At right, Flight Lieutenant F. A. Moore is shown test flying a production model of the CAE CF-100 flight simulator. Simulator is believed to be unique in that it provides both flight and weapons system training for crew of two.

RL, 892-1957

Flying the CF-100 Simulator

By R. J. CHILDERHOSE

HAVING ASKED permission to fly the new CF-100 simulator built by Canadian Aviation Electronics Ltd., Montreal, the writer was a bit taken aback by the reply. "Sure, we'll give you the opportunity to fly it. Or crash it."

Naturally this invitation was enough to arouse the competitive instincts of any airframe operator. And also naturally, since this driver was reared in the Sabre school of flying, there was the ingrained day-fighter scepticism of CF-100's. They couldn't be that hard to fly. And neither could the simulators.

Qualms: Nevertheless, it was with a bit of inner hesitation that I lowered myself into the black box of tricks at the CAE plant in Montreal.

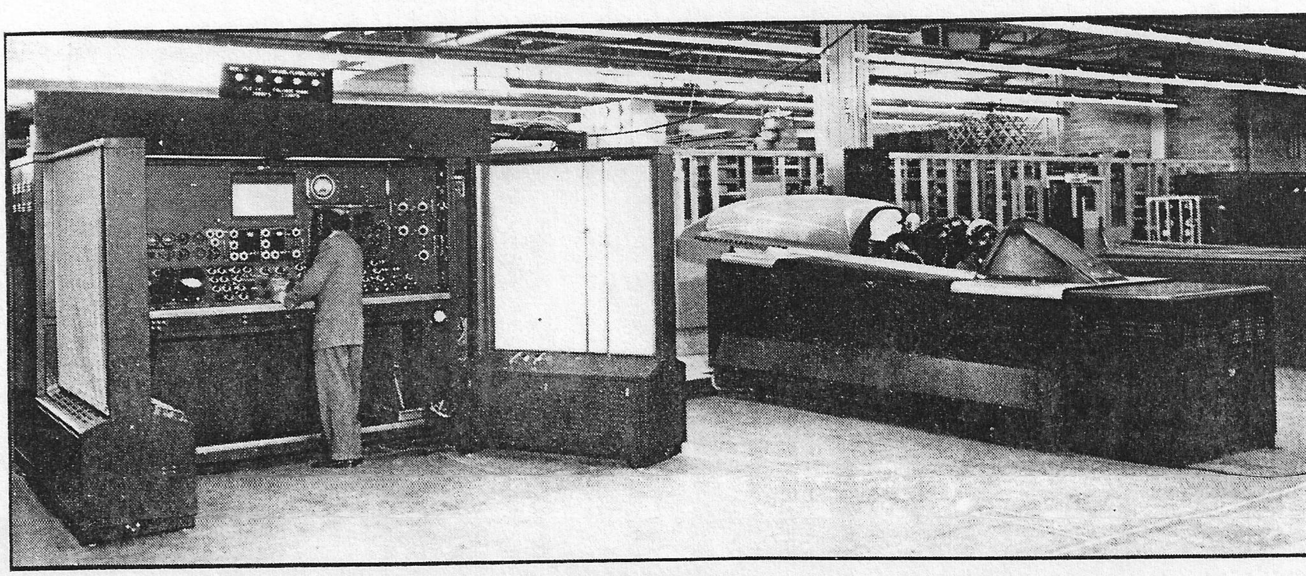
"The start procedure is exactly the same as in an actual CF-100 start. We've plugged in the ground unit, so you're set."

Following the man's directions, I flicked the necessary switches. WHOOF! The starboard engine catching its fire was duplicated in sound. The noise was doubled when the second engine started up. Small loudspeakers installed somewhere in the cockpit fanned my ear drums with Orenda noise. Carefully I worked my way around the cockpit performing necessary checks. Controls, hydraulics, radios. Everything that has to be done before calling for taxi instructions.

