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A PIECE OF CAKE

Flying the C-102

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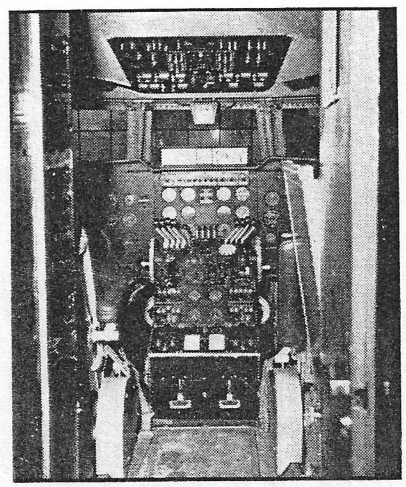


The Front Office.

It is not often that a first prototype aircraft comes so close to living near to its design values as has turned out in the case of Avro Canada's C-102 Jetliner. Too many times some member of the design staff in effect puts a decimal point in the wrong place, with the result that the test crew is constantly searching for a few more miles per hour speed or a few more feet per minute climb so that the aircraft will come up to the performance which the engineers' slide rules say it should do.

Happily, the Jetliner has demonstrated such promising qualities that even at this early stage of the test program the indications are that the aircraft will reach and likely even surpass its design aims with little difficulty.

For a pilot to fully appreciate an aircraft as the Jetliner, it is of course necessary to fly it. However, it is proposed here to attempt to pass on some of the first impressions the test crew has received of the aircraft. And because this article is intended to co vey impressions, technicalities ha been largely av ded.

Taking first ngs first, on ope into the flight k pilot is initially impressed t ument layout. The sensib of the controls is good. The engine instruments are nicely separated, but easy to read. This group is set right in the centre of the overall panel, and on each side of it, directly in front of each pilot, is a complete blind flying panel. In the centre of the forward cabin overhead is a small panel on which is located the engine starting and fire emergency controls.

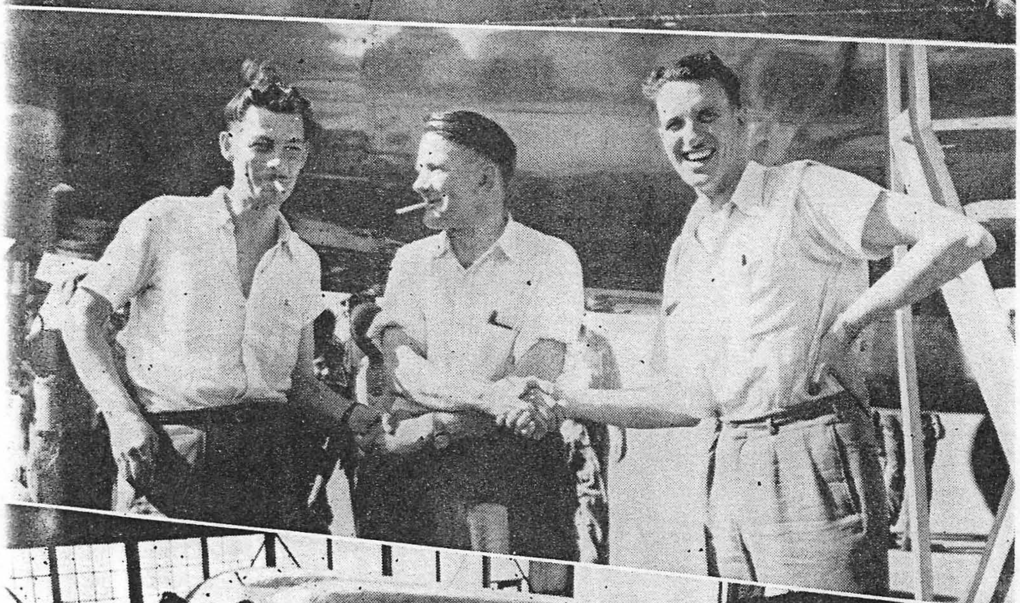
On either side of the pedestal between the pilots is a set of throttles, so that pilot or co-pilot can control the Rolls-Royce Derwent 5's without having to do any awkward reaching. One of the beauties of the jet turbine is that a single throttle is the only control necessary for each engine. There are, naturally, no mixture or propeller pitch controls required.

