Introduction to Jet Flight

By F. M. O'CONNOR

SINCE THE early years of powered flight, aircraft have been modified or specially designed for the *ab initio* training of pilots.

The first forty years or so of aviation brought a clearly discernible pattern of pilot training and a distinct breed of training aircraft designs dictated by current commercial and military operational requirements.

Air force training courses are of particular interest since they consistently reflect trends of pilot training through the years, and therefore offer a reliable basis for an examination of pilot training development. A typical pilot's training course in the years immediately following World War II was essentially unchanged from the pattern that had been followed throughout the war and earlier.

Phase 1: This dealt with so-called "basic" flying training, circuits and landings, stalls, spins, aerobatics, pilot navigation and engine handling. The aircraft would usually be an elementary two-seater type with speeds in the 40-170 mph range.

Phase 2: Basic flying techniques were applied to formation flying, gunnery, advanced pilot navigation, instrument and night flying. Much flying time in this phase would still, however, be absorbed in "pure" flying as in Phase 1. In this, the "Applied" stage of flying training, a more advanced type of aircraft was employed with speeds in the 60-250 mph range.

Upon completion of Basic and Applied flying the successful pupil graduated and received his wings.

The next step was now an operational conversion course using a higher powered version of the training machines. Power and airframe handling techniques acquired earlier still applied with minor modifications. Approximately two years from the start of training a pilot arrived on squadron strength ready to embark on operational flying. The close of the war saw the slow but wide-spread introduction of jet-propelled aircraft to the air forces of the world. At first this did not interrupt the orderly pace of pilot training. Jet-powered aircraft were delivered to squadrons and the pilots duly converted to them with varying success. A newly trained pilot joining the unit would benefit from his colleague's advice, but being ill-prepared for the innovations of jet flight, often made serious mistakes.

Outmoded: Rapid operational aircraft development had outmoded pilot training equipment and techniques.

Soon, however jet trainer aircraft were to arrive on the scene, and the complete process of jet conversion was thereby placed on a sounder and safer basis. However the system of piston-engined training is still perpetuated to "wings" standard in many instances.

Typical jet conversion machines are the T-33, Vampire Trainer and Meteor 7; versions of well-known current or former operational aircraft.

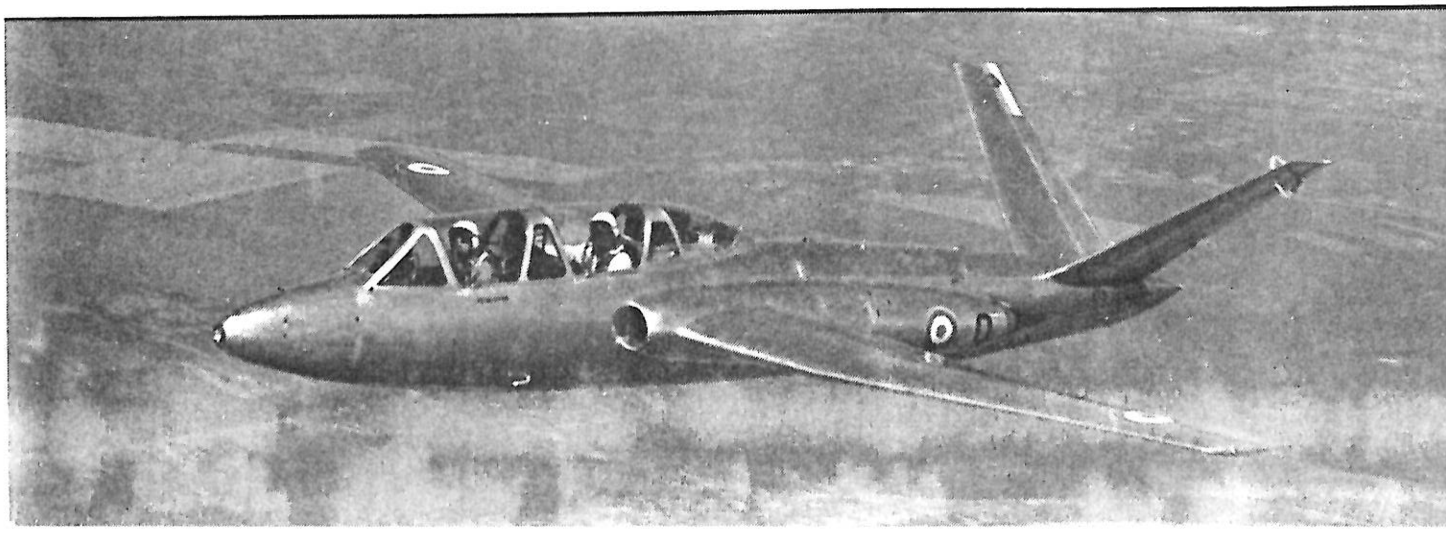
Training on propeller driven aircraft is acceptable where but a small fraction of pilot output is destined for jet squadrons or units; a pilot unsuited to jet flying may be absorbed in another branch of flying. Today's trend however, to all-jet air forces flying supersonic fighters and intercontinental bombers, means that this alternative pilot employment is increasingly unavailable.

The military jet pilot today wields a powerful, intricate and expensive offensive weapon. He shoulders a large measure of responsibility for his country's safety. Economy and expediency dictate that a trainee who is found to be unfitted for jet flight be suspended from flying training early in his career. But this may be reliably achieved only by introducing all-through jet training where, from the outset, the student flies aircraft in the same family group as front line squadron equipment.

Conversion Problems: Upon conversion to jet aircraft a pilot is called upon to master new techniques. But almost as important is that he rapidly unlearns some fundamental lessons peculiar to piston engined flight. Piston engined techniques include: propeller effects inducing yaw with varying degrees of power applied; propeller discing effect producing drag and rapid deceleration, affecting the flight path in the glide; the immediate power response to throttle manipulation and the "artificial" elevator and rudder response and feel resulting from propeller slipstream, even at low airspeeds. These things are absent in jet flight.

Characteristics of jet flight are the

Now in service with the French air force, the Fouga C.M. 170R Magister is also to be used by new West German air force.



compressibility stall at high subsonic Mach numbers, the considerations involved in transonic, supersonic and high altitude flight, plus jet engine handling.

In 1951 the inspector general of the RAF, after a special enquiry into the high jet accident rate, announced: (1) That nearly 50% of accidents were directly attributable to habits formed during training on piston engined aircraft, and (2) During the period of training on piston engined aircraft the pupils built up a state of apprehension in regard to jet aircraft, making them very unreceptive to training on jets. The very fact that training had started on piston engined aircraft and progressed onto jets gave the impression that jet flying was essentially more difficult.

