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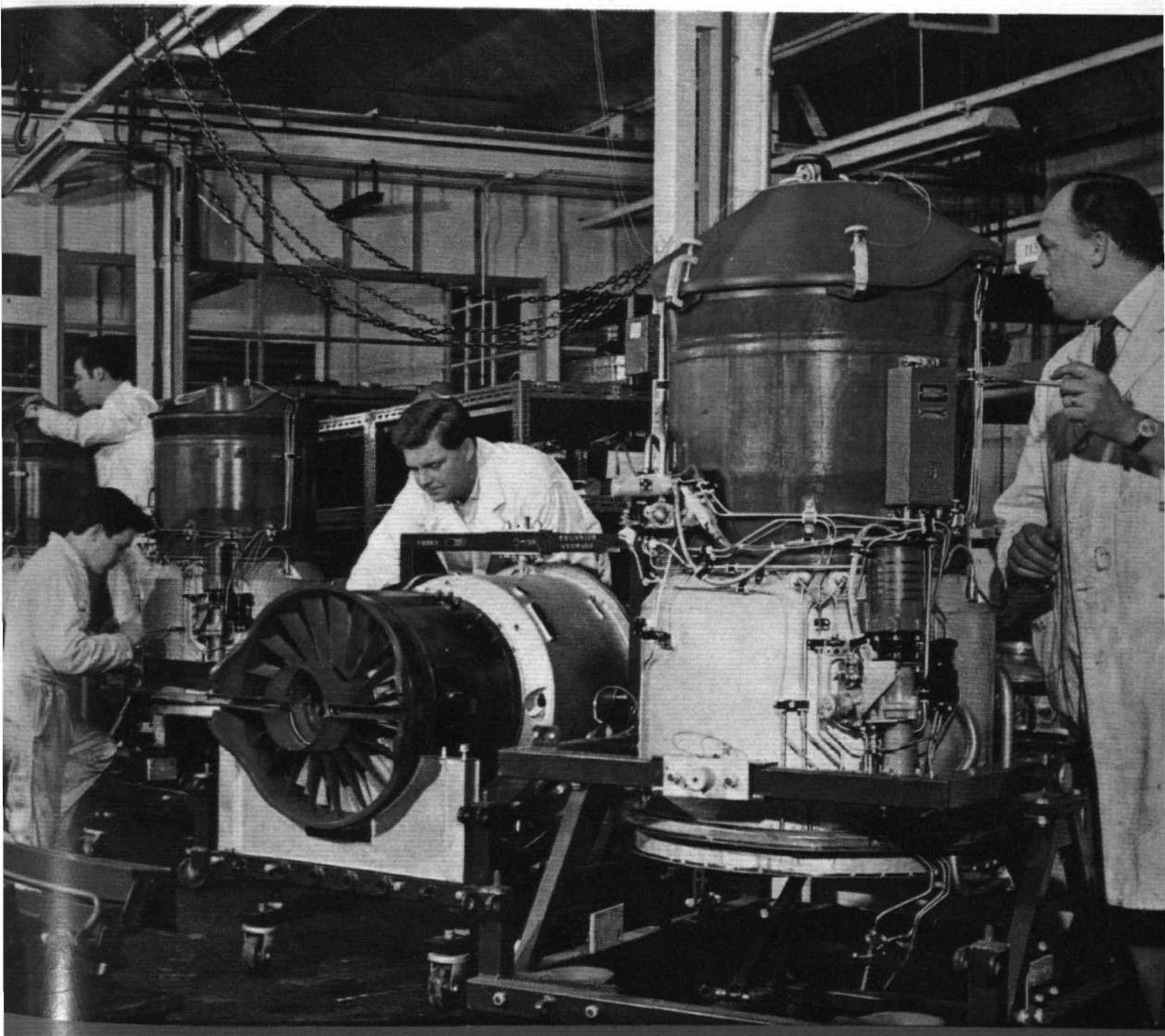

