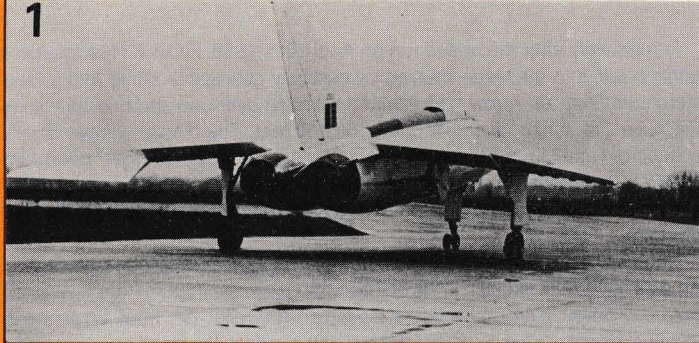
"Although he didn't talk much, he usually got his message across. He would often sign the "snag" sheets, after a flight, with a simple "N N S", meaning "no new snags" . . . a subtle hint that the old snags hadn't been cleaned up.

"He was a stickler for cockpit cleanliness. There had been one or two instances of stray bolts or other lost items jamming controls. His method of checking for such items (while he was testing the Arrow's predecessor, the CF-100) was to fly upside down and see what ended up on the canopy. If he found anything, the groundcrew knew they were in for a chewing out because he would appear over the field upside down—just as a forewarning!"

The flight testing of the Arrow proceeded at a gratifying pace, partly because of the high quality of the test pilots and their aircraft, and partly because the process for analyzing the flight test results had been organized with the utmost efficiency. During the testing of the earlier CF-100, on-board recorders had been used, and in most cases observers had sat in the rear cockpit monitoring temporary instrumentation set up for each particular test. The Arrow also used on-board recorders; but on only one occasion was a rear cockpit observer carried.

Instead, for analysis of the Arrow's flight performance, extensive use was made of telemetry. The transmissions were received in a trailerized telemetry station where the data were fed to a real-time operations room in which engineering and flight test specialists observed the readings while the flight was actually in progress.

1. With the roll-out ceremony behind it, Arrow No. 1 leaves to begin its ground trials and taxi trials. This shot affords a clear view of how the undercarriage recessed in the thin wing. Ground handling trials began in November, 1957, with the first low speed taxi trials occurring in late December.
2. The Arrow taxis past with the rectangular panels of its speed brakes extended.
3. The Arrow aloft on its first flight, photographed from a chase plane, March 25th, 1958.
4. The critical first landing: everything hinges on Jan Zurakowski, a talented test pilot. Zurakowski's helmet is visible in this shot as he begins his flareout perfectly positioned over the end of the runway. After landing, all four main tires blew.
5. Jan Zurakowski, having successfully completed the momentous first flight of the Arrow, is carried off by his exulting co-workers. On the left and right of "Zura", each holding a leg, are Peter Martin of the Project Office (wearing the short-length coat) and Deric Woolley, Flight Test Engineer (in suit).
6. Jack Woodman, a Flight Lieutenant in the R.C.A.F., flying the Sabre chase plane. Note the camera mounted on Woodman's visor, with which he photographed the Arrow at every salient point in its early flights. Woodman flew on operations as an air gunner in World War II and took his pilot's training in 1949. He was the only R.C.A.F. pilot to fly the Arrow, having previously been a member of the team evaluating the F-102 for the United States Air Force. Woodman is presently Director of Flying Operations for Lockheed Aircraft, and lives in Palmdale, California.
7. Arrow No. 1 touching down. Pilot's visibility was good, even in the nose-up attitude prevailing on touchdown.



ARROW

On Friday, April 18th, 1958, the Arrow was scheduled to make a high speed run. It had already flown once that day, but shortly before 5:00 p.m. Zura took off again, this time accompanied by two chase planes. Again Spud Potocki flew a CF-100, and F/L Jack Woodman an Orenda-powered Sabre. Although the Arrow had gone supersonic before, watchers on the ground that afternoon got clear evidence of the fact that Zura had opened the throttle wider than usual. The contrails spawned by the Arrow during its high altitude run drew away sharply from the flanking trails of the Sabre and the CF-100, tracing a graphic picture of the great disparity in speeds.

Zura had been instructed to take the Arrow on a route high up over Tobermory (at the tip of the Bruce Peninsula between Georgian Bay and Lake Huron) and then back for a run towards Peterborough and Kingston. His flight path was designed to take him right over the Air Force radar site at Edgar. Fred Matthews was at his post in the operations room as Zura began to feed the power to the Arrow:

"As the aircraft accelerated past Mach 1 and started to approach Mach 2, you could hear the radar operator at Edgar muttering to himself 'Look at that son-of-a-bitch go! . . . WILL . . . YOU . . . LOOK . . . AT THAT SON OF A BITCH GO!!' He probably hadn't seen anything much faster than an F-86 before.

"I don't recall the exact speed reached (which was determined after detailed analysis of the data and corrections applied for instrument error and the like). However, the exciting part was that at the end of the run, *the aircraft was still climbing and still accelerating!* We never did find out how fast it would go, particularly with the Iroquois, which was never flown in an Arrow . . . From the data of this and other flights it was apparent that the Arrow was at least as good as the estimates, and probably better, although the maximum speed might have been constrained because of the structural effects of temperature. One of the things being probed in the flight test program was structural temperatures and their build-up and dissipation in the aircraft. For safety reasons, we constrained the 'g's' in the early flying after the aircraft had flown at high Mach numbers until we learned more about the heating characteristics of the aircraft."

Immediately after the speed run on April 18th, 1958, R.C.A.F. Headquarters announced, in a message marked by carefully guarded wording and understatement, that the Arrow had attained a speed over one and one-half times the speed of sound at an altitude of 50,000 feet. The official release simply pointed out that Mach 1.5 was roughly equivalent to 1,000 miles per hour; then went on to say that for security reasons it was not proposed to release any further specific performance figures as the aircraft went through its test program.

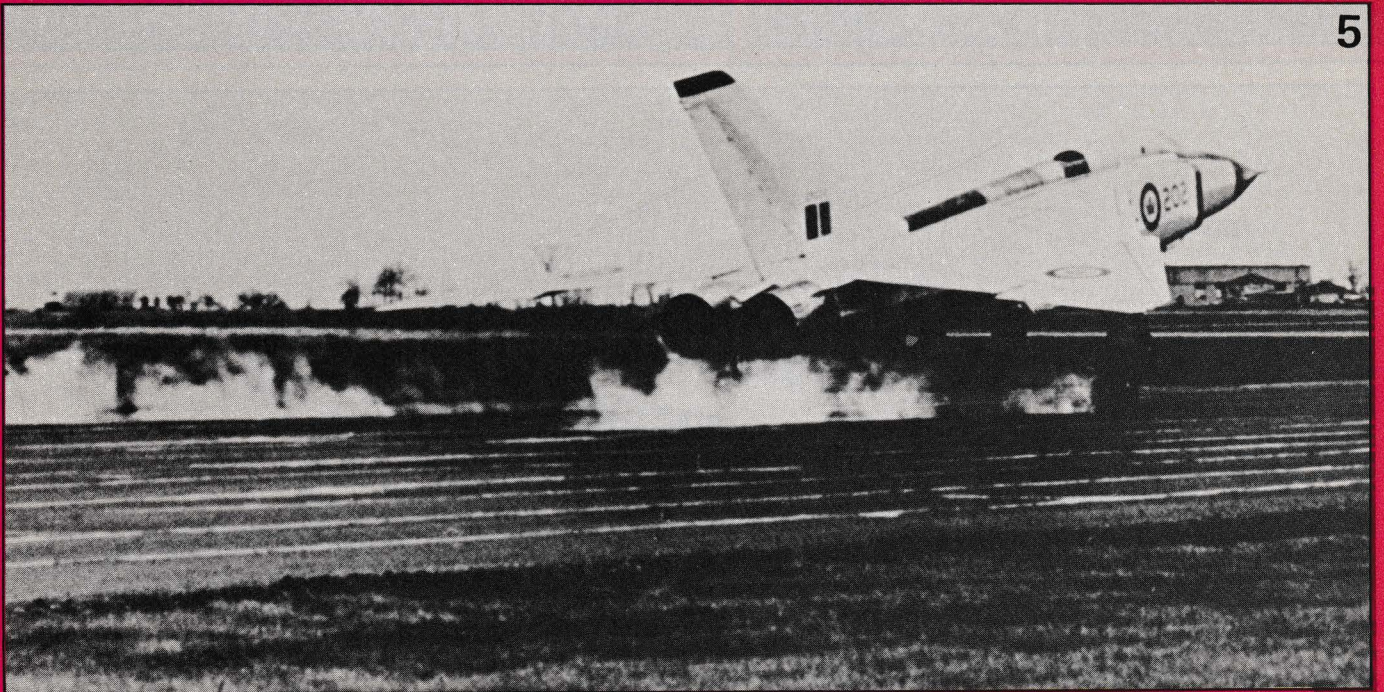
Unofficial estimates, some of them from knowledgeable sources, placed the Arrow's maximum speed—while still operating with the interim Pratt & Whitney J-75 P-3 power plant—at a figure close to 1400 miles per hour. While these were admittedly "guesstimates" they did not overlook the significance of those two vitally important factors associated with the April 18th run: "*still climbing and still accelerating*." Each of those conditions—since they had been substantial enough to record—meant that even more speed could be demonstrated in a level flight test. And a few months hence a further and much more impressive increase in speed was assured when the Iroquois engine became ready for installation in the Mark 2 airframe! There was a distinct air of exultation in the operations room.