Still No Pattern: It is significant that 11 years have passed since the end of World War II, and yet no well-defined pattern of pilot training, employing jet aircraft for all stages, has crystallized to be widely accepted. Britain's RAF, however, has pioneered by mating the Jet Provost and the Vampire T.11, the student receiving his wings after his Vampire T.11 training.

The following review of jet aircraft designed specifically for training purposes is intended to shed some light on the trend of pilot training for the future, since it is on this select class of aircraft that tomorrow's would-be military pilots will receive the basis of their future flying.

It should be noted that this review deals only with aircraft already flying, or at an advanced state of development. For this reason, no speculation has been included on the jet trainer proposals on which de Havilland Canada and Canadair have been working sporadically.

Similarly, the J-34 powered T2J jet trainer which North American Aviation Inc. is understood to have under development at its Columbus Div., is not dealt with in detail here.

jet trainer flypast

•**Aero Caproni Trento F.5:** The F.5 is a two-place, tandem seat, low wing monoplane with tricycle gear. The singlee jet engine is a Turbomeca Palas delivering a static thrust of 330 lb. The F.5 is intended as an *ab initio* trainer.

It is a unique aircraft by today's standards insomuch as wood is used almost exclusively in its construction, including the skinning of all surfaces, with the exception of the controls, which are fabric covered.

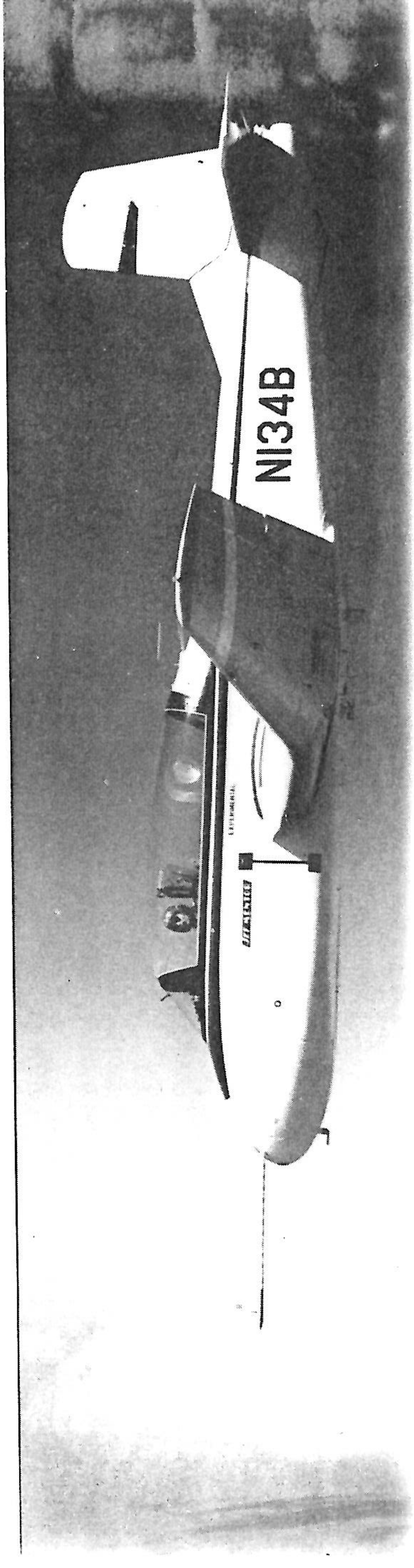
Its manufacturer claims that this feature has many advantages: the initial price is kept at a low figure; maintenance of the airframe is simplified, and repairs can be affected by non-skilled ground crews; stocks of necessary spares are smaller than required for an all-metal aircraft.

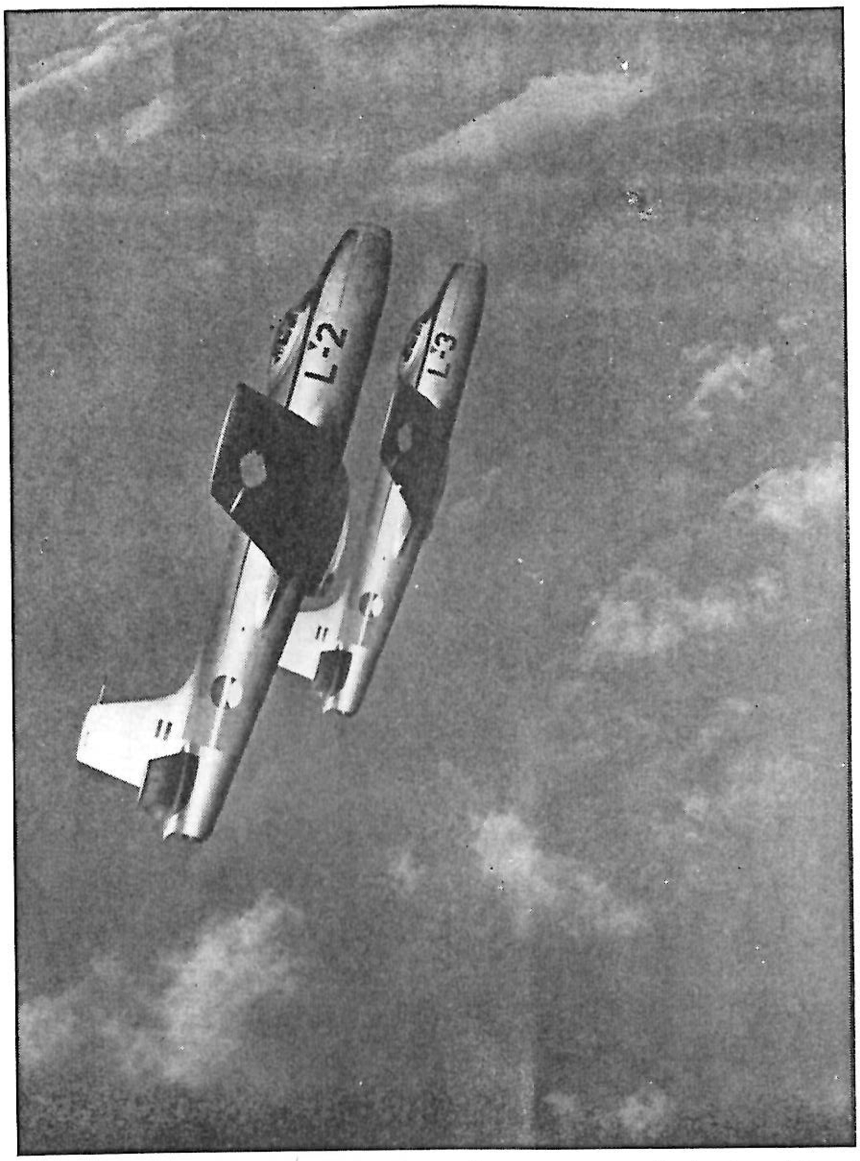
The front cockpit, normally occupied by the pupil, is fully instrumented. The instructor's rear cockpit is equipped only with engine controls and airspeed indicator, but since he is able to see all the front cockpit instruments, any disadvantage is small.