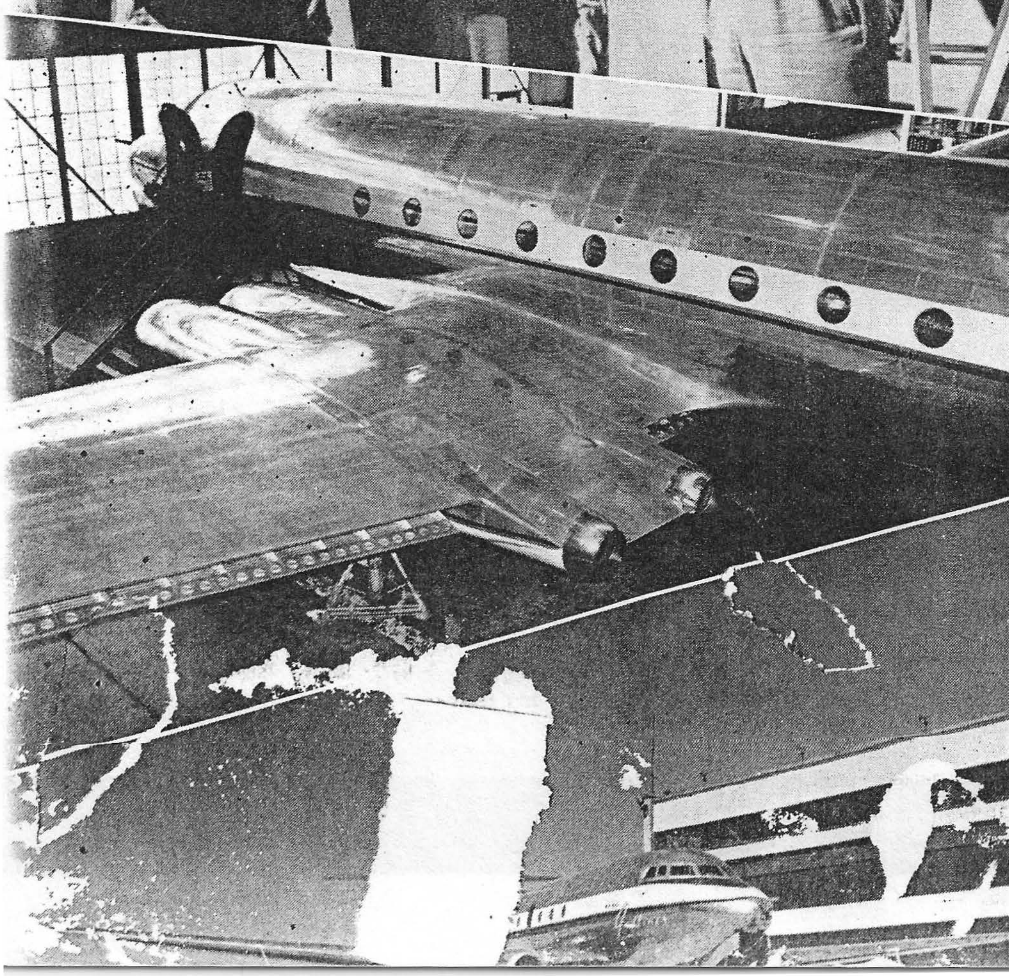
Additi

This ned at carries the elevator an it is po ners. At its back end This o pilot and radio controls are lo ed. The latter are of a dua e en n addition to his normal duties, aptain of the aircraft looks afte the pressurization panel, which is located alongside him o the left hand side. On the co-pilot's list of duties and to his right is the heating and ventilating system control panel. The co-pilot also handles the radio. The actual flying controls are completely orthodox.

The engine starting procedure is a simple operation and takes only about 20 to 30 seconds per engine. The first act is to see that the low pressure fuel cocks are in their normal tion. Next select the engin started on the starter panel and the starting button. Wh begins to turn over, turn at pressure fuel cock and boo nd which fires two of the engi ger bers. From then on the firin the the chambers is a continuous pr and the Derwent settles at idling rev of about 34-3500 rpm.

