necessitates triangulated mounting pylons with their apices adjacent to the surface. The nacelles project well ahead of their pylons so that the engines mass balance the wings, as well as their own mountings, against flutter. In side elevation the paired nacelles are reminiscent of Busemann's supersonic biplane, so that there may well be favourable shockwave interaction.

Wing Joint: Two hints have been given by Dr. Wallis about the wing joint, the key to the project. Dr. Wallis has likened it to the human hip joint and in his lecture he said it is "something like that used for training a gun". This suggests that, instead of having a hinge at the very root of the wing, a fulcrum and lever have been evolved by Dr. Wallis' genius. The "hip joint" could be the fulcrum or trunnion, with an inboard extension of the wing spar and an arcuate rack-and-pinion representing the "gun mechanism". Such a device would have the immense advantage of giving relief in bending, since the traditional bogey of the encastré wingroot has been sidestepped — it would be analogous to the ball joint at the base of a tall radio mast. To be effective, bearing loads have to be reduced to a low value (as in the pin joints of idealized structures) another key secret.

Dr. Wallis is known to have worked out some most unusual solution to the heat problem of flying for many hours at Mach 3. In this connection he mentioned that he considered the limit for sustained atmospheric flight would be M4.57, since "the equilibrium temperature of 300°C. was too high even for steel", and the practical speed would be M2.5-3.0, equilibrium temperature about 150°C.

Flight control of the "Swallow" would be by conventional control column and rudder pedals. Nothing has been divulged about the wing sweep control, but since it is a function of acceleration and speed it is psychologically linked with the throttle, so far as the pilot is concerned, although it would obviously be related to some form of automatic control through a Machmeter. So long as increase of drag, when rapidly applied, is not accompanied by unpleasant compressibility effects, the reverse action is potentially the most powerful speed brake yet devised. Put another way, the speed of the "Swallow" will always lie below its M_{crit}, which is related to the Mach angle of the bow shock, behind which the wings lie at all speeds. Acceleration must, therefore, be a co-ordinated effect of reduced wing wave drag (and frontal area) plus, perhaps, increase of thrust from the rising ram recovery. Once accelerated, power would be reduced to the remarkably low values needed to maintain the design speed.

Calculations: Some simple sums based on figures given at the lecture add interest to the project.

(Continued on page 55)

CF-104: VARIATIONS ON A THEME

A round-up of the points of difference and features of the CF-104, as compared to the Starfighter variant on which it is based, was recently released by Canadair Ltd.

The CF-104 strike-reconnaisance fighter being built for the RCAF is the Canadian version of the F-104G, which has been adopted also by the air forces of West Germany, Belgium and Holland. The Canadair-built CF-104 is intended as a replacement for the Sabre 6's presently in service with Canada's eight day fighter squadrons in Europe.

Like earlier marks of the F-104, the Canadian version will be capable of Mach 2 flight. Major difference is in the beefed up structure to withstand the higher wing and airframe loadings that can be expected in its low-flying role. A number of new forgings are incorporated in the fuselage main frames, wing fittings and spars, fuselage longerons and joints, fuselage tail frames, tail unit spars and ribs.

The vertical tail surfaces have been enlarged by 25% and a fully-powered rudder has been added to give more precise control during attacks on ground targets. The horizontal stabilizer mechanism has been modified to give increased hinge-movement.

Maneuvering flaps have been added to provide an increase in the available load factor. This will reduce the turn radius by one third at an altitude of 5000 feet, a significant advantage for ground attack operations.

The drag chute diameter has been increased from 16 feet to 18 feet to reduce landing roll. To meet possible icing conditions during low high-speed flight, electrical de-icing elements are fitted to the air intakes.

Max range for specific bombing missions is allowed for by the provision for installing aluminum fuel tanks in the ammo, gun and shell case compartments of the fuselage. This installation is interchangeable with the gun and increases the internal fuel capacity by 120 gallons.

As with other late models of the Starfighter, the CF-104 has a conventional upward ejection seat instead of the downward system used in early models.

Other interesting features of the CF-104 include: anti-skid wheel brakes; provision for the pylon-mounting of Sidewinder missiles under the fuselage; a large-calibre rocket and other external armament stores under the wings along with extra fuel tanks.

The CF-104 will be equipped with an autopilot complete with "stick steering". This will include modes for preselecting and holding altitude, speed, heading and a constant rate of turn.

It will be fitted with the multi-purpose NASARR radar system consisting of a radar set and fire-control computer; a bomb computer; an air data computer; and the PHI (position & homing indicator) developed by Computing Devices of Canada.

Other items: TACAN radio air navigation system; provision for a data link-time division set; and UHF radio.

Powerplant specified for the CF-104, and which will be produced by Orenda Engines Ltd., is the GE J79-7 rated at 15,000 lbs. thrust with afterburner in. Wing span is 21 feet 11 inches; sweepback at the quarter-chord line is 18.3°, and length of the slender fuselage is 54 feet 9 inches.

The first of 200 Canadair-built CF-104's will be delivered to the RCAF in the spring of 1961.