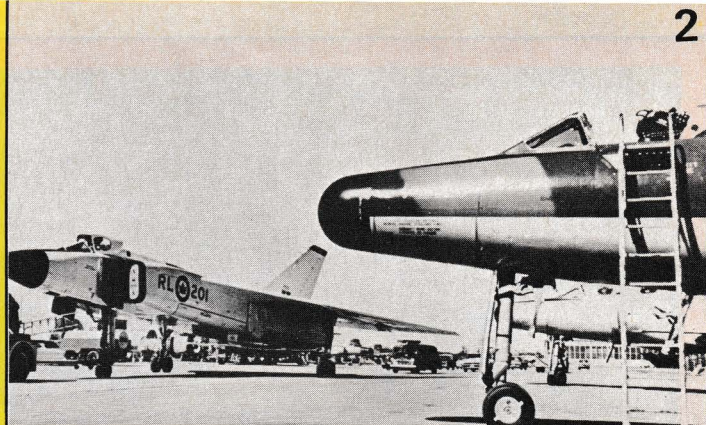
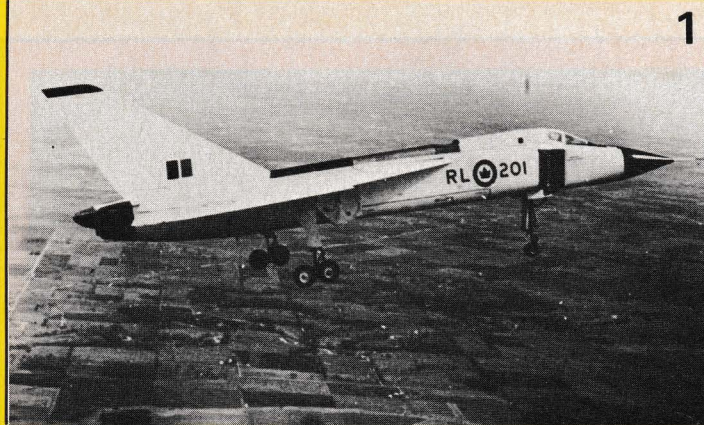
Excitement was occasionally generated there by less satisfying events; but the efficiency of the ops room met the challenge. Fred Matthews had assigned one of the flight test engineers, a recently retired R.A.F. Wing Commander, to act as ops room-to-aircraft communicator. The purpose in having a specific individual, and a well qualified individual, discharge this role was primarily to ensure an orderly and systematic linkage between the aircraft and the ops room. As Matthews explains: "there is nothing more confusing than having a couple of engineering 'experts' both trying to talk to the pilot at once". Matthews had also given the communicator instructions to make contingency plans covering various potential problems in flight. The former Wing Commander did his job well.

On one flight, as the Arrow was returning to base, a T.C.A. Viscount holding an earlier position in the landing pattern landed on a short cross runway. As it approached Runway 32, the 11,050 foot main runway, its undercarriage collapsed, and the Viscount came to rest completely blocking the only runway at Malton capable of accommodating the Arrow.

The Arrow was at the end of its flight, hence short on fuel; and there were few runways in those days that could handle it. But the ground-to-air communicator had everything organized in a matter of minutes. As part of his contingency planning he had listed all the available landing fields suitable for the Arrow

¹The Pratt & Whitney J-75, with which the Mark I was equipped, could generate, with afterburner, approximately 18,000 lbs. of thrust—the Iroquois, 25,000 lbs.





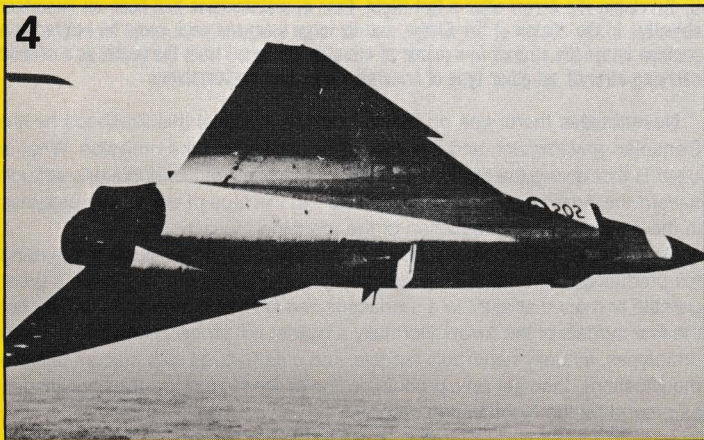
1. Its undercarriage down, the Arrow prepares to join the circuit at Malton. Except for minor problems with main gear extension, CF 105 breezed through its test phase.

2. Three CF-100's are visible in this photo, as well as Arrow No. 1, which is being towed into the hangar.

3. The old and the new. Arrow No. 4, standing beside a CF-100, reveals the great disparity in size and height between the two aircraft. All up weight of the Arrow was twice that of the CF-100.

4. Arrow No. 2 banks slightly away above the chase plane and extends her speed brakes preparatory to lowering the undercarriage. The leading edge notches are particularly noticeable in the strong sunlight. (Canadian Forces Photo).

5. Arrow No. 2 evidences a slightly uneven touchdown. Entire trailing edge of wing was taken up with flaps and ailerons.



(including one or two in the United States), with phone numbers, contacts, facilities and distances all set out—including the vital information of the quantity of fuel necessary to reach them.

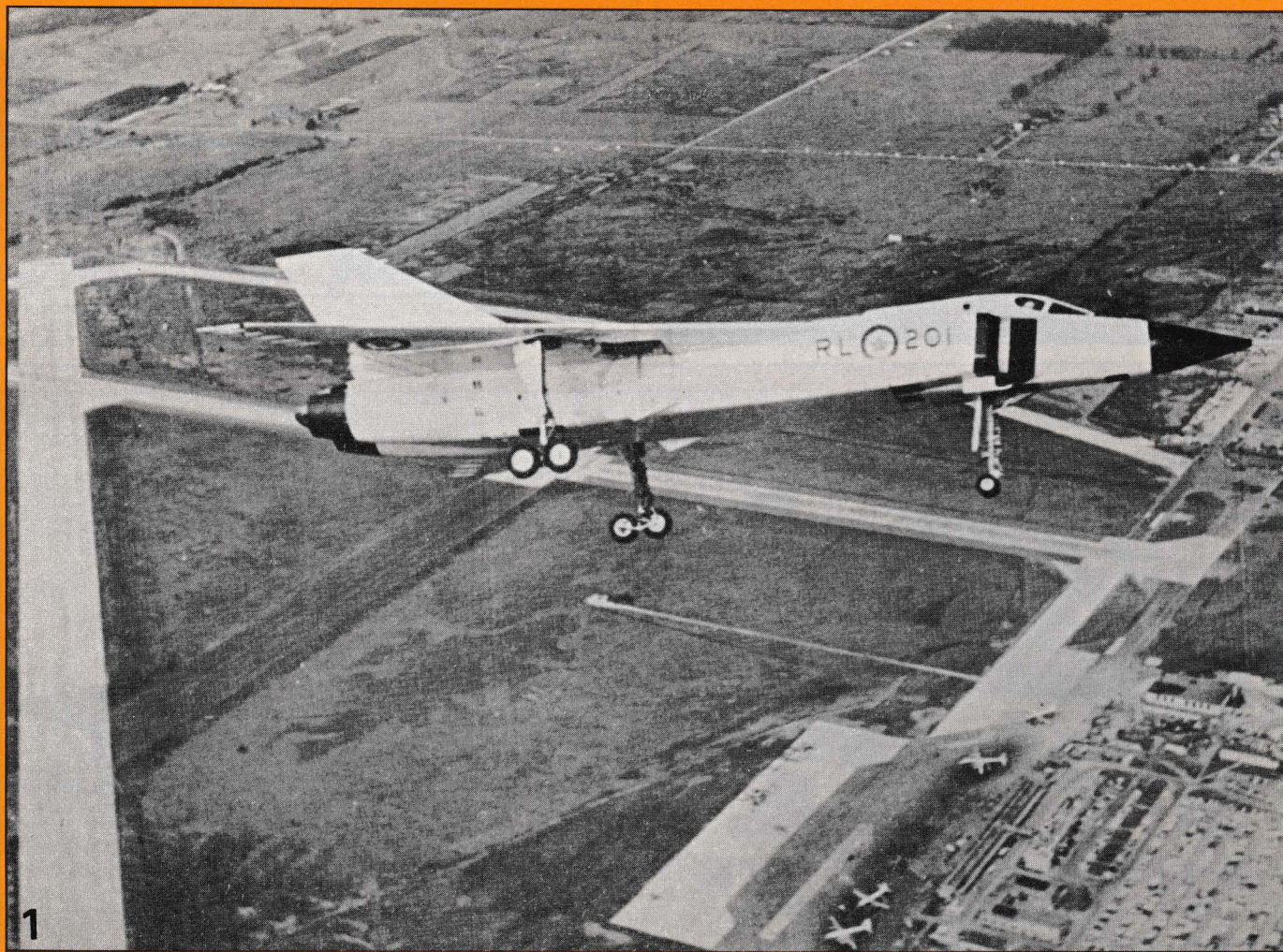
The communicator quickly diverted the Arrow to Trenton, Ontario, and by the time it got there all had been made ready. Fred Matthews adds a wry commentary to this chronicle:

"While the aircraft was on its way to Trenton, the top management did not realize that we had already diverted the aircraft, and were busy contemplating the pros and cons of having the Arrow land at Ottawa for political reasons—i.e., an opportunity to show off the aircraft.