Since no warming up is necessary, you can start taxiing out to take-off position as soon as all four engines are





running. Slight extra power is necessary to start the aircraft rolling, so the engines are opened up to about 9,000 rpm. As soon as the machine starts to move you close the throttles down to about 6,000 rpm, this being all that is necessary to maintain a taxiing speed customary for an airliner the size of the Jetliner.

Because there is only slight swing effect from the thrust of the close in engines, all steering is done with the nosewheel for small changes of direction while taxiing. For sharp turns the brakes can be utilized.

Prior to take-off a normal cockpit check is carried out. For take-off the Jetliner's flaps are depressed 25°. When take-off clearance is obtained from the tower, you taxi into position, taking care that the aircraft is lined up directly down the runway and that the nosewheel is plumb straight. The brakes are then held on and you open up the engines to full power. This procedure gives an opportunity to check that all power is available. It also obviates that which is always a possibility with piston engines: the choking of an engine and subsequent temporary loss of power through opening the throttles too rapidly when beginning the take-off run.

When the engines are winding up at their take-off speed of 14,700 rpm, you release the brakes and the Jetliner starts to roll. The acceleration is not sharp; the surge or sudden pressure against the back that is found in piston engine aircraft is absent. The gain in speed is steady and fluid because the thrust increases with the forward speed.

This continuous gain in thrust as the forward speed increases could be explained with mathematics, but genetics are slightly more intriguing. It's like breeding rabbits. You start off with two and first thing you know you have four, then sixteen, with this business continuing ad infinitum—a sort of a chain reaction. So it is with thrust: two pounds of thrust breed several mph of forward speed, which in turn result in additional pounds of thrust, and so on up to the maximum thrust available.

HE PICTURES

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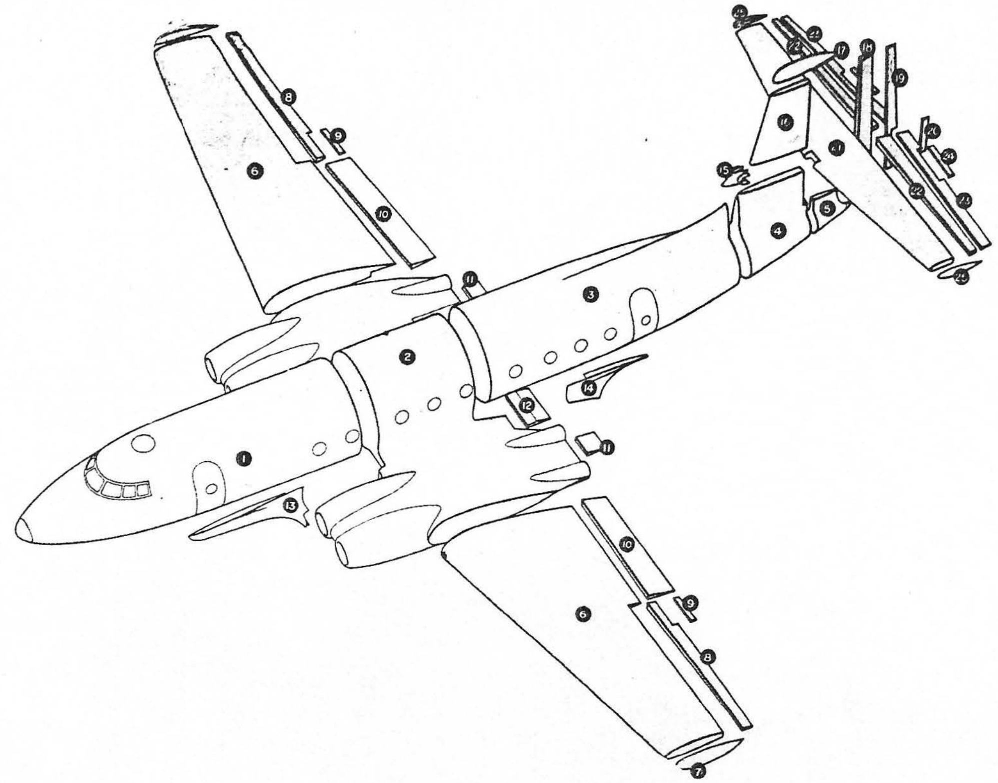