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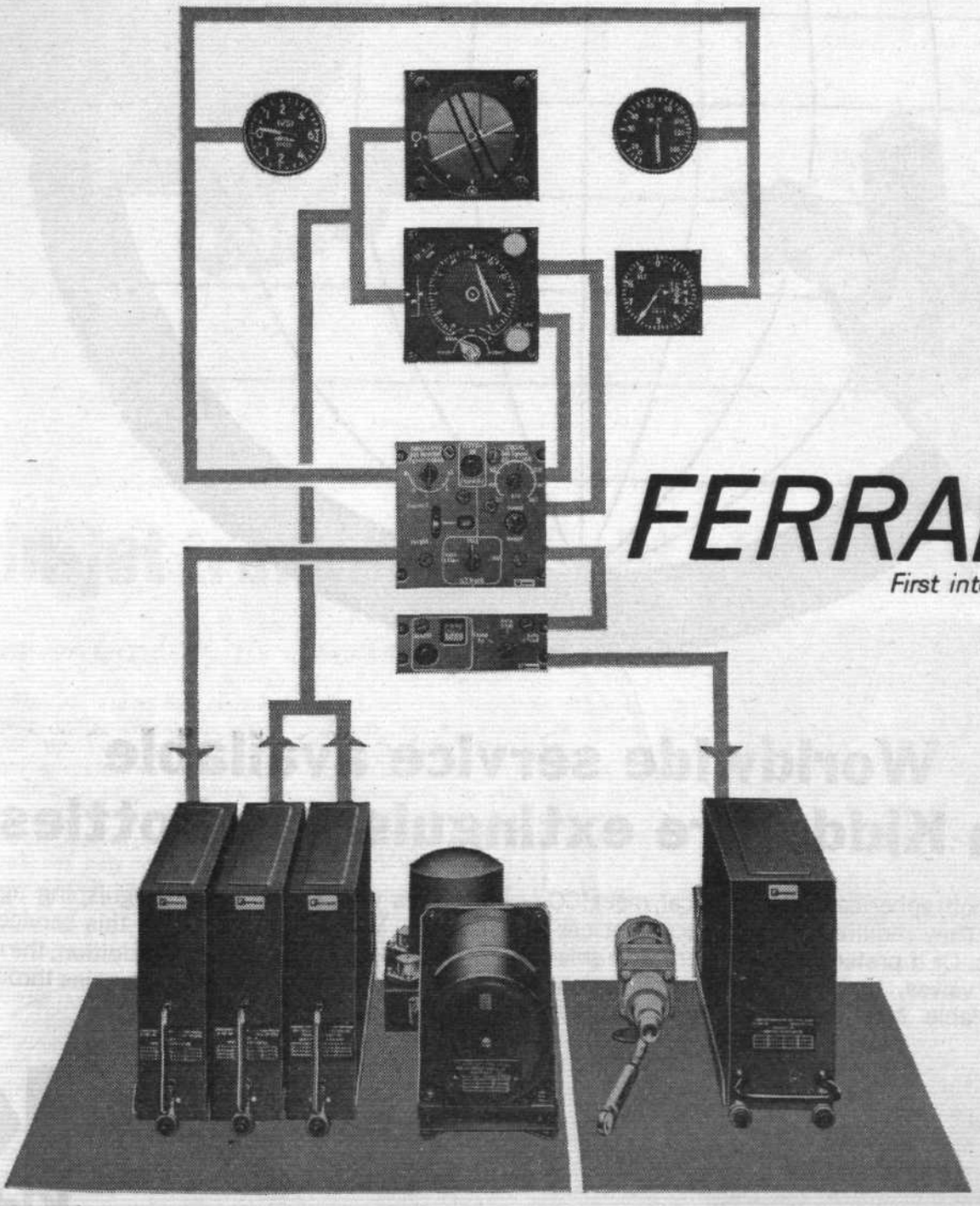

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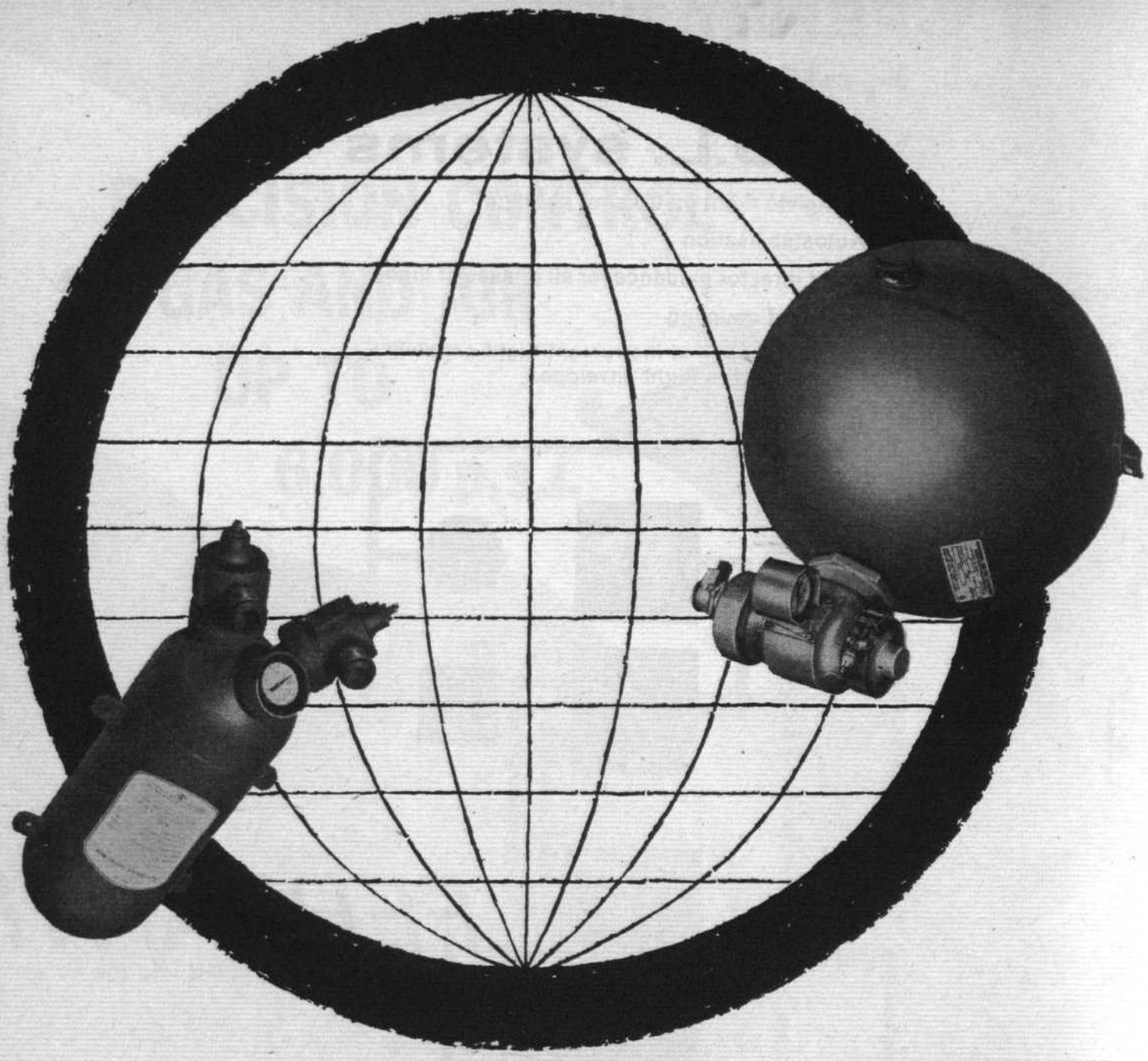

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# twin-jet trainer and light attack aircraft

## — *now ordered by the Swedish Air Force*

The Swedish Air Force has received government authorization to order 130 SAAB 105 twin-jet trainer and light attack aircraft. The SAAB 105 is the outcome of a private venture development programme started in 1959.