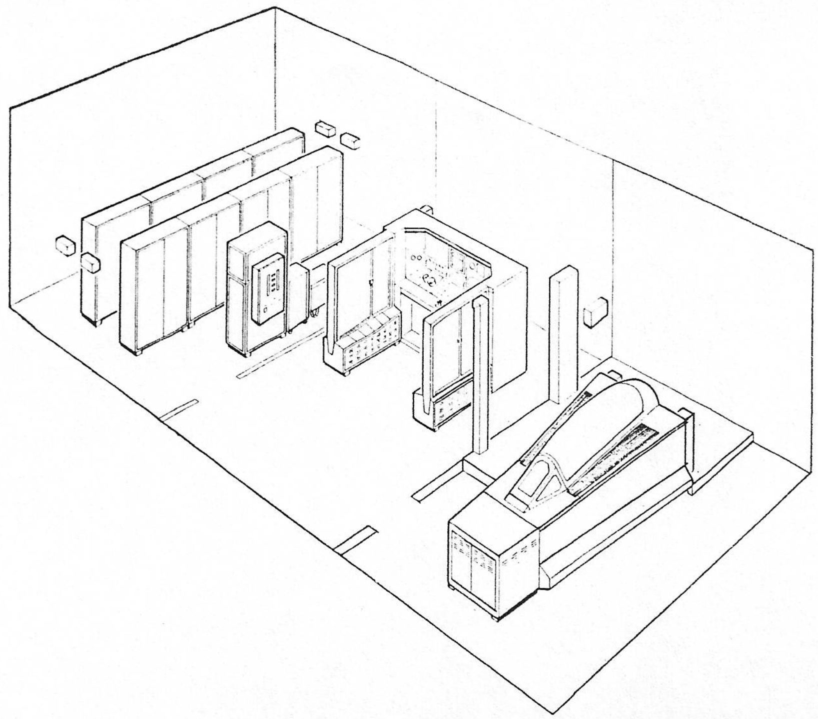
"Roger, you are cleared to taxi, runway heading is zero four."

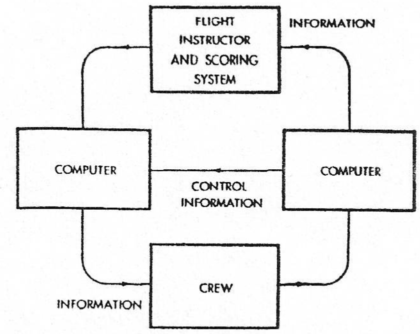
To the rising sound of engine noise as I opened the taps and released the brakes, was added the bump-bump-bump of aircraft wheels rolling on a concrete taxi-path. On the way out to the runway, I went through the standard pre-takeoff checks. Trims, pressures, temperatures, gyros. Finally there was nothing left but the pitot heat switch. I flipped it, too.

Burning Rubber: Bearing down on the brake pedals, I poured open the throttles and scanned the dials. Tail pipe temps climbing smoothly, RPM gauges winding up, pressures okay. Suddenly over the roar of the engines



Layout of simulator equipment at CAE plant is shown above, with simulator at right and instructor's console at left.





Schematic drawing at left shows the layout of a production CF-100 simulator as they will be installed at RCAF stations. The diagram above shows information flow of simulator.

came an unbearable high-pitched screeching noise. A turbine seizure? Did a compressor throw a bucket? Terrified, I began hauling off the power when the tower operator prompted over the radio: "Release the brakes. You're burning rubber."

The noise stopped immediately and my heart came out of overdrive. The inner scale on the airspeed indicator began winding up. Then the needle twitched and began its move. The noise of the wheels bumping over the concrete blocks of the runway mounted in tempo. The compass needle began to slide, we caught it with a jab of brake. The sweat began to trickle.

At 105 knots I tried the stick. It felt heavy. Up to 110 knots. I hauled a bit harder and felt it unstick. The big beast was airborne. A wing dropped while I fumbled for the undercarriage button. We lost a few degrees of runway heading. It seemed to sink and then surge ahead as the altimeter finally decided to move. Now let's get some air under us.

As the undercarriage "Up" signs appeared in the three little windows, the airspeed began building. Since I'd forgotten to ask what initial airspeed to use on the climb, I selected 350 knots. It seemed like a reasonable figure.