The engine is mounted in the lower fuselage, with the jet pipe exhausting ventrally just aft of the wing trailing edge. A plain, spun-glass firewall protects the wooden airframe from the heat produced by the powerplant. Measurements showed that the temperature in the engine bay never exceeded 10°C above outside temperature.

The A.C.T. F.5 would be appear to be a trainer embodying many of the best features of the old school, but at the same time embracing training needs

Below, the Hunting Percival Jet Provost; right, the Beech 71 Jet Mentor.





The Fokker S.14 Mach Trainer has been adopted by the Netherlands and Brazil.

by being jet powered.

Principal Data — Span, 25 ft. 8 in.; Length 21 ft. 8 in.; Empty weight, 1,032 lbs.; Gross weight, 1,650 lbs.; Wing loading, 15 lbs./sq .ft.; Static thrust, 330 lbs.; Fuel consumption, 26.4 g.p.h; Max. speed at SL, 224 mph; Max speed at altitude, 242 mph; Max. dive speed, 300 mph; Time to climb to 16,400 ft., 23 mins.; T/O run with flaps, 920 ft.; Landing run wit flaps, 500 ft.; Actual ceiling, 26,300 ft.

•Beech Model 73 "Jet Mentor": Built to military specifications as a private venture, the Model 73 utilizes many components of Beech Aircraft Corp's piston-engined T-34 Mentor. Identical components are wings, tail surfaces and landing gear.

Billed as a military trainer and general purpose aircraft, the 73 would appear on inspection to be a simple primary trainer. Standard equipment includes cockpit air conditioning and two ejection seats.

The airframe is stressed for a 11.25 G load factor. Power is supplied by a French designed jet engine, the Turbomeca Marbore II built under license by Continental as the J69-T-9, and delivering a static thrust of 920 lbs. The engine is started by internal "nickel clad" batteries for convenience in service.

Alternative application of the Model 73 could be as a gunnery trainer, provision for the fitting of two .50 calibre guns being made. It can also carry 500 lbs. of anti-personnel, incendiary, general purpose, napalm or other bombs.

Full details of the 73 are not yet available. The protype first flew as recently as December 18, 1955.

Principal Data — Engine, Continental J-69-T-9 turbojet developing a max. thrust of 920 lbs.; Cruising speed, 245 mph; High speed at 15,000 ft., 295 mph; Diving speed, 500 mph; Service ceiling, 28,000 ft.; Rate of climb, 1,400 fpm; Range (max. with reserve), 450 miles; Gross weight, 4,521 lbs.; Empty weight, 2,925 lbs.; Useful load, 1,596 lbs.; Ultimate load factor, 11.25 G; Wing loading, 25.5 lbs./sq. ft.

•Carma VT-1 "Weejet": A private venture on the part of Carma Mfg. Co. of Torrance, Calif., the Weejet was designed as a primary jet trainer, with CAA trainer requirements being used as a basis for design.

Production plans are in the proposal stage. According to Carma, production aircraft would be available 13 months after receipt of a go-ahead.

The airplane features all-metal construction with lightness, simplicity and safety emphasized in keeping with the design mission. Student and instructor are seated side-by-side in the fuselage forward of the wing. The midwing incorporates leading edge air inlets in the root section. The aircraft has a boom-mounted butterfly tail. Power is by a Continental J-69-T-9 developing 920 lb./st./th. at SL.

Principal Data — Span, 28 ft.; Length, 24 ft. 6 in.; Height, 6 ft. 8 in.; Design weight, 3,826 lbs.; Empty weight, 2,481 lbs.; Useful load, 1,345 lbs.; Max. speed, approx. 322 mph @ 15,000 ft.; Stall, power off, 74 mph; Take-off over 50 ft., 1,800 ft.; Rate of climb, SL, 2,200 fpm; Time to 20,000 ft., 11.1 min.; Duration, 1.72 hrs.; Usable ceiling, 35,000 ft. Normal fuel capacity is 132 U.S. gals; with tip tanks this can be increased to 232 gals.

•Cessna T-37: The Cessna Aircraft Co. has received a production order worth $26,000,000 for a quantity of T-37 jet trainer aircraft.

The T-37 is a twin-engine, low wing monoplane, with single fin and rudder. The engines are Continental J-69 (French Marbore) turbojets, each developing 920 lbs./th. Seating for instructor and pupil is side by side. Cockpit layout, including flaps, airbrakes, trim tabs and radio controls are positioned and operated similarly to USAF fighter-type aircraft, intended to simplify the transition of jet pilots from training to combat machines.

The twin J-69 engines offer dependability and safety. Landing speed is comparable to many smaller commercial business aircraft. At the other end of the speed range, the T-37 performs well at high altitudes, and is reputedly in the 400 mph class.

Power steering for the nosewheel, plus individually-controlled brakes, make for ease of taxying.

Principal Data — Engine, Continental J-69, 920 lbs./th.; Span, 33 ft.; Length, 27ft.; Height, 8.8 ft.; Design gross weight, 5,600 lbs.; Range, over 700 nautical miles; Speed, over 350 mph.; Speed for max. range at 35,000 ft., 310 mph; Single engine service ceiling, 19,200 ft.; Stall speed, flaps up, 92 mph; Stall speed, flaps down, 77 mph; Rate of climb at SL, 3,000 fpm.

•**Fiat G-82:** The Fiat G.82 is a development of the G.80-1B and the G.80-3B, and is currently in production. The first machines were recently delivered to the Italian Air Force.