The Swedish Air Force has ordered the aircraft not only for training but also in an attack version, primarliy for support of army and naval forces. The trainers will be provided with equipment for speedy conversion to combat duty.

"Light attack" in this context means that the aircraft is designed for tactical operations with external weapon loads equal in many respects to those carried by far more expensive aircraft.

For example: This aircraft can be armed with either two 30 mm cannon, two 550 lb (250 kg) bombs, two 660 lb (300 kg) air-to-ground missiles, six 275 lb (125 kg) bombs or twelve 13,5 cm rockets. This weapon load in combination with the excellent performance of the aircraft, for example a range of 1120 miles (1800 km), makes the SAAB 105 a combat factor of consequence.

Flight tests have shown that the new aircrafts is very pleasant to fly and has good handling qualities both in normal flight and in aerobatics.

The SAAB 105 and its Turboméca Aubisque engines have proved very reliable in operation. Which has contributed to the succesful realization of an intensive flight test program.

The SAAB 105 is also suitable for photographic reconnaissance and as a liason/executive aircraft carrying up to five people.

*SAAB 105 — armed with air-to-surface missiles. (above) and (below) with 12 rockets.*

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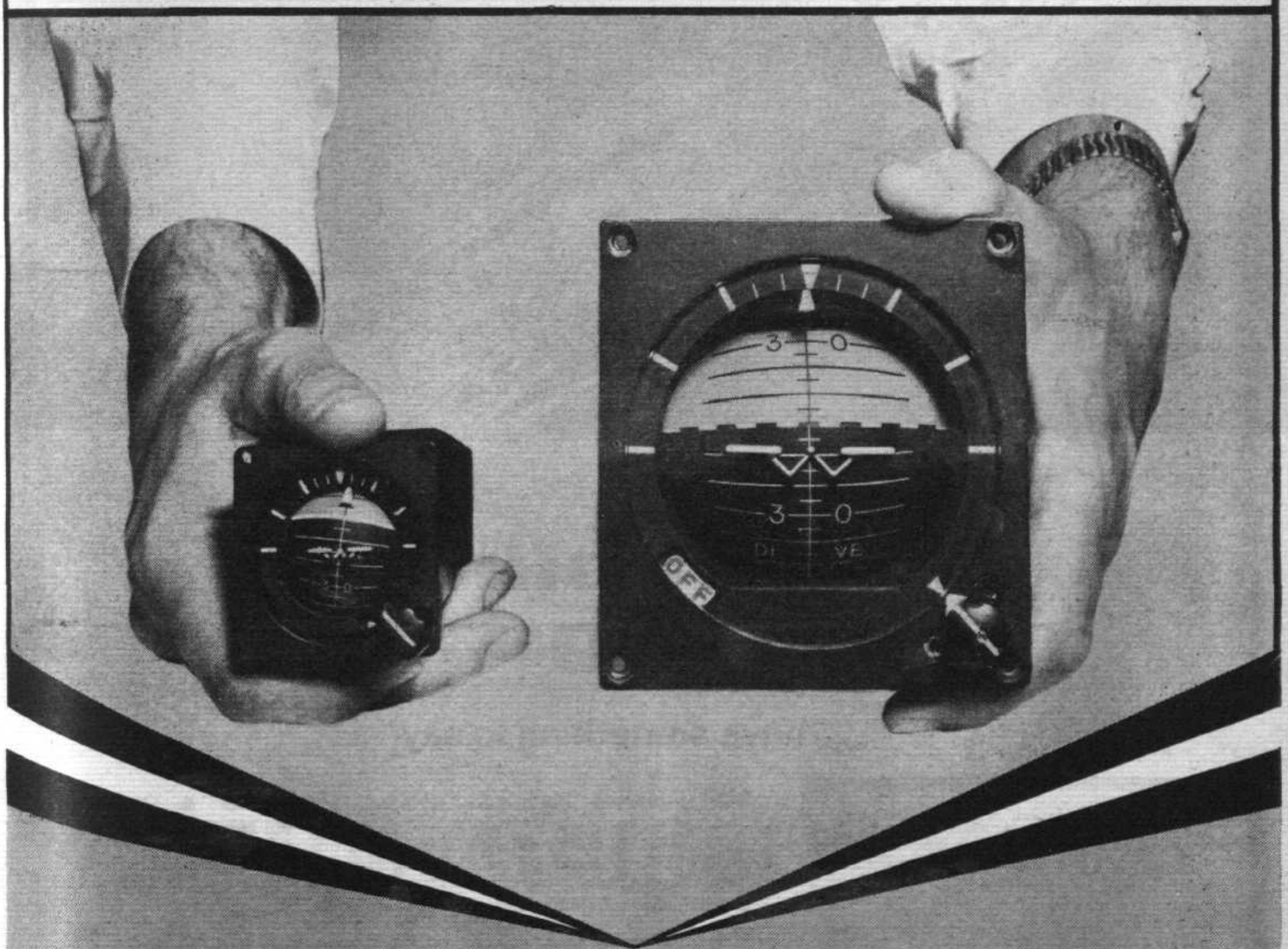


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# HILLER—R.N.


*Photo by courtesy of The Admiralty (Crown Copyright)*

Now in service with the Royal Navy and Marines, Hiller 12E's are demonstrating the rugged performance that the rigours and trials of operational and training conditions demand. Hiller helicopters are designed and built to "rough it" the smooth way. This is why these machines have already been in service for some years with the American and Canadian Governments, and are also a popular choice amongst commercial operators and private owners.