The actual flying technique of taking off is the same as with any other aircraft. There is no tendency to swing. The nosewheel comes off at about 80 mph IAS and at about 100 mph IAS the aircraft gets light, with a tendency to become airborne. At an indicated speed of approximately 110 mph the Jetliner lifts off.

Immediately following take-off, climb to keep the speed below 200 mph IAS until the flaps are up. Or, the speed can also be kept down by throttling back. The undercarriage should of course be retracted as soon as possible after becoming airborne.

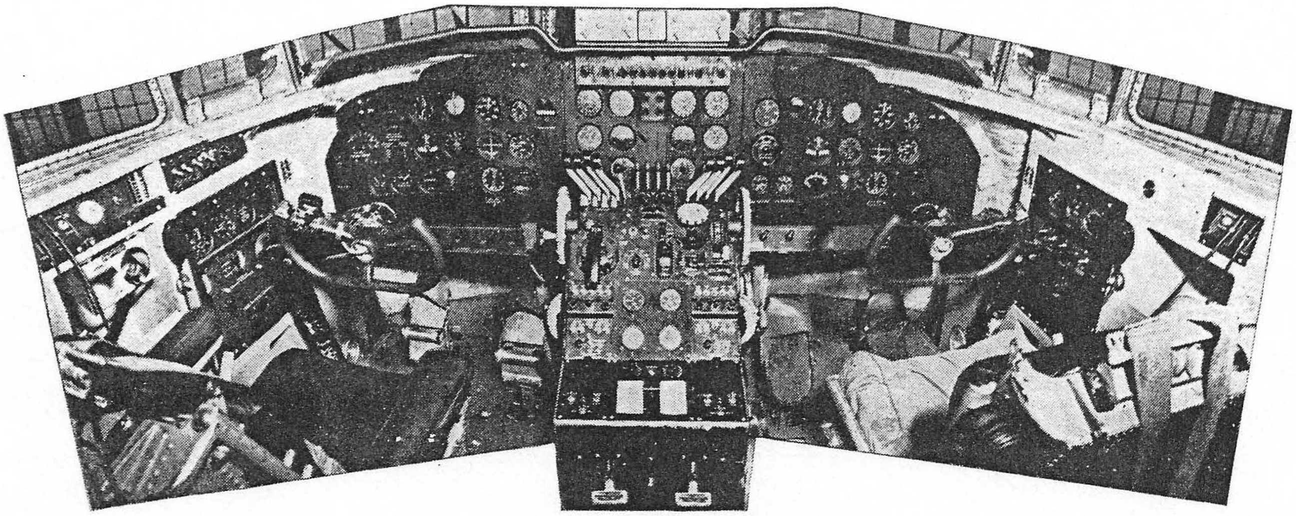
The recommended engine speed for climb and maximum continuous cruise is 14,100 rpm. So far the procedure has been to climb the Jetliner from take-off at a rate of 2,500 to 3,000 fpm at an IAS of 200-230 mph. It has been climbed 8,000 feet in one minute from a level speed of 300 mph as a demonstration of power and speed. These figures are quoted only to give some indications of what has been done with the Jetliner so far.

Engine synchronization is entirely by throttle, and at no time is it any particular problem, as it often is with piston engine aircraft ... exception to this statement mig... found a... idling speed when ... se lack of sync... n ... to consequence. The principal engine instruments that must be watched are the oil pressure and the tailpipe temperature. In the case of the latter it is necessary only to avoid allowing the tailpipe temperature to exceed the maximum figure recommended. If there is engine trouble, the powerplant in question may be cut off by shutting off the high pressure cock. Because there is no propeller to windmill or to feather, cutting off an engine in the Jetliner does not cause the same bother as a similar action would do in a piston engine type.