Greater Forces: Being accustomed to a lighter aircraft, the stick forces in the CF-100 simulator semed greater. However a few exploratory thumb flicks on the trim button settled her into the climb. A rather steep ascent according to the artificial horizon and vertical speed indicator. Above 15,000 feet I switched to the Mach meter and climbed at .7, which was another number I picked out of the air. Everything seemed fat. For the moment at least, the only dials moving in the shop seemed to be the altimeter and the sweep second hand.

"You can level off at 35,000 feet."

The voice in my head-phones startled me. The transmission was unmilitary. Engrossed in the methodical cross-checking concentration required in flying the gauges, I'd forgotten momentarily that this was a ground-borne exercise. It had been agreed that I would climb to altitude, and after intercepting the Montreal west range leg, fly to Ottawa and back. The consol operator had set in the two range stations for me.

At altitude I chose 92% as an average-sounding cruise power setting. Temperatures and pressures were all "in the green", fuel and oxygen okay. Once established on the range leg I relaxed. All trimmed up, this beast seemed fairly docile. Almost friendly. Over Ottawa I called in a position report.

"By Ottawa at zero two, three-five thousand, IFR. Estimate Montreal at twenty-two."

Back to Montreal: The consol operator, who acts as control tower, ATC, GCI and GCA all at the same time, cleared me back to Montreal and notified me that I was to call St. Hubert Approach for further clearance. In short order I was there and ready to descend through the worst weather in Montreal's history.

"You are cleared for a standard jet penetration. Call by the beacon outbound, and call in penetration turn. St. Hubert altimeter twenty-eight, eighty-four."

As the radio compass jerked around announcing station passage, I hit the dive brake switch. The stick jerked under my hand as the aircraft bucked and shuddered. Throwing out the anchor in a CF-100 really slows you down. Now I was chasing the instruments. Things were getting ahead of me.

"In penetration turn at angles seventeen."

Bending it around in the tear-drop letdown pattern, it seemed that the controls were getting heavier. They weren't, but for a second I thought of airframe icing. I checked the engine instruments. The old familiar scare shot through me: Cripes, don't flame-out now! On the approach I dredged my brain for the landing instructions given me in the pre-flight briefing. Something about "at 2,000 feet set up a 1,000 feet per minute rate of descent. Use about 70% power and hold 140 knots. Don't forget to round-out at field elevation."

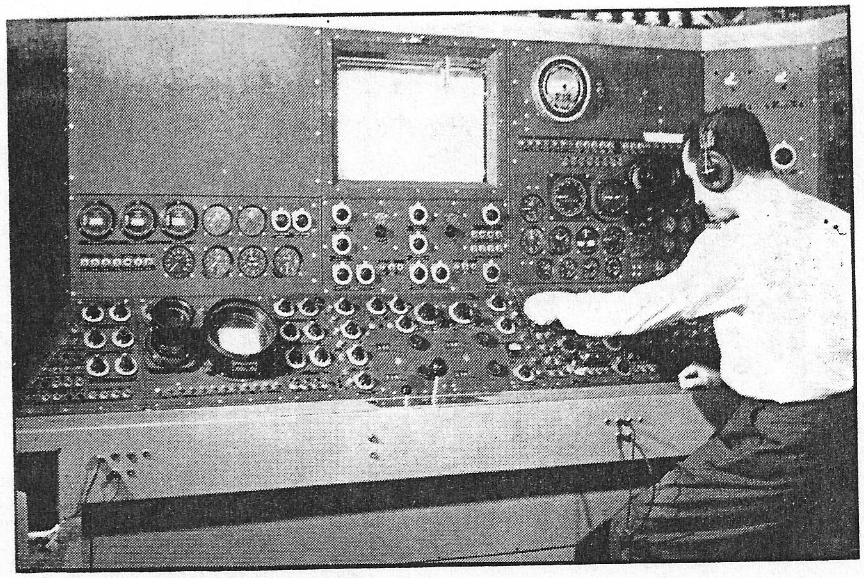
Hard Work: Down went the wheels and flaps. The anchor had been pulled in some time ago. Heading, air speed, rate of descent. It was the hardest work

I'd done in a month. Over the button of the runway I chopped the power and flared-out. There was a sharp screech of protesting rubber as the wheels touched concrete. The rumble of the wheels steadily diminished as I climbed on the binders. Thank heavens, I was taxiing. After setting the parking brakes, I flamed out the engines. The end of a tough flip.