Latest Hiller models are the L3 and L4 which introduce auto-stabilisation and give this proven airframe an increased maximum all up weight of 3,100 lb. and a substantially increased pay-load.

*All versions of the Hiller 12E are supplied by:—*

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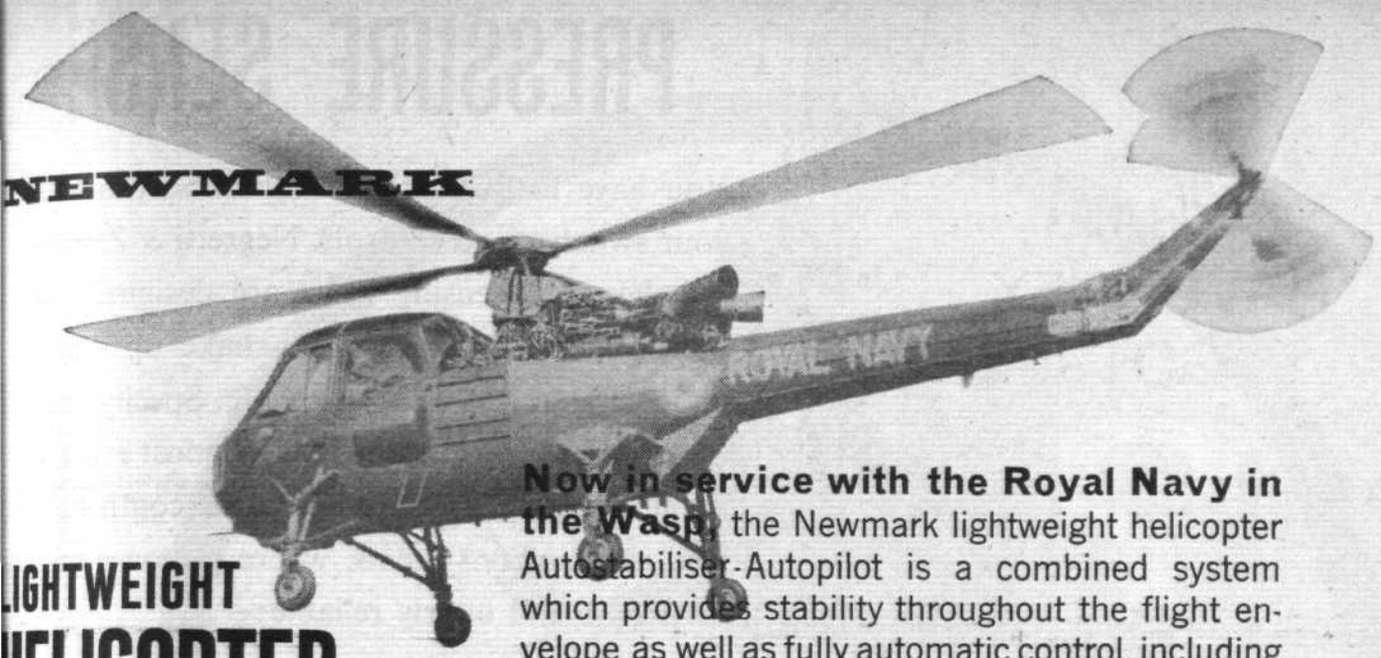
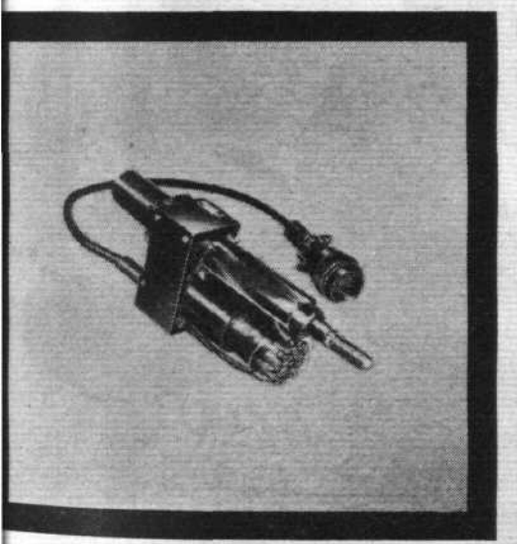
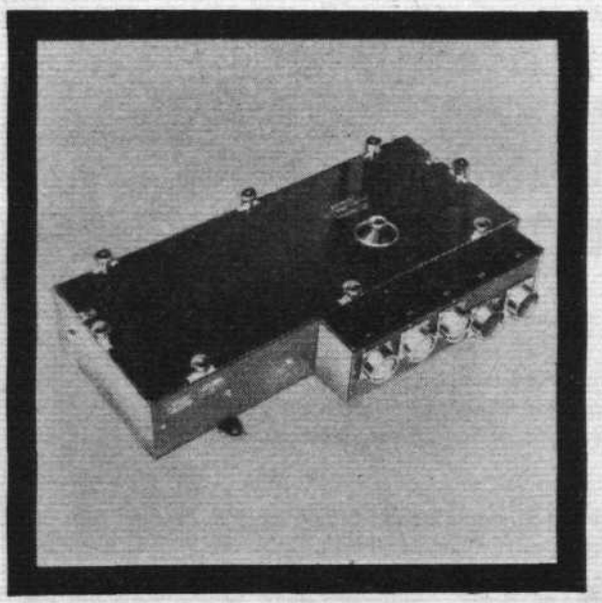
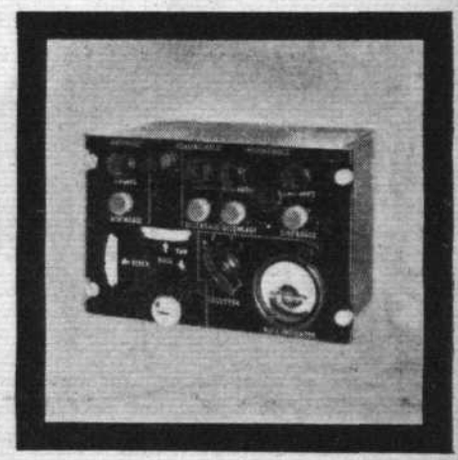