"There was a considerable amount of disappointment when they realized we had already diverted, and some surprise that we were so well organized and able to do it so quickly. I must say it was a bit disconcerting to us in Flight Test that they should be surprised that we were organized!"

A minor setback occurred on June 11th. As the Arrow approached to land, a malfunction occurred in the mechanism of the port landing gear as it was being extended. It did extend, but it failed to rotate fully and line up truly with the fore and aft axis of the aircraft. Thus on touchdown the port wheels were canted off to the left at a considerable angle. The pilot was nevertheless able to hold the aircraft on the runway for the greater part of its landing run, despite the strong pull of the tortured rubber; but towards the end the aircraft slewed and came to rest a short distance off the runway, sustaining some minor damage in the process. Following this mishap Dowty of Canada Ltd. quickly worked out a modification in the design of the undercarriage component involved, and there was no further trouble.

Setbacks of this type were definitely the exception rather than the rule at this stage of the Arrow program. For the most part the soundness of the design was



verified by an almost unbroken string of successes in the comprehensive testing program.

Ironically, as the Arrow's deferred successes in the air began accumulating to impressive proportions, the program began encountering growing problems on the ground.

C. D. Howe's original estimate of \$100 million for the Arrow's development was already clearly identifiable as a gross miscalculation. At the end of fiscal year 1957-58 it had already cost \$235 million, and it appeared that well over another \$100 million would be required for the fiscal year 1958-59.

Bearing in mind that the Arrow program was only one program, albeit the most costly one in the Department of National Defence, the government now began to watch it even more critically than before despite the lengthening record of success in the Arrow's air trials.

In the Chiefs of Staff Committee the tide was beginning to run against the Arrow. Air Marshal Hugh Campbell, who had succeeded Air Marshal Selmon as Chief of Air Staff in 1957, faced a group of service peers who were understandably growing more and more reluctant to see the basic requirements of their own services cut each year so as to ensure the continuance of funding for the Arrow.

Furthermore, apart from Sputnik's demonstration of a significant advance in Russia's offensive potential, the Russian bomber types known by the code names *Bear* and *Bison* were the most advanced that the Russians seemed interested in producing; and those were the only two types of Soviet bomber that could reach North America from Russia and return to their bases. Thus, coupled with the Russians' premature advance in missile capability was the fact that their bomber threat was materializing more slowly, and in more limited dimensions, than foreseen. That, at least, seemed to be the Canadian Chiefs' conclusions, even though in the U.S. General White (Chief of Staff, U.S.A.F.) and other senior American airmen were expressing their considered view that Russia would likely proceed with the development of a bomber having greatly superior performance to the *Bear* and *Bison*.

1. Arrow No. 1 turns crosswind and prepares for the downwind leg parallel to the main runway. The large Dowty undercarriage was extremely long and was designed to support 35 ton maximum loads.

2. Why they named it the Arrow. Clean CF-105 cleaves the air above a backdrop of sun-touched cumulus. Its future as the leading fighter of the western world during the years until the arrival of the U.S.A.F.'s F-108 seemed assured at this point. Just discernible is outline of large belly pack for Sparrow missiles which dropped down for firing and then retracted immediately.

3. The ubiquitous CF-100 chase plane shepherds Arrow No. 1 onto the runway, cameras grinding all the way.

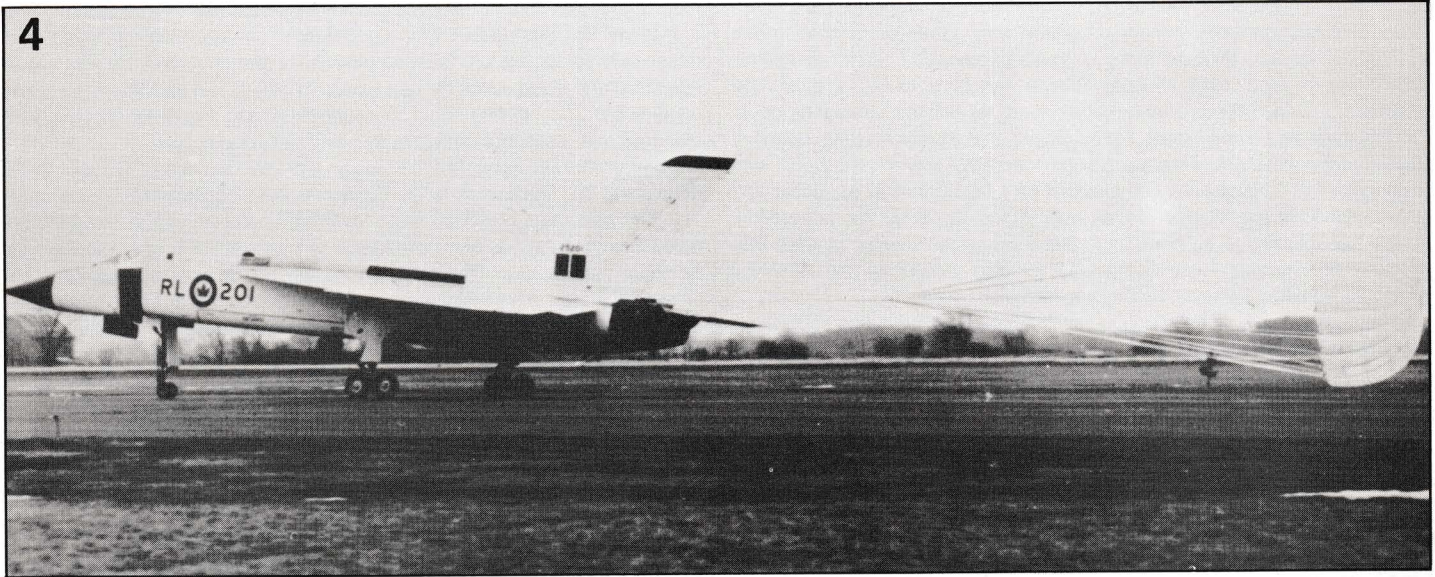
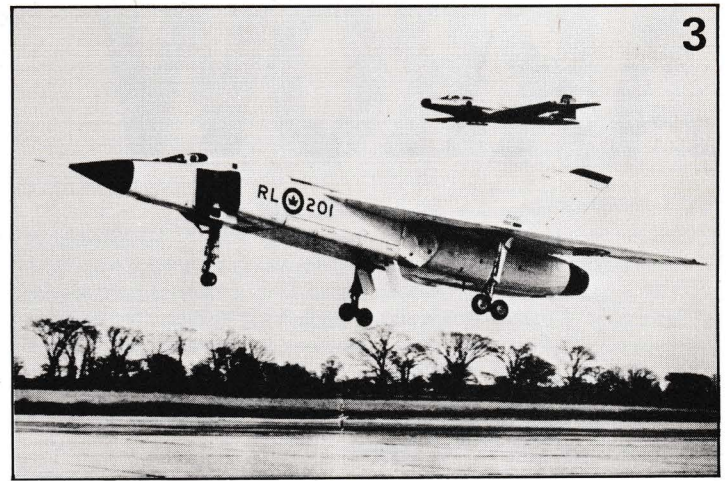
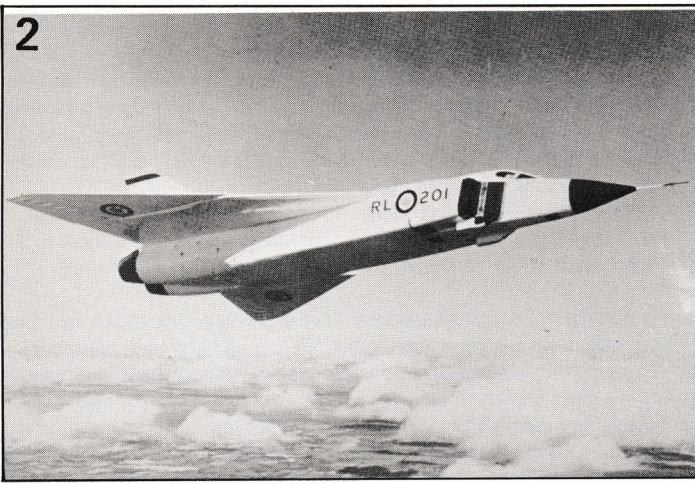
4. Arrow No. 1 streams its drag chute on its landing run. The stresses imposed by this maneuver were found to be considerably higher than had first been calculated, necessitating some minor modification.