The G.82, designed as an advanced trainer and for operational training, is a single-jet low-wing monoplane, seating two in tandem. The aircraft has a retractable tricycle landing gear and is powered by a single Rolls-Royce Nene RN 2/21. Highlights of the broad specifications that the G.82 was designed to cover are:

(1) Tandem seating arrangement for instructor and pupil; Fiat says the tandem seating arrangement is better than side by side for advanced training because the student, who is already a skilled pilot, is isolated from, and therefore independent of the direct presence of the instructor.

(2) Flight characteristics close to those of modern jet fighters.

(3) Moderate wing loading with consequent reduction in take-off and landing runs.

(4) Sufficient flight endurance to allow long training flights at fairly high speeds.

(5) Fitting of ejection seats and anti-spin parachute.

Principal Data — Engine, R-R Nene, 5,000 lbs./st. th.; Span, 38 ft. 9½ in.; Length, 42 ft. 5 in.; Height, 13 ft. 4½ in.; Normal T/O weight, 13,789 lbs.; Time to 20,000 ft., 5.5 mins.; Time to 30,000 ft., 10.5 mins.; Service ceiling, 41,000 ft.; Max level speed at SL, 553 mph.; Max level speed at 30,000 ft., 546 mph.; Endurance with normal tankage at 30,000 ft., 2 hrs. 5 mins.; Endurance with normal and external tankage at 30,000 ft., 2 hrs. 45 mins.; Max range at 30,000 ft., 865 nautical miles.

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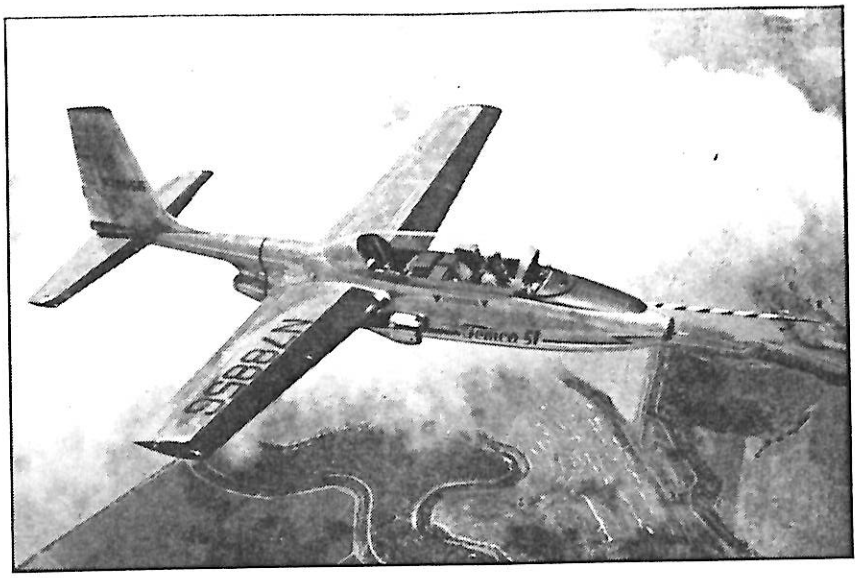
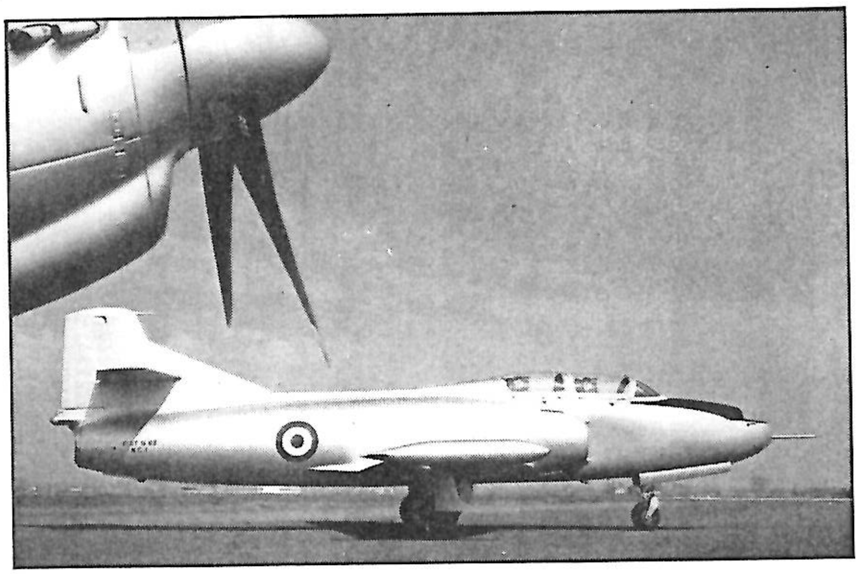
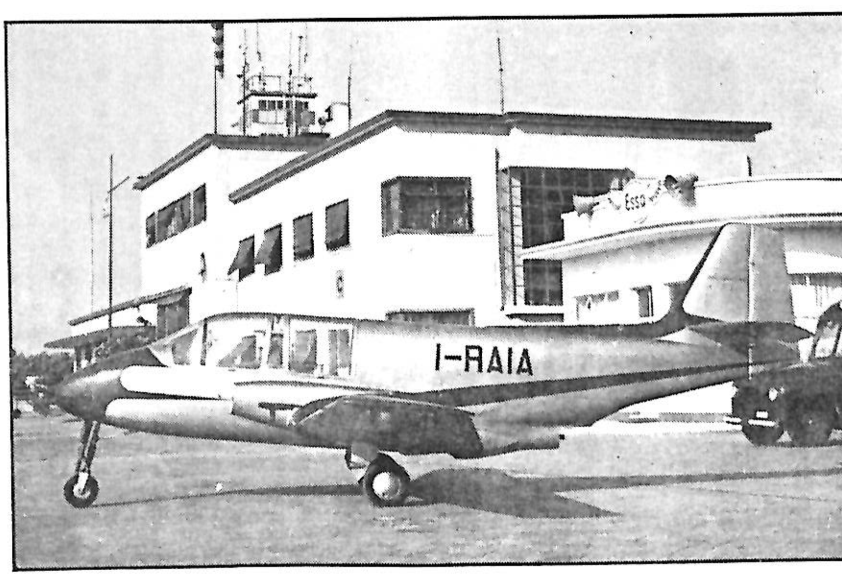
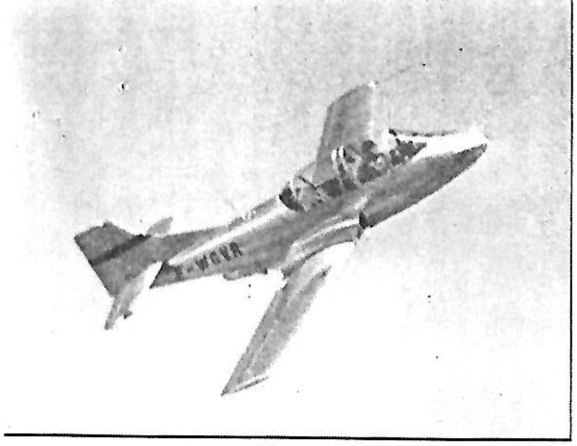


Fourteen Temco 51's (above) have been ordered by the USN for evaluation as a primary jet trainer. This is the first aircraft in this category to be ordered by the U.S. service, which has designated it the TT-1. This airplane, product of Temco Aircraft Corp., Dallas, Texas, is also under USAF scrutiny.