There is much more to the CF-100 flight and weapons systems simulator than the cockpits. The consol operator has more to take care of than both the crew. Flanking either end of the main control consol, are the recorders. On these large vertical plate-glass surfaces are inscribed in red ink the path flown by the simulator. The first of these covers an area of 70 miles, and is known as the Attack & Approach Recorder. As the name implies, it traces the movements of the fighter-simulator during radar interception and attack, and the movements of the aircraft throughout an instrument approach and landing.

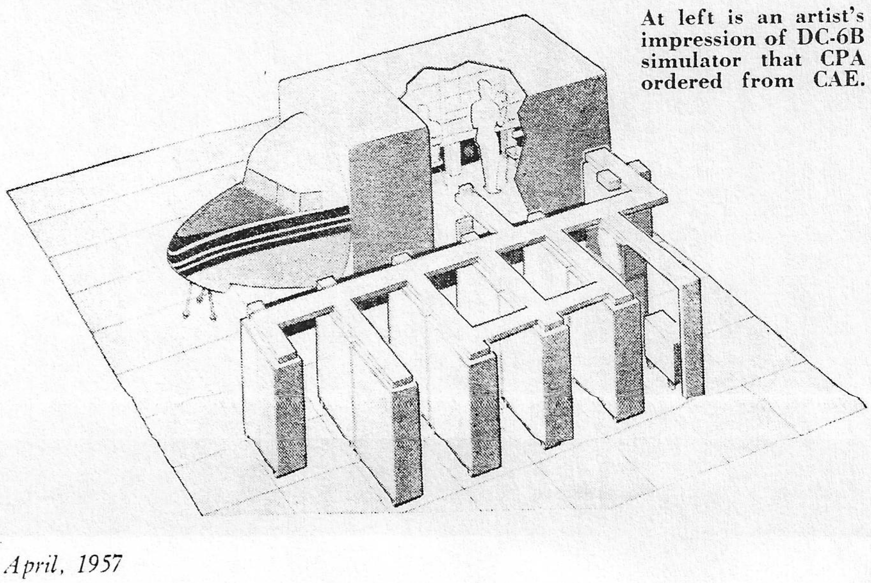
The other recorder is known as the Cross-Country Recorder. As a background, and under the glass, is a radio range map of the area surrounding Montreal. The recorder faithfully follows the path taken by the pilot during an instrument cross-country flight. On the control consol are two dials used to set-in wind conditions, both heading and velocity. Any errors in flying the range legs, or in lost orientation procedures, are left for inspection after the flight. For a magnified recording of a letdown at a distant base, the consol operator can engage the 70-mile recorder to coincide with the other.

The consol itself is a massive array of dials, buttons, toggles, rheostats, lights and gauges. Every cockpit instrument is duplicated here. The operator can observe every move made by the man sweating it out in the box. In addition, he can put emergencies into the machine. These include such thought-provoking situations as: icing, flame-outs, hydraulic leaks, engine fires, fuel pump failures, electrical failures. During a landing run the operator can induce a brake failure; either one wheel or both.



This is the instructor's console for the CF-100 simulator. Note the radar scopes used in simulation of tactical problems such as bomber interception.

Loss of Hydraulics: Perhaps the most nerve-wracking emergency that can be fed into the machine is the loss of hydraulic pressure. When the consol operator induces a loss of hydraulic boost, stick forces increase ten times. The symptoms include sloppy controls and built-in back-lash effect. The aircraft is flyable on manual controls, but it is heavy work for the driver. Other services affected by the hydraulic failure in the CF-100, and duplicated religiously in the simulator, are the flaps, dive brakes and undercarriage operation.



At left is an artist's impression of DC-6B simulator that CPA ordered from CAE.

The CAE simulator is designed to fulfill four major functions. These are, in order:

(1) Transition and familiarization training.
(2) In-flight emergencies training.
(3) Tactical training and interception techniques.
(4) Radar and rocket attack training.