Cruising flight in the Jetliner may require a bit of readjustment in the thinking of the ordinary pilot who has been taught that once the aircraft is airborne, the engines should be throttled back in order to conserve them. The most efficient engine speed is the 14,100 rpm recommended for maximum continuous cruise. This is because the maximum efficiency of the jet engine is obtained at the highest speeds, at which it is possible to get the best thrust. This may seem a bit harsh on the engine to the piston engine pilot, but it is a matter of taking the efficiency that is available. It is naturally possible to vary the cruising speed, but it is not likely that anything ... maximum cruise will be required ... h skilful scheduling. As previously mentioned, the most efficient speed with a jet is right up.

Because of its high top speed, about 50% greater than present-day air liners now in use, the Jetliner has a wide range of speeds. This is a problem inasmuch as it requires a control system that will be effective over a wider range. Here again, the Jetliner's designers have found the answer quite successfully. There is an ideal combination of good control harmonization and control pressures that are nice and suitable throughout the range of speeds.

Certainly one of the most interesting features of the Jetliner is the low noise level. This is extremely comfortable, and low even at maximum speed. There is apparently no breakaway of air right up forward to give a windrush noise. Conversation in normal tones is possible and the flight crew does not find it necessary to use headphones. There are two loudspeakers on the flight deck and it has been found so far that one is quite sufficient —and even this is not turned right up. Slight windrush noise is found in the a... of ... passenger ca... but ... atter, this is where the ... l galley are to be. ... o a definite lack of vi- ... will increase passenger ... ower the fatigue factor ... flight crew, and air- ...



The Flight Deck.

When approaching the power off stall in the "all up" or "all down" condition, the audible stall warning comes at about 110 mph IAS. In the "all up" case, buffeting starts at about 108-110 mph IAS and increases in intensity to the point of stall at about 100 mph IAS. In the "all down" case the stall comes at about 92 mph IAS.

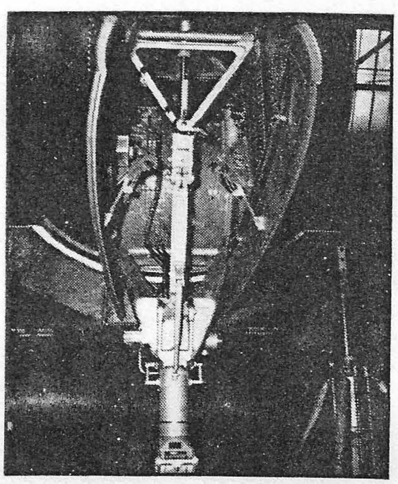
In each instance the stall is a situation of rapid descent at about 2,000 fpm, with the aircraft rocking fore and aft, showing a desire to recover. You have to hold it with a good pull force to keep it in the stall position. There is no tendency for a wing to drop. Aileron and rudder control is available right down to the stall.

The landing procedure is quite orthodox. The undercarriage is lowered at something less than 200 mph IAS and flaps are selected at the appropriate place on the circuit, depending on the procedure normally followed by the operator. The lowering of the undercart and flaps causes very slight change in trim. This characteristic was intentionally designed into the Jetliner and is very important in case of a balked landing. The designers did an exceptionally good job here.

The general approach follows the pattern of conventional piston engine aircraft, but as with other pure jets, the final close down of power is made at a slightly earlier stage in the normal pattern—about 600 feet further out from the end of the runway than with a piston engine machine. This is due to the lack of drag from airscrew discing which helps to cut down the airspeed of the conventional machines.

On a long approach the pilot keeps the engines turning up to 6½-7,000 rpm. This allows him to open up successfully and quite rapidly if necessary. As long as the engines are kept revving at this speed, the delay in response following the opening of the throttles is no greater than with piston engines.