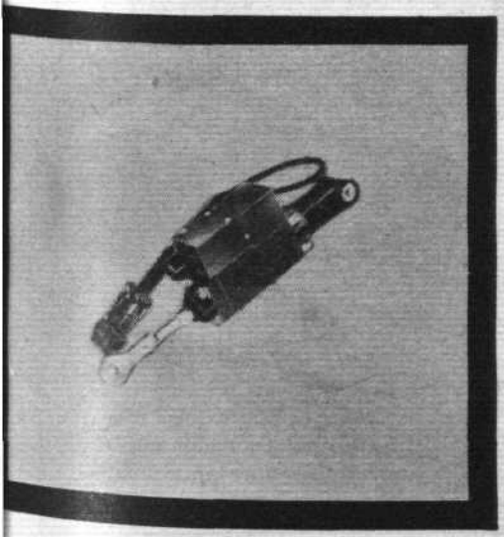

# LIGHTWEIGHT HELICOPTER AUTOPILOTS

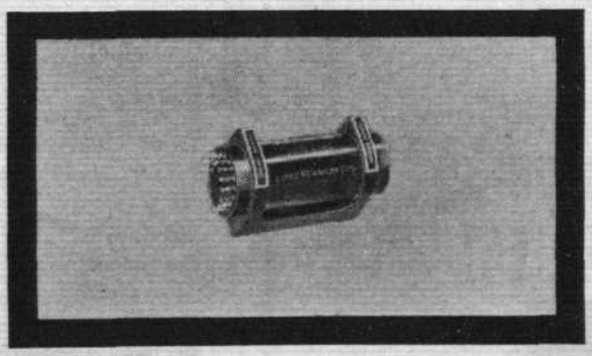
**Now in service with the Royal Navy in the Wasp,** the Newmark lightweight helicopter Autostabiliser-Autopilot is a combined system which provides stability throughout the flight envelope as well as fully automatic control, including heading, radio and barometric height holds under steady flight conditions. It is designed for maximum reliability under the most strenuous environmental conditions. Its easily-maintained modular construction is fully transistorised and weighs only 50 lbs.

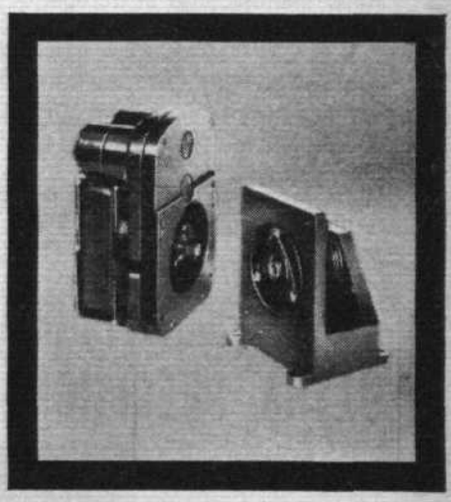












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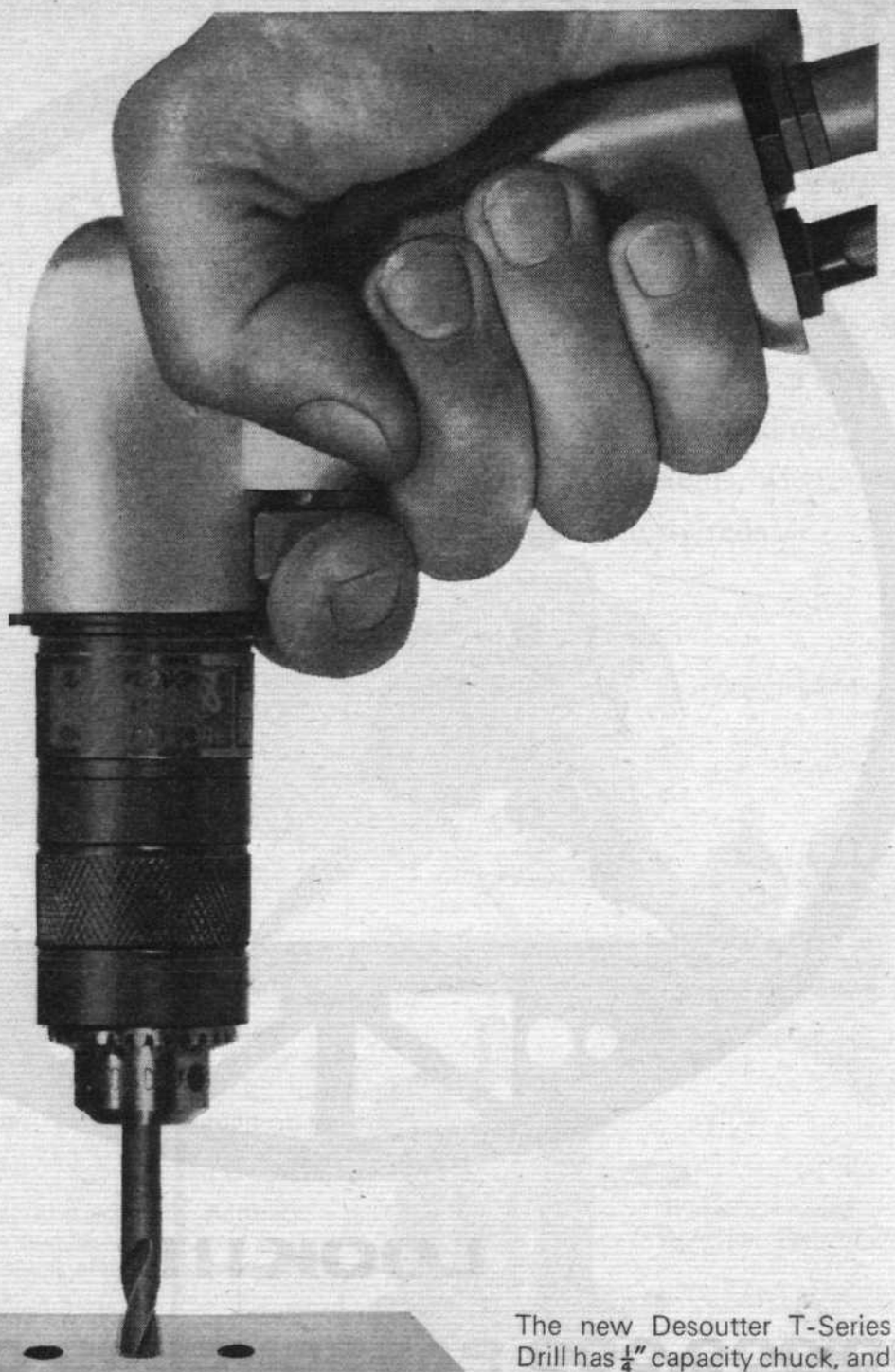

