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By John Gellner

● Canada is the tenth country to select the Northrop F-5 tactical fighter and the second which will manufacture it under license (the other is Spain, where Northrop will build the aircraft in a joint production arrangement with a local firm, Construcciones Aeronauticas S.A.). All the F-5s now flying have been built at the Northrop plant in Hawthorne, California.

Northrop is one of the smaller companies in the giant U. S. aerospace industry—"small", of course, only relatively speaking. With all its subsidiaries, Northrop employs about 17,000 people, and its sales in the past few years have averaged well over 300 million dollars annually.

Airframe manufacture is concentrated in an L-shaped building. The shorter leg contains the production lines for aircraft parts produced by Northrop under sub-contracts, and in the longer leg are the parallel production lines for the T-38 Talon supersonic trainer and for the F-5. Present output is relatively modest—12, each, of the two types a month—but facilities are available for an immediate increase in production if required.

There are no aerostands or ladders. The aircraft body, moved in a ring-and-rail arrangement, is flanked by permanent platforms of appropriate height for each operation. This makes work easier and safer. It also gives an unaccustomed air of neatness to the assembly line.

Canadian industry already has a share in Northrop's production. The fuel cells for the T-38s and F-5s are being made by Dominion Rubber in Kitchener, Ont., and parts of the hydraulic systems by Jarry Hydraulics in Montreal. Single smaller contracts have gone to Ferranti Packard Elec. in Toronto, and to McGill University's Hypervelocity Impact Laboratories.

The factory field—the Hawthorne municipal airport—is in the middle of a densely populated area and no jet flying is permitted. Consequently, final assembly is done at Palmdale, outside the metropolitan area. Production tests are also conducted, there.

Of immediate interest to a Canadian observer is the quasi-experimental work done at Williams AFB, Chandler, Arizona, about 35 miles beyond Phoenix. I was flown there in a company Piaggio 166 with Flt. Lieut. T. R. ("Terry") Thompson, of the Directorate of Operational Require-

Building, flying and servicing C

HIGH PERFORMANCE version of the Northrop F-5, scheduled for Canadian forces, leaps from the concrete.

ments at CFHQ in Ottawa, who was in California to fly the F-5N, the type Canada will be getting under the designation CF-5. At Williams AFB there is another Canadian, Flt. Lieut. Keith Booth, who is instructing on T-38 Talons as an exchange officer with the 3525th Pilot Training Wing.

A unit of special interest at Williams is the 4441st Combat Crew Training Squadron of the U.S. Twelfth Air Force, commanded by Lieut. Col. Clyde Voss. The unit has seven F-5As and five F-5Bs, and its task is to train air and ground crews of countries which will be getting the F-5, as well as some American personnel.