5. Another good view of the Arrow "clean". Rather than perform before a limited audience on its maiden flight, CF-105 performed before thousands, testifying to Avro's confidence in its design.

6. Servicing the Arrow after a test flight. Ease of maintenance had been an important objective in the design of the Arrow, and its large weapons pack could be hoisted into position under the aircraft in a matter of minutes. Designed from the outset as a missile carrying aircraft, no other type of armament was ever contemplated.

Nevertheless there was no public mention made of this likelihood by the Canadian government, and it is difficult to understand the omission. What is clear is that during the summer of 1958 Prime Minister Diefenbaker's attitude toward the Arrow turned distinctly hostile—in the face of exemplary progress in the air testing and production of the machine.

On this latter point it should be mentioned that for the purpose of speeding full production, when that step was finally authorized, Avro had taken a great gamble and gone straight to a production line form of operation in turning out the first models of the Arrow. Normally a builder will proceed with one or more prototypes, virtually hand-built models, iron out the bugs with custom tailored modifications, then set up a production line geared to turn out the final version as proved by the flight testing program.



Gambling on the validity of their intensive wind tunnel testing, Avro's management had gone directly to production line construction. If a serious flaw in design had been revealed in the flight testing program, something entailing substantial modification of the aircraft, this could have resulted in formidable expense and considerable delay. But the testing uncovered no such error; rather, it rapidly verified the soundness of the design and established the great potential of the basic airframe. Thus the first machines, although frequently referred to as prototypes, were not prototypes in the normal sense; they were basically production line aircraft. In spite of the delays caused by factors beyond their control—such as delays occasioned through requiring Canadian suppliers to build to much higher specifications than they had been accustomed to, and the time wasted as a result of the abandonment by British and American engine manufacturers of two different power plants chosen for the Arrow—the company had recovered much lost ground by its own initiative. Unfortunately, its boldness and enterprise were not to be rewarded.

On September 23rd, 1958, the Prime Minister issued a chilling press release in which he said:

"The government has concluded that missiles should be introduced into the Canadian air defence system and that the number of supersonic interceptor aircraft required for the R.C.A.F. air defence command will be substantially less than could have been foreseen a few years ago, *if in fact such aircraft will be required at all in the 1960s* in view of the rapid strides being made in missiles by both the United States and the U.S.S.R. (author's italics). The development of the Canadian supersonic interceptor aircraft, the CF-105 or the "Arrow", was commenced in 1953 and even under the best of circumstances it will not be available for effective use in squadrons until late in 1961. Since the project began, revolutionary changes have taken place which have made necessary a review of the program in the light of anticipated conditions when the aircraft comes into use. The preponderance of expert opinion is that by the 1960s manned aircraft, however outstanding, will be less effective



ARROW

in meeting the threat than previously expected.

While the Prime Minister's statement had clearly ominous overtones so far as the long-term future of the Arrow program was concerned, it was highly indefinite to say the least. It had been fashioned by a cautious hand, leaving Mr. Diefenbaker a comfortable supply of loopholes and ambiguities which he could cite selectively and with infinite variations of emphasis to soothe challenges of whatever stripe. The company recognized the speech's motivating concern as economic, and indeed thoughtful Canadians everywhere had reason to review the economics of the government's situation over-all, not just the segment relating to National Defence.

The worrying economic situation which included the largest budget deficit since WW II had prompted earlier vague expressions of concern regarding the Arrow and Iroquois development programs from a variety of government sources. There had been so many of these expressions, public and semi-public, that in June, 1958, Charles Grinyer had gone to Mr. O'Hurley, the Minister of Defence Production, and protested. He pointed out that he could not organize and keep intact highly skilled design and testing teams if government spokesmen were going to go out of their way to taint the air with uncertainty. Mr. O'Hurley assured him that he could ignore all the doom and gloom pronouncements—the aircraft and engine would go into production. Mr. Grinyer returned to his plant and spread the word. He was satisfied that O'Hurley was sincere—and to this day remains convinced that O'Hurley genuinely believed that they were going into production.

In retrospect one is constrained to say that the government had been given every reason to be satisfied with progress on the Iroquois engine development program. In 1957 the president of Curtiss-Wright had been so impressed with the engine's performance and potential that he had journeyed to Orenda's plant at Malton and signed a 7-year contract. Under its terms Curtiss-Wright would be entitled to build the Iroquois under license in the United States. He had been candid enough to state publicly that the Orenda Iroquois was several years ahead of any engine then under development in the United States—and coming from the president of one of aviation's Big Three this was certainly a ringing endorsement of the calibre of the Canadian power plant. Under a proviso of the contract, Curtiss-Wright would not be bound until the engine had actually passed its Official Type Test; but it was obvious that Curtiss-Wright was familiar enough with current progress, and with Charles Grinyer's past accomplishments, to realize that at this stage passing the Type Test under the aegis of Charles Grinyer was as good as done. After the contract was signed there was speculation that the Iroquois might be used eventually to power the North American F-108, which was still a long way from completion.

Having secured Mr. O'Hurley's reassurance in June, 1958, Mr. Grinyer returned to Malton where Orenda was in the process of completing a new \$6,500,000 high altitude test cell facility under the immediate direction of P. K. Peterson, the Chief Equipment Engineer. The new test cell was capable of providing a flight operating range, for an Iroquois under test, from Mach 1.3 at 35,000 feet to Mach 2.9 at 100,000 feet. The construction of the Malton cell marked one stage in an \$11,000,000 program begun three years earlier with financial assistance from the Department of National Defence.

The September 23rd press conference called by the Prime Minister came as another unexpected blow to Charles Grinyer after the commitments given him by Mr. O'Hurley. Nevertheless, he carried on, and managed to keep things in the plant on an even keel until, a few weeks later, the October 25th, 1958, issue of *MacLeans* hit the newsstands. This issue contained a truly remarkable article by *MacLeans'* Ottawa Editor, Blair Fraser. It was remarkable in its merciless criticism of the Arrow program, in its eager interpretation of the September 23rd speech as the certain death knell of the whole project, and in its support of the Prime Minister. This latter feature was perhaps the most surprising aspect of the whole article.

Blair Fraser had never served in the armed forces himself (he was 30 years of age in 1939), having spent the years of World War II in Montreal and Ottawa writing about it. Nevertheless, in this October article he unhesitatingly delivered himself of dogmatic pronouncements on difficult questions of continental defense that were still dividing the counsels of Canada's professional service experts.

His article was an effectively written piece, compounded of roughly equal

portions of fact, distortions of fact, gross error and half truth. Showered largely upon a relatively uninformed segment of the public, who were neither equipped nor disposed to challenge it, the article was a heavy blow. From its first paragraph it portrayed the Prime Minister as almost revelling in a Jack-the-Giant-Killer role, directing his energies against hidebound aero-industry Establishment and R.C.A.F. fatcats of the Colonel Blimp mentality, struggling to launch an aircraft already a museum piece akin to the Spitfire. This was the opening sentence of Fraser's spiteful diatribe:

"Never, not even in June, 1957, has Prime Minister Deifenbaker met the press with such well-earned glee as when he announced the discontinuance of our all-Canadian supersonic fighter aircraft, the Avro Arrow."

The fact that nine months earlier the Minister primarily responsible for these matters had been quoted in the *Calgary Herald* as flatly contradicting allegations of the Arrow's imminent obsolescence did not prompt Blair Fraser to qualify his own confident assessment. On January 18th, the *Herald* had attributed this statement to Mr. Pearkes: "I do not share the opinion that the Arrow will be obsolete before it is operational. When Russia stops building bombers it will be time for us to start thinking of some other defense." Not surprisingly, that scrap of sturdy logic has stood the test of time and remains true today. But Blair Fraser was a journalist of considerable reputation, and deservedly so, for, his pronounced political asymmetry apart, he was a well educated and gifted writer. He had a wide following; and an editorial blast like his October 25th offering could be counted upon to mold a lot of opinions. It also had one result that undoubtedly never occurred to him.