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THURSDAY MAY 21, 1964

*Number 2880 Volume 85*



*In this issue*



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# H.P. and BLC

A PAPER which is certain to prove of lasting interest and importance is the Second Handley Page Memorial Lecture, *Sir Frederick Handley Page, the Man and his Work*, being delivered in London today, May 21, by "H.P.'s" associate of many years (and today the company's director of research) Dr G. V. Lachmann. In sketching a portrait of H.P. the man, Dr Lachmann remarks: "He enjoyed in particular the satisfaction that belongs to good salesmanship. This was his life and his hobby . . . He hardly had any other hobbies worth mentioning. He did play an occasional mediocre game of golf, of course; but on the accordion, in spite of great perseverance, he never got beyond *Silent Night, Holy Night*."

The lecture is no mere historical dust-blowing. In fact—to pursue the analogy of H.P.'s accordion—it is more concerned with sucking: that is, with the removal of the turbulent boundary layer by this means. With this technique, almost as closely as with the leading-edge slot, has the name of Handley Page come to be associated throughout the aeronautical communities of the world. Yet what has Dr Lachmann to say on the subject of BLC (boundary layer control)?

In respect of Sir Frederick's own contribution he recalls that throughout all the frustrating delays and disappointing setbacks, H.P. remained convinced of the importance and ultimate success of the laminar flow technique as a means of reducing direct operating costs of commercial aircraft and of increasing the range of military transports. He goes on: "His moral backing ensured continuity of research at his company's expense. Our work, of course, has been supported from national funds, although the amount has been very meagre compared with the endowment received by the American team at Northrop. Research contracts on a fixed-price basis in Britain are not profitable. In fact, it is a great achievement if one manages to scrape through a contract without excessive losses. Furthermore, a large amount of work—theoretical investigations, design and technological studies and so forth—has been done by Handley Page Ltd without contract cover in order to build up and to extend our know-how."

## Northrop, Boeing, Douglas, Lockheed

The reference to Northrop's work on BLC is a reminder that in the X-21A laminar-flow research aircraft (a converted Douglas WB-66D) the Americans have a research tool of major dimensions. Northrop report: "When X-21 flight testing began in April 1963 the aircraft had sufficient fuel for a flight lasting two hours twenty-five minutes. But with the X-21 reducing air friction with laminar flow control over 65 per cent of its wing span, the test flights were extended to approximately four hours using the same amount of fuel."

Already we begin to glimpse the first practical applications of BLC to the next generation of heavy logistics aircraft for America's Military Air Transport Service. Only last week we reported of the Boeing CX-HLS: "All feasible means of achieving short-field performance and high cruise efficiency (including laminarization) are considered, and Boeing believe any military equipment can be flown into, or out of, a rough 3,500ft strip." And what is true of Boeing is equally true of Douglas and Lockheed, in their studies to meet the field requirements for these mammoth aeroplanes of the future.

Dr Lachmann's lecture, then, comes not only as a tribute to a great Englishman, but as a sharp reminder that yet another technique nurtured in Great Britain seems destined to achieve productive realization in another land.

# WORLD NEWS

**XB-70A Rolled Out**

North American Aviation Inc and the US Air Force rolled out the first of the two XB-70A research aircraft on May 11. As is now well known, severe manufacturing difficulties were encountered in this programme, and for at least 15 months the factor determining the roll-out date has been whether or not the stainless-steel wing structure could be welded together and joined to the fuselage without leaving pinhole leaks through which the fuel could escape. Static testing under simulated flight conditions had shown that achieving a fuel-tight wing was impossible without fundamental developments in welding over distances of the order of 100ft at a time.

This first aircraft still cannot accommodate fuel in the tanks immediately above the powerplants, where the environmental conditions are at present regarded as too severe for complete integrity, and this restricts the range to less than 6,000 miles. But, with its sister-ship, the 550,000lb canard XB-70 will be able to carry many tons of instrumentation and fly for several hours at Mach 3 (2,000 m.p.h.)—more than the YF-12 can do. Presumably its research programme will be managed by USAF Systems Command, but details have yet to be made public.