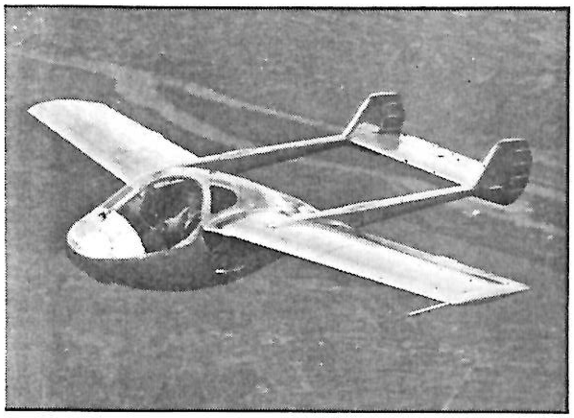


Two Italian contributions to the jet trainer field are shown here. Above is R-R Nene-powered Fiat G.82, designed for advanced & operational training; below is the tiny Aero Caproni Trento F.5, intended for use as a primary trainer. Built almost entirely of wood, it has a 330 lb. th: Turbomeca Palas.

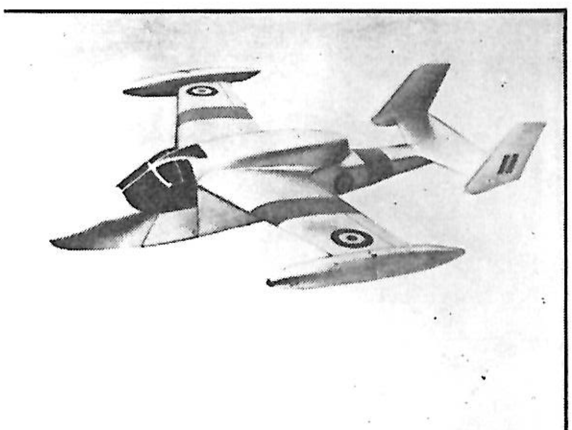




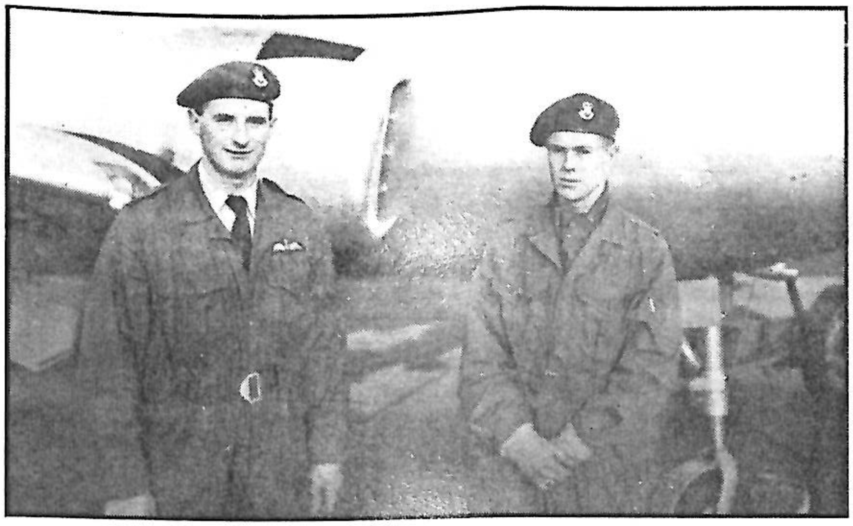
Above is the tandem SIPA 300 Primijet, while below is the side-by-side SIPA 200 Minijet, both French-designed and built for primary training.



Below, a drawing of the Miles M.100 Student, a general purpose light jet trainer. The Student, a British project, has not yet been flown.



Below, the Morane-Saulnier MS-760 Paris, a four-place liaison version of the MS-755 Fleuret. The Fleuret was designed as a jet fighter trainer.



Right is Cadet T. Foster, said to be first pilot ever to go solo without first flying a piston-engined trainer. Cadet Foster, shown with his instructor, F/L D. Wiley, soloed a Jet Provost on RAF's first all-jet training course.

•Fokker S.14 "Mach Trainer": With more than 35 years of aircraft and construction behind them, the Fokker team produced the S.14 shortly after liberation of the Netherlands. The Mach Trainer is a single-engined, low-wing monoplane with single fin and rudder. Side by side seating is provided for instructor and pupil. Power is supplied by a Rolls-Royce Derwent 8 or a Nene 3, the latter giving the S.14 improved performance coupled with lower fuel consumption.

The S.14 has been adopted by the Netherlands and Brazilian Air Force as an advanced training aircraft.

Its makers claim fighter-like handling qualities, without the high landing speeds associated with fighter types.