Charles Grinyer tendered his resignation to the company, reluctantly concluding that he could no longer serve any useful purpose in an atmosphere that was becoming poisoned with ill-informed criticism and growing uncertainty. The shock waves of his announcement were immediate. No sooner had he heard the bad news than Mr. O'Hurley was on the telephone pressing Mr. Grinyer to withdraw his resignation and carry the Iroquois program to completion. Mr. Grinyer in turn re-stated the points he had made four months earlier: he simply could not expect to keep men of the calibre he had been able to attract to Malton working together on projects that looked as though they were going to be flushed down the drain. Once again Mr. O'Hurley pacified him, repeating his statements that the work was not going to be wasted, that the projects were going ahead. At his repeated request Mr. Grinyer finally agreed to withdraw his resignation, and once again relayed Mr. O'Hurley's unequivocal assurances to his senior people.

But there was a growing apprehension that the final decision would not be based upon a balanced consideration of all the germane factors, that many politicians seemed not to know whether there was a genuine need for the aircraft, and that few had any real appreciation of the Arrow's potential.

But the uncertainty and disappointment generated at Avro and Orenda Engine by the September 23rd press release and the *MacLeans'* article of October 25th now began to dissipate in the wake of some positive acts that dispelled much of the temporary fog of bewilderment. Under the pressure of the Prime Minister's clear concern over the economics of the Arrow, government representatives approached Crawford Gordon at A.V. Roe with the request that his people re-assess the whole Arrow program, take whatever drastic steps necessary, and come up with his rock-bottom unit price for 100 Arrows. The major steps were very obvious at A. V. Roe; they simply involved doing what the company had recommended from the outset, namely, abandoning the development of the ASTRA weapons system and the Sparrow II missile and going with the "off the shelf" Hughes MX-1179 weapons system complemented by Falcon missiles. The R.C.A.F. were reconciled to the reversion to the Hughes system at this stage, the development of ASTRA having proved more difficult and much more expensive than originally contemplated. (Its ultimate cost had begun to look like something between 100 million and 200 million dollars.)

The company now calculated that with the switch to the Hughes MX-1179 and the Falcon missile they could offer the Diefenbaker administration a flyaway cost of 3.75 million dollars per aircraft. When the total number of aircraft required was reduced to 100, that meant a figure of \$375,000,000, but there were other costs entailed in the full package: support spares and equipment would amount to \$98,400,000; missiles would amount to \$42,600,000; and the completion of the full development program on 20 aircraft (8 of which would be operational) would cost another \$295,000,000. Thus the government was looking at a grand total of \$781,000,000 for 100 aircraft including all the development costs and a supply of weapons and spares. (This figure was arrived at by deducting from the first figure of \$375,000,000 the cost of the 8 operational aircraft included in the development program.)

Work continued at Avro Aircraft and Orenda Engine in a cheerier atmos-

1. Prime Minister John G. Diefenbaker won the greatest electoral victory in Canada's history; but he never developed any real feel for Canada's special role as a western air power; neither did he grasp the full ramifications of his action in destroying Canada's facilities for military aircraft design and testing.

2. George Pearkes, V.C., Minister of National Defense in the Diefenbaker government.

phere, and an even stronger current of optimism was stirred on November 24th, 1958, when the Deputy Commander of NORAD, Air Marshal Roy Slemmon, with General Earle Partridge, the Commander, standing beside him, issued a public statement at Colorado Springs. It went a long way toward correcting misconceptions propagated in Blair Fraser's article, and was even interpreted in some quarters as a NORAD correction of possible misunderstandings engendered by the Prime Minister's September 23rd press release. The editor of the Canadian magazine *Aircraft* made careful notes of Air Marshal Slemmon's statement.

In a subsequent editorial he reiterated the points made: That NORAD considered the manned interceptor a requirement for as far ahead as it was possible to see; and that an item by item comparison of the Arrow with other types of aircraft available within the same period, designed for a similar purpose, showed that the Arrow would be the highest performing interceptor available until the advent of the North American F-108.

"For as long as we can see we must have manned interceptors and missiles to meet the manned bomber threat.

"What sort of manned interceptor? Particularly in the fringe areas... experience shows the long-range interceptor with two men on board can best do the job. Why two men? Two men can best cope with the long-range navigation, interception problems, ECM operations. . . . What aircraft come near this? The F-106 is a first class all-weather interceptor. The majority (built) will be single seaters, single engine."

The editor then continued: "Pointing out that it was very difficult to make direct comparison, as the peak performance of an interceptor depended on the role for which it was designed, A/M Slemmon then went on to say that the CF-105 'generally speaking, will have an edge in speed, altitude, range and maneuverability over the single seat F-106, and an even greater edge over the two seater version'".

These widely publicized statements went unchallenged and uncontradicted by the government. The fact was that the government was hardly in a position to challenge them, even if it had chosen to. Only four months earlier the Minister of National Defence himself had been recorded in the minutes of a meeting of the Committee on Estimates as saying (July 4th, 1958):

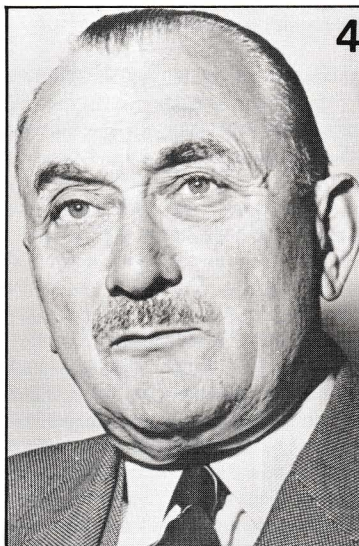
"For several years at least after the introduction of the I.C.B.M. the manned bomber will be an effective means of delivering attack with the degree of accuracy required. . . .

"There are important factors necessitating the use of manned interceptors in the air defense system for many years; indeed, as far as we can see into the future. . . .

"The supersonic manned interceptor is the development of a proven weapon, whereas the long-range surface-to-air missile is as yet untried."

Far from attempting to explain away or distinguish his earlier statement, George Pearkes stuck to his guns, called a press conference himself on November 25th, the day following Air Marshal Slemmon's pronouncement, and confirmed the point that the R.C.A.F. would require a manned interceptor for some years to come. He was also quoted in the press as having amplified this statement in a reference to the September 23rd press release in which he said: "What we decided last September was not to produce the Arrow under the conditions that surrounded Arrow production at that time. Let the makers re-examine the cost and then we will know where we are going." This exercise, of course, the manufacturers were in the process of completing, as a result of which the flyaway price per unit of 3.75 million dollars was determined.

These authoritative public pronouncements were instrumental in elevating morale at Avro and Orenda. The only thing that could have increased confidence still further would have been an announcement that George Pearkes had finally been successful in his continuing quest for another NATO government willing to buy the Arrow. But it was common knowledge that he was engaged in an up-hill fight. He had gone to Washington a few months earlier, in the summer of 1958, to deal personally with the American Secretary for Defense, Mr. McElroy. As Mr. Pearkes subsequently explained: "I did my best to interest him in this aircraft . . . then, when we were attending the NATO conference in Paris we did our best once again to interest the United States in the program of the CF-105. Mr. McElroy was there on that occasion together with Mr. Dulles and other representatives of the United States. . . . We were told



3. Paul Hellyer, Defense critic for the Liberal Party in 1958. Hellyer was effective during the debate on the Arrow cancellation; but in 1966, as Minister of Defense himself, he was the prime sponsor of the "Unification" Bill which many people regarded as the most damaging blow ever inflicted upon Canada's armed forces by any administration.

4. General Charles Foulkes, Chairman of the Canadian Chiefs of Staff. Foulkes tried to obtain a unanimous recommendation from the Chiefs to cancel the Arrow; but the Chief of Air Staff, Air Marshal Hugh Campbell, adamantly refused to recommend that short-sighted policy.

5. Air Marshal Hugh Campbell, Chief of Air Staff, R.C.A.F., 1957-1962. Campbell, and his Deputy, Air Marshal C. R. Dunlap, were both convinced of the necessity of retaining manned interceptor aircraft as an element in a balanced defense force and fought against cancellation of the Arrow to the bitter end.

6. Air Marshal C. R. Slemmon, appointed in 1957 as the first Deputy Commander of NORAD.



ARROW

definitely and with finality that the United States could not include the CF-105 in its armament inventory." In fact the United States' government's attitude had been hardening for many months, as was evidenced by the U.P.I. dispatch carried in the *Toronto-Telegram* as early as June 16th, 1958.

"United States defense officials said today the main reason for the continued refusal of the United States to buy Canada's Avro CF-105 fighter plane is that the Arrow cannot fly at top speed long enough.

"The Arrow is capable of speeds above 2,000 miles an hour only in short bursts.

"The officials said further that the United States could hardly buy the Arrow from Canada when it has suspended production at home of two very similar aircraft."

Mr. Pearkes did not give up easily; as he later pointed out, he had taken the matter up with the Minister of Defence of the United Kingdom. He pursued the matter diligently until the middle of February, 1959, at which point he received a telegram stating very definitely that the U.K. government would not be able to consider the purchase of the CF-105.