Although the third aircraft originally scheduled for flight status is not at present being funded, the programme for two flight aircraft and one static-test machine has already cost a reported $1,300,000,000 (about £464,000,000). With the outer part of the wings spread (they folded down for Mach 3 cruise) the span is 105ft; overall length is 184ft. Engines are six General Electric J93-3 reheat turbojets (described in this journal last September 26), each rated at more than 30,000lb static thrust. First flight is expected "about 90 days from roll out."

**Air League Honours Lord Douglas**

Lord Douglas of Kirtleside, chairman of British European Airways for 15 years until his retirement last March, was presented in London last week with the Air League's Founder's Medal in recognition of 50 years' service to military and civil aviation. Making the presentation, Air Chief Marshal Sir Francis Fogarty, chairman of the League, said that Lord Douglas had created a transport organization "second to none."

**Fairey's £527,781 in Heathrow Suit**

Another, and possibly the last, milestone was passed on May 13 on what seems the endless course of the longest lawsuit in British aviation. The Fairey Company was awarded £527,781 of its claim for £1,813,221 against the Ministry of Aviation for the loss of its Great West Aerodrome, which was incorporated years ago into what is now London (Heathrow) Airport. The MoA had proposed £235,227 compensation.

The Lands Tribunal awarded Fairey £320,570 in respect of the freehold lands and buildings which were requisitioned during the war, when the plans for what was to be London's major post-war airport were drawn up. A further £157,211 was awarded in respect of rental for the lands and buildings for the period from November 1943, when the 240-acre aerodrome was requisitioned, to June 1960, when agreement was reached on a compulsory purchase order for the property.

But Fairey claimed a further £1,087,803 in respect of "disturbance," stating that they intended to make the Great West Aerodrome the centre of their activities. Its loss, the company described as a "major disaster," which had affected their development and profitability. The Lands Tribunal awarded them nothing on this claim but in its 25,000-word judgment (the longest in Lands Tribunal history) made an alternative award of £100,000 under this heading "if wrong on a point of law."

This "point of law" may be contested by the MoA, which has until June 1 to lodge an appeal.

**Mr Amery for Australia**

Today, May 21, the Minister of Aviation, Mr Julian Amery, is due to leave London for Australia, which he is visiting during the Parliamentary recess. During his 14-day stay he will inspect facilities at the Woomera range. In recent weeks an MoA team has been in Australia investigating the possibility of TSR.2 flight development being done there and it is likely that Mr Amery's visit will result in a definite agreement.

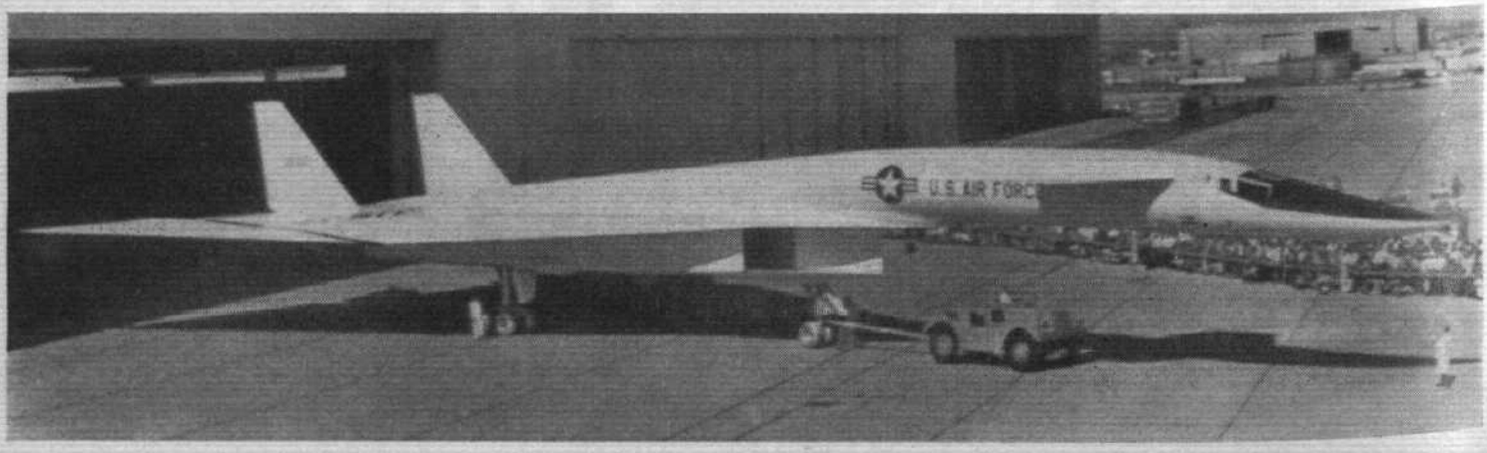
**Woman Pilot's World Solo**

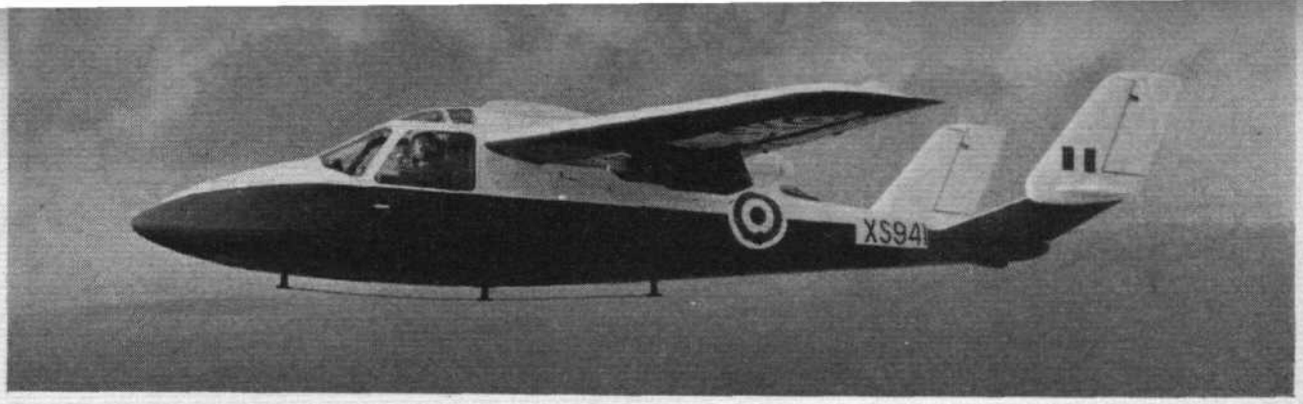
Mrs Joan Merriam Smith completed her round-the-world solo flight in a Piper Apache on May 12, landing at Oakland, California, the place from which she had taken off on March 17. Her route was similar to that attempted by Amelia Earhart in 1937. For the last 100 miles Mrs Smith was escorted by Coast Guard aircraft after she had reported trouble in one of the Apache's engines.