The last mentioned, the radar intercept finishing off with a salvo of rockets is the most interesting feature of the machine. Understandably, the simulator's radar capabilities are heavily cloaked in security. It is known that target blips are fed into the simulator's radar weapons system. These blips are controlled by the consol operator as to altitude, speed and direction of flight. At any time during the attack, the operator can maneuver the blip exactly as an aircraft might take evasive action.

Jamming: To further complicate matters for the hard-working crew in "the idiot box", the operator can jam the radar in several ways. There is the ordinary, common types of noise and pulse jamming, and the elaborate "Window" jamming. These bundles of tinfoil known as window have long been a most effective radar-jamming device. The effect, induced in the machine by the operator, produces a second blip on the navigator's scope. Since the radar locks on both, the crew may choose to follow the wrong one. If they do, they end up with a zero-score for the trip.

The Canadian Aviation Electronics'

(Continued on page 75)

and this we must solve.

Ferdric Flader has suggested that the least we could do now is to bring them together "early in the game." But E. H. Heinemann, top engineer for Douglas, stresses the time aspect. In discussing the integration of engine designers with airframe designers he says, "The consideration of practical aspects during the design stage is most important, and it may actually short cut a large amount of detailed and meaningless analysis, as well as developmental work."

WEEKEND WARRIORS

(Continued from page 27)

one of the Canadian squadrons based there.

But even while Canada's citizen-fighter pilots are relearning their deadly contrail-trade, the same voices that were raised before are heard again. The same squadron leader is still standing at the bar, older now, but still repeating it. The tune is familiar. Though the words have changed a bit: "They'll never hack Sabres. Those bombs are too hot for part-time jet jockeys."

Unimpressed with carpers, the Auxiliary squadrons are going ahead with it. There is an increasing flow to the Auxiliaries of trained Sabre pilots who have completed their term in the Regular and are returning to Civilian Street. Strengthened by these men and re-equipped with an advanced type of airplane, the Warriors are proving that they can "hack it".

CF-100 SIMULATOR

(Continued from page 25)

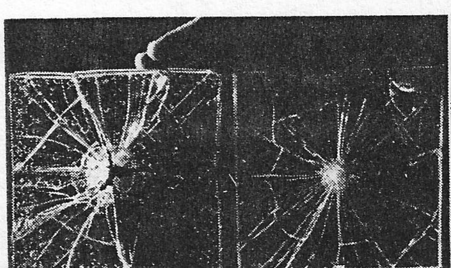
flight and weapons systems simulator is the first to be developed by an exclusively Canadian company. In accuracy of radar simulation, it is believed to be the finest in the world. According to a CAE spokesman, the United States Air Force "has expressed great interest in the integrated weapons system." As for the RCAF, the main advantage lies in the fact that the simulator provides special training in operational roles where training would naturally be limited.

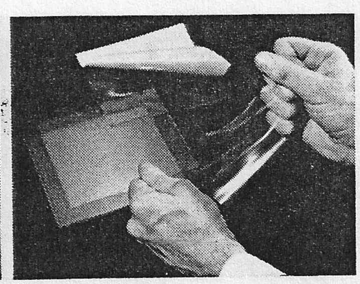
On February 12th, the first production model was turned over to the RCAF. This was the first installment of CAE's contract which calls for one prototype and 11 production models of the simulator. CAE has also recently received from Canadian Pacific Airlines, a $755,000 order for a DC-6B flight simulator.

BRITANNIA

(Continued from page 19)

The alternators have two three-phase outputs: one at 208 volts and the other supplying, at a lower voltage, 112 volt and 28 volt rectifiers. Although sharing a common magnetic circuit, which is excited and regulated by the 208 volt output, the two windings are electrically independent. A synchronous booster on the same shaft, with its wind-





RUBBER GLASS: New type of Dow Corning safety glass for supersonic aircraft, based on silicone rubber, stays clear and shatterproof at temperatures of 350°F. Above, ordinary safety glass bubbles and oozes out the edges (left); top right, illustrates elasticity and strength of Silastic Type K inter-layer; right, panel of new Dow Corning glass held before pilot's face shows outstanding clarity feature.