The hold-off and landing are quite ordinary. Once on the ground the practice is to keep the nosewheel off the runway till the speed drops to about 70 mph IAS, this giving the maximum head resistance. Then apply brakes as befitting. The landings are completed in the average distance taken by present-day air liners. All landings and take-offs executed at the time of writing have been under normal wind conditions, although because there is only one runway in use at Malton at present there has often be[illegible] quite a [illegible]



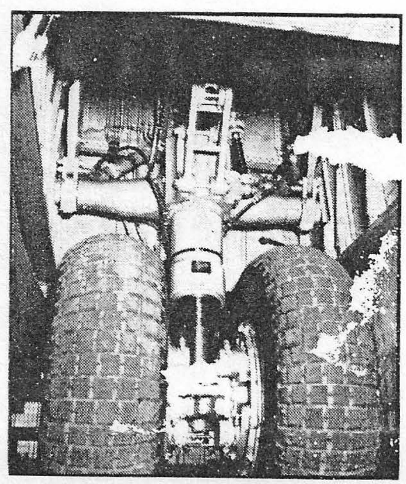
Nosewheel Leg.

One beauty of the Jetliner is that to convert an air line pilot to it from piston engine types would take no more time than would normally be required to give him his periodical instrument flight and engine cut checks, etc.

All in all, there's not much wrong with the Jetliner. There are those adjustments which one expects to find in any new type, but most important: in living near to design values in general, the Jetliner is about the best prototype in my experience. It's a piece of cake.

JETLINER GEN

GENERAL DESCRIPTION: The C-102 is a 50 passenger aircraft of short to medium range, powered by four Rolls-Royce Derwent 5's (centrifugal). Max. cruise, 427 mph. at 30-35,000 feet at all up weight of 60,000 lb. Normal range (50 pass. plus baggage and all allowances for taxiing and take-off, stooging, fuel for alternate, instrument approach, etc.),



Main Undercart Leg.

500 miles. Max. still air range (without emergency allowances), 1,400 miles. • Designed to operate from runways of 4-5,000 feet under standard ICAN conditions.

FUSELAGE: Circular cross-section; diameter 10 ft.; four components — nose, centre section (inc. centre wing), rear centre section, rear section (inc. lower fin). Pressure domes located immediately forward of main instrument panel, and at joint between rear centre section and rear section. Windscreen of high strength aluminum alloy casting; three centre panels of sandwich construction with "NESA" electrical de-icing. Vinyl core ensures pressure being retained in event of windscreen damage. Other flight deck windows of plexiglas. Non-misting circular, double windows in passenger cabin. Pressure-sealed entrance doors located fore and aft.

MAINPLANE: Fully cantilever construction, built in three main sections with detachable wingtips. Centre portion integral with fuselage centre section. Centre section structure conventional two-spar arrangement, chordwise ribs and heavy gauge skin. Spars are twin-boom, solid shear-web type. Outer wings have two-spar arrangement, but heavy gauge skin and stringers take place of concentrated spar booms. Inner portions of outer wings between spars form integral fuel tanks. Two tanks port, two starboard, total capacity 2,300 gals. Aerodynamically unbalanced ailerons are power assisted hydraulically in ratio of 5:1. Control surfaces all use piano hinges (except flaps). Split type, metal covered landing flaps plus same type dive flaps fitted in centre wing. Extension or retraction time about 10 secs.

EMPENNAGE: Comprises upper and lower fin section with high tailplane, double rudder and double elevator surfaces. Lower fin integral with fuselage. Elevators of double surface arrangement, rear surface manually operated, auxiliary power operated. Electrical trimmers can be operated manually. Rudder set-up similar to elevator. Unbalanced control surfaces in both cases.

MISCELLANEOUS: A Dowty tricycle undercarriage is used with twin wheels on both main and nose units. All units retract forward in about 8 secs. Nosewheel, self-centering and self-trailing, is steerable by a hand wheel adjacent to first pilot. In event of hydraulic failure, gear may be gravity lowered. Wheel rims are to American Tire and Rim Association specs. All main flying controls are of push-pull type, using aluminum alloy tubes for elimination of differential expansion and contraction under extreme temperature changes. Up to 60 pass. may be carried by using five seats abreast and 19 in. aisle.