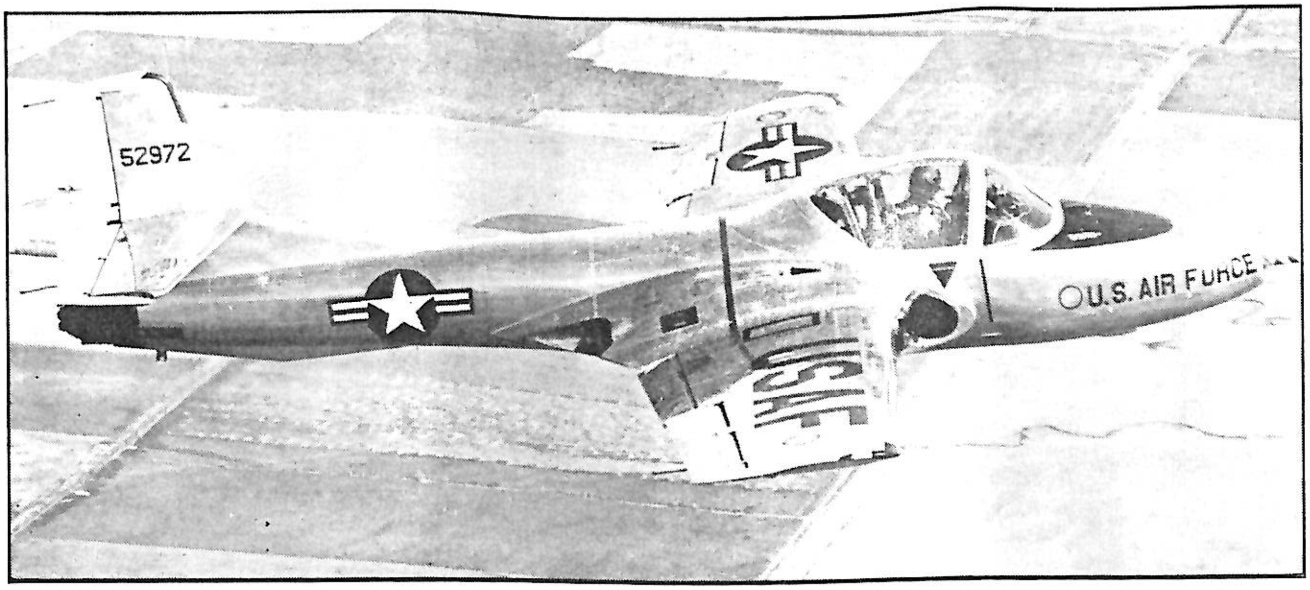
A condensation of test pilots' evaluation reports reveal that: spinning characteristics are considered excellent and safe; aerobatic manoeuvres, including all the classic figures, can be evolved without exceeding 3.5 G and loss of height, using climb power; compressibility effects can be demonstrated in 15-degree dives up to Mach .81 within a height band between 32,000 and 28,000 feet. (This enables repeat dives to be performed in one flying session, an obvious advantage training-wise. The S. 14's critical Mach number is .86, at which speed moderate wing dropping occurs.); The S. 14 is considered to be suitable as a second-line fighter.

Martin Baker ejection seats are fitted as standard.

Principal Data — Span, 39 ft. 5 ins.; Length, 43 ft. 8 ins.; Height, 15 ft. 4 ins. The following performance figures are given with that for the Derwent-powered version first, and that for the Nene version following in parentheses. Static thrust, 3,470 lbs. (5,100 lbs.); T/O gross weight, 11,800 lbs. (12,230); Rate of climb at SL, 3,100 fpm (5,450 fpm); Time to 30,000 ft., 19.4 mins. (8.8 mins.); Service ceiling, 36,700 ft. (42,500 ft.); Max range at 30,000 ft. at 355 mph, 600 miles (565 miles); Max speed at 20,000 ft., Derwent version, 455 mph; Max speed at 10,000 ft., Nene version, 536 mph; Wing loading, 34.5 lbs./sq. ft. (36 lbs. sq. ft.)

•Fouga C.M. 170R "Magister": The Magister, a mid-wing, all-metal monoplane with butterfly tailplane, is powered by two Marbore II turbojets. Seating for instructor and pupil is in tandem within a pressurized cockpit. The makers, Fouga & Cie., claim that the tandem seating arrangement has many advantages, including: the pupil is seated in the symmetrical plane of the aircraft, an advantage during formation flying and aerobatics; the pupil does not feel uncomfortable because of the instructor watching his movements; the whole cockpit is arranged around the pupil as in a single-seat fighter aircraft.

Also cited as advantages of the C.M. 170R as a training aircraft are: high aspect ratio wings, giving good handling at high altitudes; moderate wing loading, allowing relatively low take-off and landing speeds; two engines, decreasing power failure hazards, and enabling the pilot to increase duration by stopping one engine; wide track and low landing gear providing good stability when taxying; good vision for



The Cessna T-37, now in volume production, will be the first primary jet trainer to go into service with the USAF.

instructor and pupil.

Principal Data — Span (without tip tanks), 37 ft.; Length, 33 ft.; Height, 9 ft.; Wing area, 186 sq. ft.; Empty weight, 4,270 lbs.; Max. all-up weight, 6,100 lbs.; Max speed in level flight at SL, 423 mph; Max. speed in level flight at 30,000 ft., 444 mph; Limiting Mach number, .82; Rate of climb at SL, 3,347 fpm; Time to 30,000 ft.; 17 mins.; Servicing ceiling, 39,400 ft.; Max. endurance, 2 hrs. 40 mins.

•**Hunting Percival "Jet Provost":** The Jet Provost is unashamedly a direct "steal" from the piston-engined Provost airframe, but is modified extensively to take the power of the Armstrong Siddeley Viper. Pilots' reports indicate that nothing was lost in the transition, and its acceptance for *ab initio* training by the RAF confirms this opinion.

Built as a private venture by the U.K.'s Hunting Percival Aircraft, the Jet Provost is a conventional low-wing monoplane with single fin and rudder. Seating for instructor and pupil is side by side.

The Jet Provost fits into the "two aircraft" training policy in being in the RAF, the bulk of the pupil's training — 180 hours — being on the Jet Provost, and the 60 hours balance on the Vampire Trainer.

Its manufacturers say that no other jet trainer aircraft in existence can cover pilot training so effectively; either they are relatively high-performance trainers, too formidable for the average run of air force pilot candidates, or they are in the elementary (primary) class, in which learning saturation point is reached in less than 100 hours. The first type demands an additional primary stage trainer; the second demands an additional intermediate stage trainer. In both cases the very great economic advantages of two-stage training are lost.

The Mark II Jet Provost, a cleaned-up version, to cover NATO jet training aircraft requirements, is now flying.

Principal Data — Engine, Armstrong Siddeley Viper, 1,750 lbs./st./th.; Span, 35 ft. 2 ins. (without tip tanks); Height, 10 ft. 2 ins.; Length, 31 ft. 9 ins.; All-up weight, normal — 5,850 lbs. (Note: References to "normal" refer to the without-tip tanks configuration) tip tanks full — 6,800 lbs.; Fuel capacity, normal — 164 Imp. gal., with tip tanks — 264 Imp. gal.; T/O to 50 ft., normal, 610 yds.; Landing from 50 ft., normal, 660 yds.; Rate of climb at SL, normal, 2,650 fpm; Time to height, normal, 10.6 min. to 20,000 ft.; Max level speed, 330 mph; Max. permissible speed, 442 mph; Stalling speed, normal, 73 mph (with tip tanks full, 79 mph); Range at 230 mph at 30,000 ft., with tip tanks, 660 statute miles; Endurance, normal — 1.7 hrs., with tip tanks — 2.9 hrs.