Apart from the reason stated above, it was obvious that the United States government would be less than enthusiastic about the Arrow, not because it did not live up to its projected performance, but for the much more practical reason that Lockheed was busily developing variants of the F-104, McDonnell was developing the F-101 Voodoo, and the F-106 and F-108 were under development. Any realist would understand that the American government would be subject to strong pressure to put its taxpayers' money into American-built aircraft. And, no less than Air Marshal Curtis, the American Chiefs of Staff would realize the potentially prejudicial consequences of being dependent upon a source of supply north of the border for such an important weapon. They had never bought the CF-100 from Canada, despite its admitted excellence and their frequently repeated adjurations that the NATO partners should standardize upon the best weapons and buy from one another, rather than buying domestic products of less than top calibre. Nevertheless, while it was obvious that they could not be expected to have all their interceptor aircraft built in Canada and subject to the vagaries of Canadian politics, it remained quite within the realm of possibility, bearing in mind the size of their own domestic aircraft industry, that they could at least have purchased a limited number of CF-100s or CF-105 Arrows; or built them under license in American factories. George Pearkes, V.C., did his best; and Canada could hardly have sent a representative with better credentials or a better product: at least a better product on paper.

That the attitude of the United States had cooled and hardened was due in part to a factor which had nothing to do with strategic considerations—at least this is the firm opinion of a number of senior Canadian officials who were close to the events. This extraneous factor was Mr. Diefenbaker himself—and his policies.

John Diefenbaker made it clear from the outset that he was definitely not pro-American. He appointed some Ministers with a similar or even stronger bent, and none of them were at pains to disguise their sentiments. Those sentiments might more fairly have been described as energetically pro-British rather than anti-American, although at a later stage the anti-American animus was patent.

The earliest manifestation of these feelings had occurred in the summer of 1957 when Mr. Diefenbaker proposed to divert no less than fifteen per cent of Canada's imports from America to the United Kingdom. He reiterated this proposal on a number of occasions, and at least once coupled it with a vague justification that hinted at the economic hazard implicit in Canada's existing trade pattern, linked arterially as it was with the American economy.

There were other straws in the wind as well, and they did not go unnoticed by the American government. By the beginning of 1959, the co-operative ardour of senior American officials, who had hitherto gone out of their way to assist with the development of the Arrow and the Iroquois engine, cooled noticeably. The Diefenbaker government seemed unaware of the fact that it requires much charm to retain friends while you amuse yourself by poking them in the eye. But at year-end, 1958, the climate of inter-governmental

relationships was not at the forefront of anyone's consciousness at Avro or Orenda. Everyone was too busy.

Under the spur of government requests to speed delivery dates December and January were marked by feverish activity on the Arrow production line. By February five fully completed and airworthy Arrows were in existence—one of which had been briefly sidelined by the landing accident of June 11th, 1958—and February was ushered in at Avro in the exhilarating knowledge that in a few short weeks Arrow Number 6 would be ready. Over Arrow Number 6 great expectations hovered. Number 6 was the first of the Mark IIs, the first Arrow equipped with Orenda's tailor-made Iroquois engine; and the Iroquois PS-13 promised to send the Arrow through the air at unheard of speeds. The first Arrow had been equipped with a J-75 P3 engine and its four Mark I successors had each carried a J-75 P5, an engine with a "dry" thrust of 12,500 pounds which could generate 18,500 pounds of thrust with its afterburners.

The brand new Iroquois was designed to produce 20,000 pounds of dry thrust, of course—a remarkable 54 per cent increase—and 25,000 pounds of thrust with afterburner augmentation, the latter representing a 40.54 per cent increase over the J-75's power with afterburner. The Gummman F-14's P&W TF30-P-412A engines developed 12 years later are rated at 20,000 lbs thrust each at sea level.

Everyone at Avro realized that the Mark I could probably set a new world's speed record itself if given the assignment. So what would Arrow Number 6 do, with a full 40 per cent increase in power? In addition, it was noted, Arrow Number 6 with the Iroquois engine would have that large increase in power applied to a lighter aircraft; for not only were the pairs of J-75s in the first Arrows heavier than the Iroquois engines, but the use of J-75s in the aircraft, originally designed for another power plant, had in turn necessitated the use of nose ballast to maintain the centre of gravity at the appropriate point. (In high performance aircraft particularly, a shift in c.g. of only a few inches can precipitate acute and dangerous handling problems.)

With the great increase in thrust, coupled to a reduction of 4,000-5,000 pounds in all-up weight, a radical increase in speed was guaranteed for the Mark II Arrow. Complementing this greatly enhanced performance, the plans for succeeding Marks of the Arrow called for the installation of extra fuel tanks for longer range. All in all, the aircraft's capabilities were so outstanding that, in the minds of the Avro and Orenda work force, there could be no question of holding back on full production once Number 6 was sent aloft. This conclusion could only be reinforced by the reasoning that a nation that had spent \$341,000,000 to bring itself to the very threshold of full production of what promised to be the finest interceptor aircraft in the world for several years was not likely to cast its advantage away. Furthermore, apart from the production contract, which was all the September 23rd press release had deferred judgment on, Avro had separate contracts on an initial group of 37 aircraft, and contracts that called for advanced research and test programs on approximately 20 of those. None of these development and research contracts had been called into question; and behind the scenes Mr. Grinyer and other company officials had been given the private reassurances referred to. February 20th, 1959, rolled around.

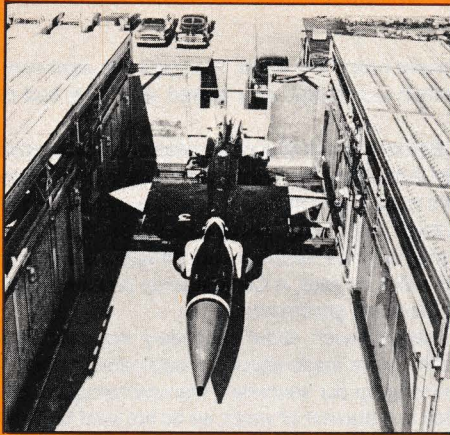
On Friday, February 20th, 1959, at 11:00 a.m., Prime Minister Diefenbaker rose at the opening of the House of Commons and spoke to a suddenly hushed audience:

"The government has carefully examined and re-examined the probable need for the Arrow aircraft and Iroquois engine known at the CF-105, the development of which has been continued pending a final decision. It has made a thorough examination in the light of all the information available concerning the probable nature of the threats to North America in future years, the alternative means of defense against such threats, and the estimated costs thereof. The conclusion arrived at is that the development of the Arrow aircraft and Iroquois engine should be terminated now.

"The development of the Arrow aircraft and the Iroquois engine has been a success although, for various reasons, it has been much behind the original schedule. The plane and its engine have shown promise of achieving the high standard of technical performance intended, and are a credit to those who conceived and designed them and translated the plans into reality.

"Unfortunately these outstanding achievements have been overtaken by events. In recent months it has come to be realized that the bomber threat against which the CF105 was intended to provide defense has diminished, and alternative means of meeting the threat have been developed much earlier than was expected.

"The first modern long range bombers with which Canada might



be confronted came into operation over five years ago, but the numbers produced now appear to be much lower than was previously forecast. Thus the threat against which the CF-105 could be effective has not proved to be as serious as was forecast.

"Potential aggressors now seem more likely to put their effort into missile development than into increasing their bomber force. By the middle of 1962 the threat from the intercontinental ballistic missile will undoubtedly be greatly enhanced in numbers, size and accuracy, and the I.C.B.M. threat may be supplemented by submarine-launched missiles. By the middle sixties the missile seems likely to be the major threat and the long range bomber relegated to supplementing the major attack by these missiles. It would be only in this period, namely after mid-1962, that the CF-105 could be fully operational in the Royal Canadian Air Force.

"The United States government, after full and sympathetic consideration of proposals that the U.S. air force use the Arrow, reached the conclusion that it was not economical to do so. Already the U.S. air force has decided not to continue with the further development and production of U.S. aircraft having the same general performance as the Arrow. The development of interceptor aircraft that is now proceeding in the United States and abroad is on different types.

"Since my announcement of last September much work has been done on the use of a different control system and weapon in the Arrow. These changes have been found to be practical. Although the range of the aircraft has been increased it is still limited. It is estimated that with these changes the total average cost per unit for 100 operational aircraft could be reduced from the figure of about \$12,500,000 each to about \$7,800,000 each, including weapons, spare parts and the completion of development, but not including any of the sum of \$303 million spent on development prior to September last.

"Now I wish to turn to another aspect of defense. As previously announced the government has decided to introduce the Bomarc guided missile and the Sage electronic control and computing equipment into the Canadian air defense system, and to extend and strengthen the Pinetree radar control system by adding several additional large radar stations and a number of small gap filler radars. Canadians will be glad to know that agreement in principle with the United States defense department has now been reached on the sharing of the costs of this program.

"Under this arrangement Canada will assume financial responsibility for approximately one-third of the cost of these new projects. The Canadian share will cover the cost of construction of bases and unit equipment, while the United States share of approximately two-thirds of the cost will cover the acquisition of technical equipment. . . .

"As for the technical equipment which is to be financed by the United States, both governments recognize the need for Canada to share in the production of this equipment. Within the principles of production sharing the United States government and the Canadian government expect that a reasonable and fair share of this work will in fact be carried out by Canadian industry. . . .