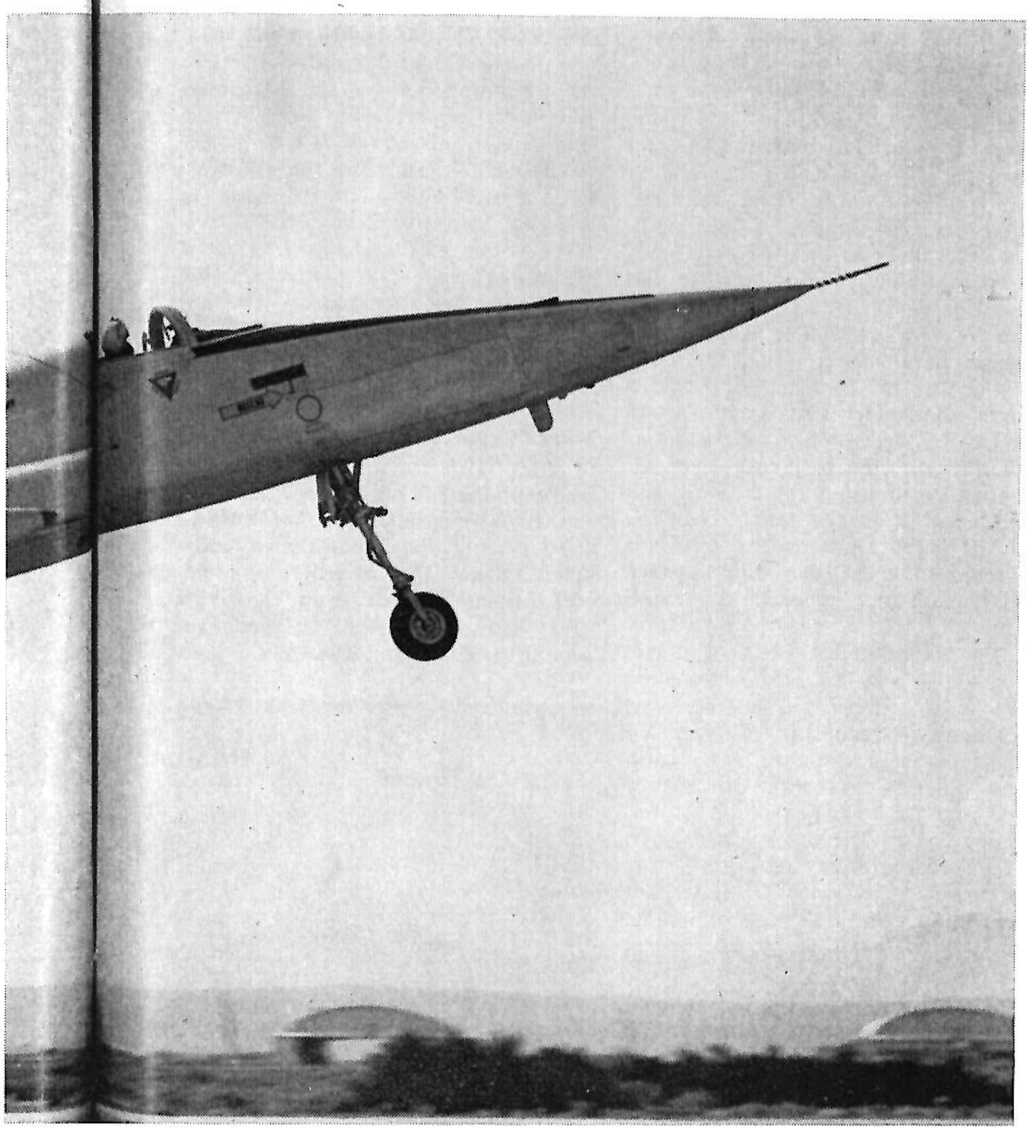
In a talk with one of the two operations officers of the squadron, Major Wayne Jenkins, he told me that the instructors of the 4441st were the most experienced men on the F-5 in the USAF, each having between 200 and 250 hours on the type. They had found the airplane the easiest to convert to—and to teach conversion on—of any jet aircraft they knew.

The F-5, said Major Jenkins, although supersonic, was simpler to handle than the F-86, simpler even than the T-38 Talon. Flame-outs were no problem. He knew of no case of simultaneous flame-outs of both engines, but had himself experienced "a couple" on one engine, always at low airspeed and in a nose-up attitude. The reaction of the aircraft was benign. It held altitude easily. The yaw could be corrected without difficulty. A graph on the wall showed the excellent results achieved by the staff of the 4441st on the firing- and bombing-ranges; Major Jenkins said that the F-5 was an exceptional gun platform.

Another, equally important aspect of an aircraft's performance—maintenance—was discussed with Hank Waklee, the Northrop management representative at Williams AFB. As a company man he could be expected to be enthusiastic about the F-5, but statistics certainly backed him up.

In August of this year, the 18 F-5s at Williams—including some there for other purposes, outside of the establishment of the 4441st—flew 675 hours. These required 9,180 man/hours for all servicing and maintenance, which works out to a ratio of 13.6 man/hours of work on the ground for each hour in the air, an almost unbelievably low figure were it not for the evidence of the work sheets. In a company release this ratio was given as 19:1, still very good, and at least three times more favorable than the comparative ratio for the CF-104.

g Canada's new tactical aircraft



Ease of maintenance is built into the F-5. All work can be done standing on the ground or sitting in the cockpit. This includes engine changes, which three men can do in something like 20 minutes. Flight-line maintenance can be carried out by a single crewman, with a standard tool box, a starter, a LOX-cart, and a small jack. Turn-around times are short, because a good deal of the armament is in exchangeable pods. Few specialists are needed; the F-5 is not supposed to carry much electronic equipment, the great maintenance bugbear of modern aircraft.

This simplicity, and the limitation of equipment to that necessary for a tactical support aircraft in a non-nuclear role, is the best feature of the F-5. Stuff it with "black boxes" and hang all kinds of devices on it and the F-5 could suffer from the same kind of nightmares other fine aircraft have in the past. Highly technically minded RCAF officers who demanded literally hundreds of mods had their share of the blame for the eventual killing of the Avro Arrow. This must not happen to the CF-5.