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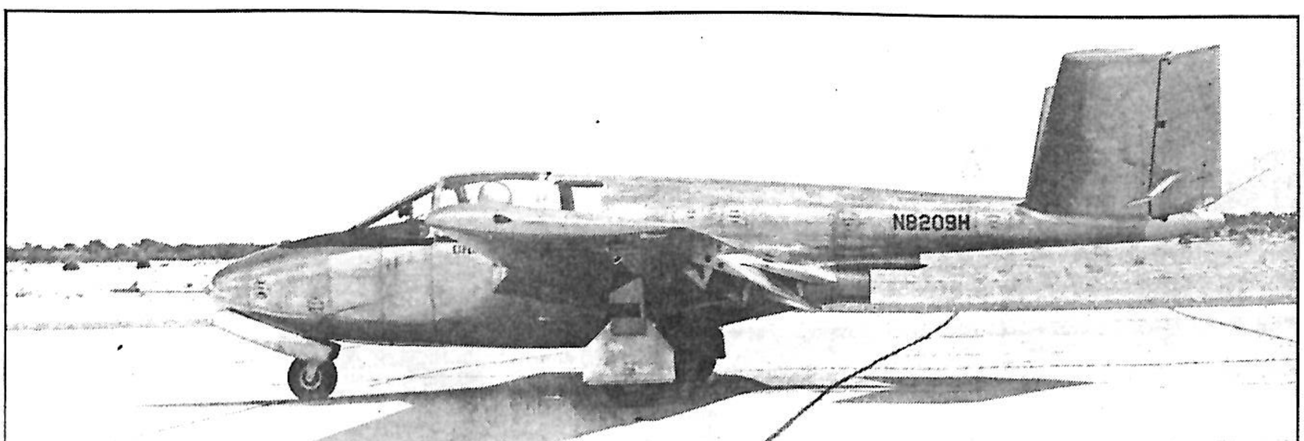
Most recent U.S. primary jet trainer to take to the air (March, 1956) is the Carma VT-1 Weejet, a private venture.



by accidents. He stressed the point that many of the accidents charged to pilot error and mechanical failure can be designed out of an aircraft.

Following the meeting with the Avro engineers on July 25, the team, which has toured almost all major aircraft manufacturers in the U.S., visited RCAF Headquarters in Ottawa, where discussions were held with Group Captain R. C. Davis, the RCAF's director of Flight Safety.

Scientist Returns

Dr. W. L. Godson, superintendent of atmospheric research for the DoT's Meteorological Services has returned from Europe after representing Canada at two international conferences.

At Ravensburg, Germany, Dr. Godson attended a symposium on atmospheric ozone held by the Ozone Committee of the International Association of Meteorology. The second conference was at Oslo, Norway, where representatives from the NATO countries discussed the atmosphere in the Arctic region.

Dr. Godson presented a paper on "Canadian Studies of the High-Latitude Stratosphere Jet Stream in Winter" at this symposium.

Manpower Conference

The three major topics to be brought up for discussion at the National Engineering Manpower Conference, which was scheduled to be held September 9-11 at St. Andrews-by-the-Sea, N.B. were: Canadian economy, present and future, and its dependency upon higher education and special skills; a review of educational trends from high school through university; and a review of educational facilities and teaching personnel.

The meeting, endorsed by the 30,000-member Dominion Council of Professional Engineers, was under the chairmanship of Toronto industrialist James S. Duncan, and some 75 leaders in education, Government, professional societies, labor and industry were slated to attend. The forums, under the direction of co-chairmen D. W. Ambridge, P.Eng., president & general manager, The Abitibi Power & Paper Co. Ltd.; John D. Barrington, P.Eng., president & managing director, Polymer Corp. Ltd., Sarnia; and Dr. O. M. Soldant, CNR vice-president, were proposed to analyze and assess the supply and demand of professional engineers and technical personnel in Canada in an endeavor to offset shortages. The conference was sponsored by a grant from A. V. Roe Canada Ltd.

A NOTE ABOUT NORMALAIR

A news item about a new Normalair liquid oxygen system for high altitude aircraft, which appeared in the "Equipment" section of AIRCRAFT (June, P. 79), stated that further information about the equipment was available from Normalair (Canada) Ltd. It has been pointed out to the Editor that this is incorrect in that Bendix Aviation Corp. is licensed to produce the equipment in question in North America, and enquiries should therefore be directed to the Aircraft Products Div., Bendix-Eclipse of Canada Ltd., 2444 Bloor St. W., Toronto 9.

JET TRAINING

(*Continued from page 28*)

•**Miles M.100 "Student":** To date the Student has not flown, being in the prototype construction stage. Preliminary information from F.G. Miles Ltd. of the U.K. indicates that the project incorporates many novel design features. Should it follow the pattern of Miles training aircraft designs of the past, it will have a large margin of success. The Student is intended as a general purpose, light jet trainer.

It is a shoulder-wing monoplane with tricycle undercarriage, twin fins and rudders and an unusual engine position, dorsally, above the fuselage, the jet pipe efflux passing between the twin fins and rudders. The seating arrangement is side by side, and is in a cabin instead of a cockpit, as normally associated with this category aircraft. The wings are moderately swept on trailing and leading edges, and have a noticeable degree of anhedral. Provision is made for single or twin jet installation, that is, either one Blackburn Marbore II or two Blackburn Palas 600 jet engines.

Fuel is carried in large wing-tip tanks.

Possible alternative applications claimed by the designers of the Student include versions for communications duties, ground support, and AOP.

Principal Data — Span, 28 ft.; Length, 27 ft., Height, 6 ft. 3 ins.; Wing area, 140 sq. ft.; Operational Weight, 3,100 lbs. (communications version, 3,600 lbs.); Wing loading, 22 lbs./sq. ft.; Design ultimate load factor, 10 G, at 3,1000 lbs. weight; Design diving speed, 460 mph; Design T/O weight, 3,600 lbs.; Design landing weight, 3,600 lbs.; Crash load factor, 25G. Performance figures follow with those for the Marbore-engined version appearing first, and those for the Palas 600 version (two engines) following —Rate of climb at SL, 2,440 fpm (2,050 fpm); Max. level speed at SL, 295 mph (284 mph); Cruising speed at 20,000 ft., 268 mph (249 mph); Max. still air range, 463 statute mi. (400 statute mi.); Max. duration at cruise, 3.1 hrs. (2.7 hrs.)