The Opposition's response in the House was momentarily muted by the sudden shock of the Prime Minister's bombshell. Mr. Diefenbaker had delivered his abrupt and stunning announcement on a Friday, some six weeks

Right: The Diefenbaker government cancelled the Arrow program in 1959, ostensibly on the ground that new manned interceptors were not required, and that sub-sonic CF-100s could fill the interceptor role satisfactorily in Canada. In 1961 the same government made arrangements with the United States to acquire F-101 supersonic Voodoos. Although Voodoos are even now being phased out of the Air National Guard in the United States, the Canadian Air Force has been reduced to such straits that its Voodoos will have to discharge their primary interceptor role—if they can be kept in the air that long—until 1983. Left: Another defensive failure, the BOMARC missile in its concrete nest. It too, proved less than successful.

before the March 31st deadline earlier intimated as the date for decision, hence the Liberals had the weekend to assess the situation, consider their strategy, and select the main lines of their attack.

The response of A.V. Roe and its employees was instantaneous once the official telegrams ordering cessation of work were received. Avro and Orenda laid off, immediately, all employees engaged on the Arrow and Iroquois production lines. Some 13,800 men, several hundred of them engineers of the highest qualifications, were put on the streets, most of them that very afternoon. The Prime Minister later denounced this as a blatant attempt by A.V. Roe Canada Ltd. to embarrass the government; but, as already noted, the ineptitude of the government in their handling of the crucial contract termination details was the primary cause of their own acute discomfiture. Even government representatives in the factories were so astounded by the announcement—which reached them via the radio before any official communication was in their hands—that several of them telephoned their departmental superiors unbelievably for conformation.

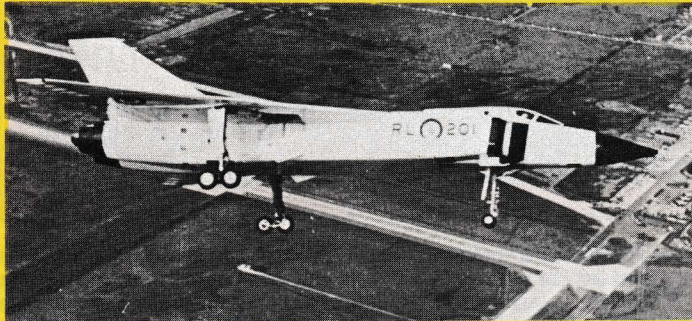
On the production lines men hurled their tools on the floor in anger. Some wept. One man was so shocked that he bundled his belongings into his tool kit and walked out with the crowd, unseeing, not realizing until days later that he had stuffed his blueprints in with his tools. He still has them.

On Monday afternoon, February 23rd, the House of Commons convened at 2:30 p.m. At the earliest opportunity Paul Hellyer, speaking for the opposition Liberal Party, rose to ask leave to move the adjournment of the House . . . for the purpose of discussing a definite matter of urgent public importance, namely the crisis in the aircraft industry involving mass lay-offs and threatened disintegration of this important sector of our Canadian defense production."

In the ensuing debate Mr. Hellyer scored effectively, despite the fact that he was operating under a distinct handicap. His own party, at an earlier stage, had been far from unanimous on the question of proceeding with the development of the Arrow, and the Conservatives were fully aware of the lack of unanimity in Liberal ranks. (General Foulkes, Chairman of the Chiefs of Staff Committee, subsequently made the statement that the Liberals themselves had been on the verge of cancelling the Arrow when the 1957 election came along and passed responsibility for the program to their opponents.)

But with a weekend to prepare, and a speech as vulnerable as Mr. Diefenbaker's to dissect, Paul Hellyer was not short of ammunition, despite the fact that he knew Lester Pearson's attack was going to be cautiously focused on the *manner* of the termination rather than the justification therefor. Indeed, any informed critic reading the Prime Minister's superficial essay on the strategic situation would have been sorely tempted to plagiarize Thomas Babington Macaulay and open the rebuttal by pointing out that Mr. Diefenbaker's delicately balanced assessment "deserved the praise, whatever the praise might

ARROW



be worth, of being the best assessment ever delivered by any man on the wrong side of the question of which he was profoundly ignorant".

Mr. Hellyer could have been harsher than he was, notwithstanding the Liberals' handicap; but he launched the debate vigorously. He began by making reference to the fact that he was opening the debate precisely on the fiftieth anniversary of powered flight in Canada, lamenting that, instead of being able to speak about a national celebration, he was constrained by circumstances to deal instead with a national tragedy. He warned to his task. "The Prime Minister commended those who had designed the aircraft and translated the plans into reality, but then he went on to say that they had been overtaken by events; that the bomber threat had diminished, and that alternative means of defense, presumably against the bombers had been developed much earlier than had been expected.

"It is difficult to understand how the threat from manned bombers could have diminished . . . I am sure from the information we have and from the information we can obtain from technical sources, magazines and other places, that the present inventory of Russian bombers is greater today than at any time in history....

"If the alternative means of meeting the threat to which the Prime Minister alluded is the BOMARC missile, some of us would have serious reservations about that, and we should like the Prime Minister to give us some more information about it. The BOMARC has not yet, to common knowledge, been proven, and early models have been less than satisfactory in performance.... Observers have also stated that the Russians would still have an inventory of between 1,000 and 2,000 bombers capable of coming over the ice cap and presenting a threat to our national survival. We have been told repeatedly that there is a continuing requirement for manned interceptors. The Minister of National Defence himself said so on several occasions; the supreme commanders of NORAD and his deputy have also made statements to the effect that defense was needed against the manned bomber. They have gone even further and said the Arrow was required as part of the defense against the manned bomber.

"Obviously, the government does not think so. In such circumstances the logical question is who is right, the experts or the government?...

"The statement went on to say that the CF-100 was still an effective weapon in the defense of North America against the bomber threat. The Prime Minister's statement should have been more precise. Is the CF-100 still effective against the total Russian capability as far as manned bombers are concerned? Surely the Right Honourable Gentleman is not suggesting that? It is true it might be effective against part of the Russian inventory of bombers, but certainly it would not be effective against their recent jets. As a matter of fact the Air Force placed a requirement for a new version of the CF-100, to be known as the Mark VI, which was to have an afterburner to increase its power and be equipped with an air-to-air guided missile. This was to be a stopgap between the present CF-100, now in squadron service, and the CF-105, but one of the first things the government did when it came to office one and a half years ago was to cancel this requirement.

"The inconsistency of the Prime Minister's statement seemed to lie in the fact that he found it necessary to rationalize the government's decision by

speaking of the very extensive cost of the Arrow. The figures he used were not figures which were common knowledge; they looked as if they had been picked from a hat."

Mr. Hellyer went on to deplore the lack of consideration and consultation on the part of the government in its abrupt cancellation order. He foretold the rapid wasting away of Canada's military aircraft industry and rapidly maturing electronics industry, citing these impending developments as the true cost Canada would pay for buying defense "on the cheap" through the deployment of American BOMARC missiles on sites in Canada to be prepared, as their only contribution, by the Canadian government.

"The government has talked much about secondary industry. We well remember the speeches that were made about Canadian development and about the necessity of building up our secondary manufacturing. We do not want to be hewers of wood and drawers of water; we do not want to dig holes for BOMARC squadrons; we do not want to be relegated just to cutting down trees and bulldozing boulders out of the way."

The Prime Minister interrupted to ask Mr. Hellyer what explanation he had for the fact that the United States had recently cancelled their F-106C and the F-106D, "of similar capabilities to the CF-105".

Mr. Hellyer knew enough about the subject to lay that argument to rest in five short sentences. "As far as the other planes are concerned, I think we should stop comparing the United States F-106 with our CF-105. They are as different as a horse and buggy and a car. They were not designed to do the same job at all. They were for different military requirements. Perhaps one good reason why the United States should have cancelled their F-105 and F-106 is that they would have looked so poor beside the CF-105."

Angrily Mr. Hellyer went on, pointing out that it was the loss of 20 years of accumulated productive capacity and potential which was so serious. Since the views expressed in a then current *Toronto Globe* and *Mail* editorial reflected his own, he read these sentences from it into the record:

"And here is the irony of it. Most Canadians will recall that in the early post-war years we were not permitted to share defense production with the United States; the reason the United States gave being that we lacked the necessary know-how. So, at great trouble and cost, we acquired the know-how. Still, there was no sharing. And now, what? Now, the brilliant array of engineering and technical talent which built up this great Canadian industry will be dissipated. Now, these highly-trained men and women—the one national asset—will probably go. Where? To the United States."

After Mr. Hellyer had concluded, Mr. Pearkes rose and gave a full and cogent resumé of the whole Arrow program, recounting again the government's failure to get any orders from the United States or Britain for the Arrow. Significantly, he indicated, in response to a question from Mr. Hellyer, that if a reasonable order could have been obtained from the United States or the United Kingdom "the government would certainly have given most serious consideration" to going ahead with the Arrow. He also confirmed that after being allowed to abandon the development of the Astra Weapons System, the company had given a fly-a-way cost which he quoted as \$3.75 million per copy for the Arrow, without spares or missiles.