At Williams we had an opportunity to appraise the effects of the major structural changes made to the new F-5N (and scheduled to be incorporated in the Canadian version). These include additional engine air-intake doors each side of the fuselage for

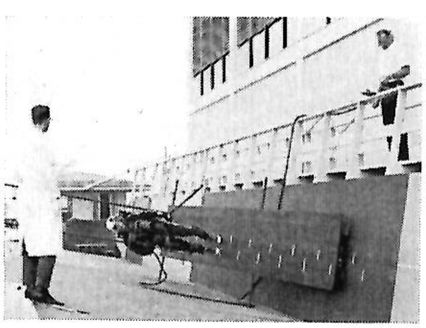
JOHN GELLNER studies the two-position nose-gear of the F-5N.

the increased take-off power, and the two-position nosewheel which will elevate the nose, increasing the angle of attack for take-off.

The F-5N has more powerful engines than the F-5A or the two-seat B version (4,300 lb thrust each, as against 4,080 lb).

Test pilot John Januleski, who flew the F-5N, assured us that these improvements made a lot of difference, especially at high loads. The take-off distance at 20,000 lb gross weight is about 6,300 ft in the F-5A, but is reduced to 4,800 ft in the F-5N and CF-5, and as little as 3,000 ft if the take-off is assisted by four JATO-bottles. Under the conditions in which this aircraft is designed to operate, these are substantial advantages.

Another improvement which would be highly desirable—and on which work is now being done—would be a cartridge starter, even though the present pneumatic starter is comparatively light and handy. A somewhat more sophisticated gunsight, instead of the plain optical sight now used in the F-5 for all weapons, might also be a worthwhile refinement that need not detract from the basic simplicity of the aircraft. This is being contemplated for the CF-5.



Moon walker at 1/6th G

Northrop is engaged in a wide range of aerospace activities, among them the flying tests on the X-21A laminar flow control (LFC) aircraft. These are old Douglas B-66s, modified and rebuilt so that they are hardly recognizable. The wing span has been increased by 21 ft; the wing area by 470 sq ft. The Allison J-71 engines have been replaced by J-79s mounted on the aft fuselage. Located where the under-wing engine pods used to be, are now two turbopumps which "suck" the boundary layer air through perforations in the wing and then expel it to the rear. Thus the film of turbulent boundary layer air is removed from the wing surface and friction drag reduced to a minimum.

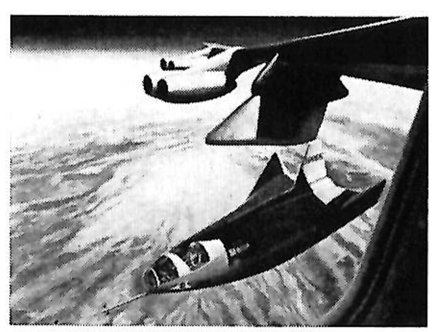
The advantages of LFC—if it can be made a practical proposition—are very great. Range can be increased enormously, acccording to Northrop by 50 per cent or more. The company predicts that with the aid of LFC and the new generation of upcoming super-efficient engines (such as the regenerative turboprop), aircraft can be designed to stay aloft three to four days without refuelling. This would mean a revolution in military aircraft, especially for radar-picket and maritime patrol duties.

Another project under way at Northrop is the study of manned lifting body vehicles (LBV) designed to travel in outer space. The experimental LBV HL-10, in an advanced stage of completion at Northrop, has a triple fin but no wings, and may be the precursor of a space taxi that will shuttle between a Manned Orbital Laboratory in space and Mother Earth. For test purposes they will be released from B-52s and allowed to glide to earth. But the HL-10 will ultimately get an XLR-11 rocket engine and will then be tested in the upper atmosphere.

Northrop is also engaged in the construction of a series of instrument satellites. They weigh about 400 lb, are box-shaped and have solar "paddles", which together with a battery, supply the power. A wide range of physical, aerological and biological experiments are scheduled for the series. Unfortunately, the first of these satellites, OV 2-1, was not put into orbit by its launching vehicle, a Titan III, at its firing on October 15th, and is now riding the booster uselessly in space.

Finally, there is the one-sixth gravity simulator used in a program designed to test man's ability to move about on the Moon. The subject is suspended by an array of cables from a movable dolly hanging on the side of a building. Attired in a pressure suit, he is supported by the cables so that he can walk almost at right angles to the wall—the precise angle is 80½ deg. given by a platform tilted at 9½ deg. to the vertical. This gives a force vector of precisely one sixth of Earth's gravity—the same as that encountered on the Moon. The human guinea pig operates a treadmill, surmounts obstacles, and performs other actions while the strains, to which humans walking on the Moon will be exposed, are measured.

After three days at Northrop one realizes that while countries with limited resources can contribute to the amazing developments in aerospace science now in progress, and—like Canada—are doing so, the really great achievements are definitely reserved for the larger nations. END



HL-10 test program concept