•Morane-Saulnier MS-755 Fleuret: Since the war, Morane-Saulnier has concentrated mainly on the design and production of trainers. Latest types are the MS-733 three-seat basic trainer and the MS-755 two-seat jet fighter trainer.

The company has developed from the MS-755 a four-seat, light communications and liaison aircraft, designated the MS-760 Paris.

The MS-755 is a low mid-wing, all metal monoplane with retractable tricycle gear. Accommodation is for two, seated side by side in a pressurized, air-conditioned cabin. Propulsive power is supplied by two Turbomeca Marbore II turbojet engines, each developing a static thrust of 880 lbs.

The 755 is fitted with a gyro gunsight and two 7.5 mm. machine guns in the nose of the fuselage. Additional offensive armament can be two 110-lb. bombs or four 3.5-inch rockets, carried beneath the wings.

Principal Data — Span, 31 ft. 4 ins.; Span with tip tanks, 33 ft.; Length, 31 ft. 10 ins.; Height, 8 ft. 11 ins.; Empty weight, 4,190 lbs.; Normal loaded weight, 5,830 lbs:; Max. permissible loaded weight, 6,710 lbs.; Normal wing loading, 30.18 lbs./sq. ft.; Max. speed at 20,000 ft., 447 mph; Initial rate of climb, 3,346 fpm; Service ceiling, 39,-360 ft.; T/O run, 438 yds.

•SIPA 200 Minijet: The SIPA 200, the first all-metal, two-place, light, jet-propelled aircraft to fly in the world, was designed as a basic trainer or light liaison aircraft. The prototype aircraft first flew on January 14, 1952, a year after the design was begun.

The SIPA 200 is fitted with dual controls for instructor and pupil who are seated side by side. It is a mid-wing, all-metal aircraft with retractable tricycle gear. The tailplane and fins and rudders are mounted on twin booms. The wing section is laminar flow. Double-slotted Fowler flaps are used. Power is supplied by one Turbomeca Palas I turbojet giving 350 lbs. of static thrust. The empty weight is 990 lbs. while the gross weight is a modest 1,675 lbs., bearing out its description as a *light* basic trainer.

Principal Data — Span, 26 ft. 2 ins.; Length, 16 ft. 11 ins.; Height, 5 ft. 10 ins.; Empty weight, 990 lbs.; Loaded weight, 1,675 lbs.; Wing loading, 16.62 lbs./sq. ft.; Max speed at SL, 248 mph; Cruising speed at 3,000 ft., 223 mph; Initial rate of climb, 1,140 fpm; Max. ceiling, 26,240 ft.; Range (without tip tanks), 340 mi.; T/O run, 328 yds.

•SIPA 300: "Primijet": The SIPA 300 is a two-seat jet primary training aircraft with pupil and instructor seated in tandem beneath a continuous one-piece canopy. It is a low-wing monoplane of all-metal construction, and is fitted with a tricycle landing gear.

The one engine is a Turbomeca Palas turbojet of 350 lbs. static thrust. The engine is mounted in the lower part of the central fuselage, with the jet pipe beneath the fuselage between the wing trailing edge and the tailplane. Fuel is normally carried internally, but there is provision for additional fuel to be carried in detachable wingtip tanks. The aircraft is fitted with complete dual controls, including full blind-flying instruments.

Principal Data — Span, 26 ft. 4 ins.; Length, 22 ft.; Height, 8 ft. 5 ins.; Empty weight, 1,283 lbs.; Loaded weight, 2,024 lbs.; Max. speed, 224 mph; Max. cruising speed, 194 mph; Rate of climb, 886 fpm; Range, 280 miles; Landing speed, 56 mph; T/O run, 400 yds.

• **Temco Model 51:** The Temco Model 51 is, perhaps, almost the "baby" of jet training aircraft, since first details have only just been released by its designers and producers, Temco Aircraft Corp. of Texas. The protoype aircraft first flew on March 26, 1956.

The Model 51, for training of *ab initio* pilots, is a two-place, tandem seat, mid-wing, all-metal monoplane, with retractable tricycle landing gear. It is powered by the French-designed, Continental-produced YJ 69-T-9 turbojet engine, which produces 920 lbs. of static thrust at sea level. The landing gear is stressed for an ultimate sinking speed of 20.4 ft./sec., a high figure providing for student error in landing practice.

In performance, its manufacturers claim stall speeds low enough for first solo, combined with a dive speed in the high subsonic range. Although unspecified, this would be a Mach number close to .85.

The aircraft is fitted with two ejection seats. The instructor's seat at the rear is raised in reference to the student's position, to provide better vision.

All primary flight controls are mechanically operated by push-rod linkages. Trim tabs are electrically-actuated and flaps, landing gear and air brakes are operated hydraulically. In the event of hydraulic system failure, the landing gear will extend and lock by gravity and air forces.

Principal Data — Span, 29.33 ft.; Length, 30.6 ft.; Height, 10.82 ft.; Gross weight, 4,137 lbs.; Training fuel load, 119 U.S. gals.; Max. fuel load, 165 U.S. gals.; Ultimate load factor, 11.25 G; Max. level speed at SL, 285 kts.; Max. level speed at 15,000 ft.; 300 kts.; Cruising speed at 25,000 ft., 215 kts.; Service ceiling, 35,000 ft.; Endurance at SL, 1½ hrs.; Stall speed at gross weight, 66 kts.; Stall speed at normal landing weight, 60 kts.; Max. dive speed, 450 kts.; Rate of climb at SL, 1,900 fpm.

ROLE OF RESEARCH

(Continued from page 18)

Canadair's field at Cartierville.

This was true applied research. To change the shape of the Sabre's fuselage, metal pads were rivetted to the outside of the existing body. Thus, this was a "bumping out", instead of a waisting in". The object of the research was to see if the drag of the airplane would be reduced in Mach 1.0 dives, so it would pick up speed faster, and still react in the normal way to the controls. This, of course, could be a combat advantage. But the flight results were not impressive. The only thing that amazed Canadair and