There was only a minor discrepancy between this figure and the one given by Crawford Gordon the previous autumn. Gordon had publicly committed the company to an estimate that "fly-a-way cost per aircraft, complete in every respect, including Iroquois engines and fire control system, would be \$3.5 million for the first hundred and \$2.6 million for the next hundred. These costs do not include spares or ground-handling equipment or development and tooling costs."

In the course of his speech Pearkes made reference to the fact that initially the government had developed some concern over what he implied was the limited range of the Arrow. At various times the Prime Minister too spoke critically of the range of the Arrow. Unfortunately both these gentlemen tended to mix *radius of action* figures with range figures, the former, of course, being only one-half the true range figure. Furthermore, neither speaker was specific about the assumptions he was making as to the proportion of the flying time during which the aircraft would be on full afterburner power. Most laymen do not appreciate what a complicated question range can be. When a jet fighter goes to full afterburner power the increase in fuel consumption is tremendous. An example or two will suffice to make the point abundantly clear.

Canada is currently considering purchasing a new fighter aircraft. Two of the contenders are the F-16, built by General Dynamics, and the F-14, built by

Grumman. The manufacturer of the F-16 shows its maximum capability as being over 300 nautical miles with "1.7 hour loiter capability or 7 minutes combat". The vast difference between 7 minutes and 1 hour and 42 minutes illustrates how radically fuel consumption changes under maximum afterburner conditions—and how precise one has to be, when talking about range, to specify the exact performance to be required during any flight.

In describing the capabilities of the F-14, its manufacturer is careful to avoid generalities. Grumman says that the F-14, with internal fuel only (16,200 pounds), can take off, climb to cruise altitude, fly 500 miles, descend to 10,000 feet, fight in maximum afterburner for two minutes, climb back to cruise altitude, return to base (or carrier), loiter for 20 minutes, and land with 5 per cent fuel reserve. With that sort of description, airmen have a clear picture of an aircraft's endurance.

As was to be expected of George Pearkes, he was fair in his presentation. He wound up this portion of his speech admitting that, with the additional fuel tanks the company had advised it could instal (once the ASTRA system had been replaced by the Hughes) the Arrow would have "a subsonic range of 506 nautical miles". From the context it is safe to state that Mr. Pearkes meant to say a radius of action of 506 nautical miles, i.e., a range of over 1,000 miles.

In a broadcast he made years after the event the Prime Minister referred to the Arrow at one point as an aircraft whose endurance, at maximum speed, was only about 20 minutes. Maximum speed means maximum afterburner. Mr. Diefenbaker might have been surprised to learn that the American Voodoos, which his government acquired, together with Starfighters, in 1961 and 1962, were comparably heavy on fuel. A Voodoo pilot whom I spoke to told me that a Voodoo at maximum afterburner would use about half its fuel in 10 minutes or thereabouts.

The fact is that the Arrow's range was not really a factor of any consequence in the final decision?

Mr. Pearkes, in his main speech, on February 23rd, 1959, made it clear in three or four different places that budget considerations were extremely important in the decision to cancel the Arrow. He laid much more emphasis upon this fact than the Prime Minister had, stating at one point: "If we met all requirements we would be running into a budget far, far higher than the budget for which we are now providing. If we had not taken this action, if we had continued with the CF-105 we would be faced with making a complete change in our defense structure. It might have meant that we would have had to stop the building of new destroyers. That would throw many hundreds of men out of work from our shipyards. We might have had to cut down the strength of the Army or something of that sort. You have to strike a balance."

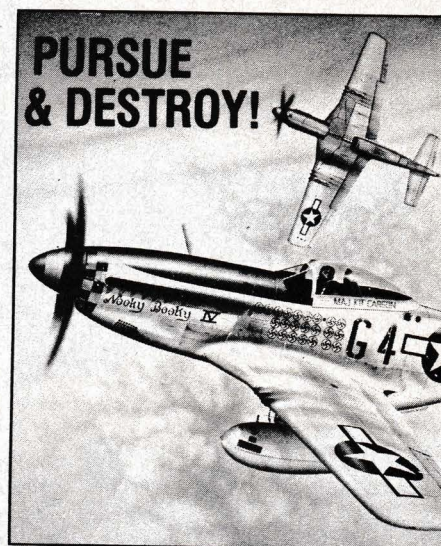
At a later point in his speech, verifying that the original figure discussed had been 600 Arrows, Mr. Pearkes said: "I have checked these figures very carefully. I merely mention that to give an indication of the enormous expense involved and what an utter impossibility it would be for Canada to provide for all the defense of this country."

In a letter he wrote to me in December, 1977, Mr. Pearkes made no reference to obsolescence of the Arrow. He said: "The decision to cancel this aircraft was most difficult for all concerned. There just was not enough money to meet all the needs of National Defence. The Navy, and the Army had to be maintained to meet international commitments as well as the Air Force.... I paid several visits to the United States Department of Defense to see if they would purchase some of the Arrows, but they were building new aircraft of their own, their air industry needed all the help their government could give it. I got nowhere. Unless Canada could sell the Arrow, the cost would have been prohibitive. The Navy had nothing but older ships, the Army had commitments all over the world. Unless the Government was prepared to assign considerably more money to National Defense, or the needs of the Navy and Army could be forgotten for a couple of years, there was no money available.... And so the Arrow had to go.

It is fair to say that the Arrow died on the altar of economics. Its planned performance was never questioned by any person who was knowledgeable enough to pass judgment.

²The commonplace nature of in-flight refuelling should be borne in mind. In September, 1955, the American Navy made in-flight refueling capability mandatory on all its aircraft. Currently, the F-4 Phantoms and F-15 Eagles of the U.S.A.F.'s Tactical Air Command routinely fly nonstop from bases in Germany to bases in America, with the Phantoms sometimes refuelling as many as 8 times in the process.

PURSUE & DESTROY IS HERE!



The Story Of The 8th Air Force's Fighter Groups In WW II, Told By P-51 Ace, Leonard "Kit" Carson (Col. USAF Ret.) A Man Who Was There, Who Lived It, And Now, For The First Time, Does For The Fighter Pilots Of The 8th, What Several Writers Have Already Done For Its Bomber Crews.

"Pursue And Destroy!" is also the developmental and operational story of the P-51 Mustang, leading to its use as the most effective strategic escort fighter ever built. Illustrated by over 400 superb photographs and drawings, many of which have never been seen before, "Pursue And Destroy!" is the tale of a unique breed of men, who built a doctrine of fighter supremacy and made it work against the most formidable ground and air defenses yet devised. It is also a testimonial to a generation of fighter pilots who carried out General Jimmy Doolittle's order, "to pursue and destroy the enemy, wherever you find him!" The story of a fighter command that swept the skies clear of German aircraft during the D-Day invasion of Normandy, a feat unprecedented in the annals of warfare, of men who flew from England in single engined airplanes, ranging as far as Poland and Czechoslovakia, to defeat the veteran pilots of the Luftwaffe over their own soil. All of it is told in brilliant detail and prose by a man, who not only was one of the 8th's leading fighter aces, with 22 victories, but also a bonafide flight test engineer and aerodynamicist, who later went on to head the Wright Field Wind Tunnel Branch.

In "Pursue And Destroy!" Col. Carson describes in compelling detail the missions accomplished, the airplanes flown, the tactics used by both sides, the strategy of long range escort, the persistent menace of weather, the problems of maintenance and supply, and perhaps, most important, his impressions of what he saw in that aerial amphitheater six miles above the earth.

"Kit" Carson has accomplished something that few aviation writers are capable of... he has told a fascinating story full of factual, important material, and made it eminently readable. In truth, his work delineates the role of the airman in society, and makes you care.

"Pursue And Destroy!" is the story of the emergence of the greatest air force in the world, described by a fighter pilot who took part in it. It is also a gripping narrative, and all of it is illustrated with some of the finest and rarest combat photography, much of it in color, that we have ever seen.

Those of you who read portions of Colonel Carson's story in an abbreviated serialized version that appeared in *Wings* and *Airpower* will have some idea of what is in store for you, but the book contains a great deal of previously unpublished information and photographs. It is truly a collector's item and, at \$19.95, a real bargain.

Considering this book's contents, rich folio artpaper stock, handsome, hardcover binding, it will be truly a collector's item for anyone taking his aviation history seriously. Order yours today.

Gentlemen: Please send me _____ copies of "Pursue And Destroy!" by "Kit" Carson at \$19.95 postpaid. Enclosed find check, cash, money order in sum of _____

Name _____

Address _____

City _____ State _____ Zip _____

Send to Sentry Books Inc. Box 3324 10718 White Oak Ave. Granada Hills, Ca. 91344 Calif. residents add 6% sales tax

Foreign orders please add \$1.00 for postage