WEIGHTS AND MEASURES: Take-off wt., 60,000 lb.; landing wt., 52,500 lb.; cabin pressure differential, 8.3 lb./sq. in. max.; wing area, 1,157 sq. ft. gr., and 1,097 sq. ft. net.; wing loading at 60,000 lb., 51.86 lb. sq. ft.; wing span 98 ft. 1 in.; aspect ratio, 8.31; overall fuselage length, 82 ft. 9 in.; mean wheel track, 22 ft. 6 in.; aileron area, 51.6 sq. ft.; tailplane stab., 251.2 sq. ft.; total elevator area, 56 sq. ft.; total dorsal, fin, and rudder area, 161.2 sq. ft.; total rudder area, 38.6 sq. ft., total landing flap area, 126.82 sq. ft.; total dive flap area, 37.2 sq. ft.

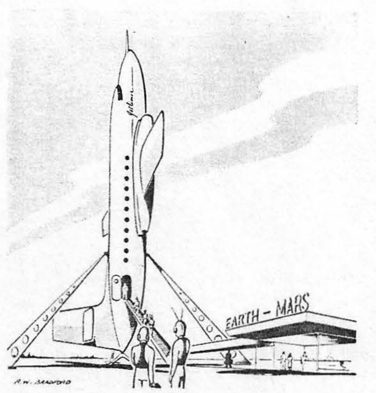
CIRCA 1995

Looking Ahead

Inside the rocket ship the Captain peered through the infra-red periscope and cursed under his breath. He twiddled a lead-plated knob to adjust the isotopes. "Ah!" he exclaimed with evident satisfaction as he straightened up and turned to face Special Prime Assistant Joe Blough. "Well Joe," he said excitedly, "we'll soon be there. We're about to become the first earthmen to land on Mars. Can't you just hear the cheering crowds when we make our triumphal return?"

"Don't hear nothin' but them bells in my head," answered Joe, "and I been hearin' them ever since my last match with Punchin' Percy the Poundin' Pugilist." But the Captain wasn't listening; he was tensely watching the geiger counter as it counted five hundred by tens.

"Get the rocket brakes ready," ordered the Captain tersely, and Joe, with an efficiency born of long practice, eased the gamma and alpha valves open a notch. A strained silence fell between the two interplanetary pioneers while the cathode tubes softly hummed "The Sweetheart of Sigma Chi", and the induction coils busily inducted everything in sight.



—*Avro News*

Oh yes, we still use C-102's!

"Now!" barked the Captain. Joe threw the beta switch that made the brakes go into operation. The distinct "alphabetagamma" noise of the triple expansion braking rockets increased to a steady roar until there was a perceptible slowing down of the giant interplanetary machine. At last there was a gentle bumping as it levelled off and rolled across the rough Martian surface

The Captain and Joe put on and adjusted their pressure helmets, taking care to see that the demagnetized Southern Comfort valves were fully operational, just in case the outer atmosphere should prove radioactive.

Thus prepared, they opened the chemi-sealed hatch and stepped out into the bright sunshine. Before proceeding further, the Captain tidily tore away a few strips of boundary layer which were rather messily hanging around the hatch opening.

They had not proceeded ten paces when a short distance (the Captain later estimated this at thirty telemeters) away, an odd figure came out of a hole and started to move towards them. "Hsst," said the Captain, "here comes a Martian now. Be careful not to antagonize him." Joe looked the Martian over as he approached.

He had a body much like that of an earthman, except for a much deeper chest and for the presence of a face on both sides of his head. "Looks like he'd be a natural to drive a Studebaker", Joe whispered to the Captain. Then he started as he realized that what he thought were the Martian's ears were in reality two small superchargers.

The Captain moved forward to greet the Martian, holding his hands out to show that he carried no weapons. Joe, however, kept his knuckledusters on. "We have come from another planet on a mission of peace," said the Captain suavely.

"A equals x to the second power plus 2.0684 minus y times the quantity, x to the fourth power minus 1.0001," said the Martian in reply. The Captain looked puzzled momentarily and then jotted the formula down into a notebook. He busied himself with his slide rule.

The Captain's voice was hoarse when he spoke. "Did you," he said, "bring any gum with you? He'd like some."