**Beagle Pointers**

Beagle Aircraft had delivered 266 aircraft since the group's formation in 1960, of which 162 had been exported, said the chairman of the parent Pressed Steel Co, Mr Alex Abel-Smith, in his report to shareholders circulated last week. All basic development costs on machines in current production, including the B.206—early deliveries of which are soon to begin to the

**Valkyrie** *This radioed picture was taken at Palmdale, California, during the relatively quiet roll-out on May 11 of the first North American XB-70A. The white-painted giant bears the US Air Force serial number 62-0001 (news-item above)*






**Contrast** *As reported last week, the Miles Group have lately test-flown the Student Mk 2 (above) and a replica Bristol Boxkite built for a film and flown by George Miles himself (left). The Student has Service markings for weapon trials at Boscombe Down; changes include underwing armament pods and a Márboré 6 engine giving a speed of 312 m.p.h.*

Government—had been completed and written off. Seventy-seven Beagle aircraft of all types were on order and now that delivery dates on the B.206 could be quoted, civil interest in the machine, which had been long evident, should materialize into firm orders.

The outlook for Beagle, insofar as this is directly connected with the health of the parent company, appears rather more sanguine, for Pressed Steel had a trading profit of £5,816,000 and a net profit of £1,430,000 in 1963, against respective figures of £1,680,000 profit and a loss of £2,108,000 for the year before.

### Super Frelon Progress

The Sud-Aviation Super Frelon 04 prototype flew, ahead of schedule, on May 4. An earlier example has just completed an impressive series of demonstrations at Bonn, Hamburg, Hanover, Kiel, Copenhagen, Verlose and Malmo (based on the carrier *La Résolue* from Hamburg onwards). The German Government and other NATO nations have a requirement for a heavy helicopter, and Sud are anxious to keep their product in the picture.

### Hiller Taken Over

The Hiller Aircraft Co, of Palo Alto, Calif, one of the world's major manufacturers of light helicopters, became a wholly owned subsidiary of the Fairchild Stratos Corp, of Hagerstown, Md, this month. No announcement of the terms was made when the acquisition, from Hiller's previous parent company, ELTRA, was revealed.

Hiller will remain as a separate unit, at Palo Alto, and will retain its familiar identity. Mr Stanley Hiller, who began helicopter experiments in 1941 when still a schoolboy, flew the world's first co-axial helicopter in 1944, when he founded the company (and who even now is only 39 years old) will remain president; he additionally becomes executive vice-president of Fairchild Stratos.

Hiller employs about 1,200 people at its 61-acre factory at Palo Alto, and has built over 2,000 light helicopters since its formation. Volume production of several types continues for world-wide military and civil orders, with the US Army far and away the company's major customer. In recent years Hiller has devoted effort to other means of VTOL, initially with ducted propellers, later with tilt wings—in 1959 it flew the world's first tilt-wing transport—and is now actively working on jet-lift systems.

For Fairchild, which employs about 3,500 people in its five divisions, and had sales totalling $62m last year, the acquisition is a major step in the recovery staged recently after several lean years. The last major Fairchild-designed aircraft, the C-119 Box-car, ceased production in the mid-1950s, although aircraft manufacture has continued at Hagerstown with the Chase-designed C-123 Provider and the licence-built version of the Fokker F.27 Friendship. Recently a licence was obtained for the Swiss Pilatus Turbo-Porter utility aircraft.

In the last two years major design, development and sub-contract work in the missile and space fields has been undertaken and the company is involved in the Titan III, Talos, Gemini, Saturn, Pershing, Atlas and Thor programmes, while being responsible, too, for meteoroid detection satellites for NASA and reconnaissance drone systems for the US Army. In what is now seen as the first step in a long-term programme to develop new V/STOL product lines, which led to the acquisition of Hiller, Fairchild built the VZ-5FA Fledgling deflected-slipstream research aircraft.

### Balloon Records Claimed

A claim for seven world ballooning altitude records was filed with the NASA on May 11, following the ascent to 37,000ft made the day previously by Mr Tracy Barnes from Minneapolis. Mr Barnes had set out to break the 3-A class record of 23,286ft set in 1940 by the Soviet balloonist Boris Nevernov, but six other records are being claimed too.

### USAF Display Cancelled

The US Armed Forces Day display planned at Wethersfield, near Braintree, Essex, for May 23 has been cancelled. Armed Forces Day displays will still be taking place at Alconbury, Hunts, and Bentwaters, Suffolk.

### TSR.2 Flight Recorder Tested

A test ejection of a Royston Midas flight data recorder of the type fitted to the TSR.2 was successfully made last week at Pendine Sands in South Wales. The recorder, a Midas CMM/7SE 270-channel model, was ejected from a rocket-powered sledge at 600kt, and it survived intact.

### February Employment Figure

Three hundred more people were working on aircraft manufacture and repair in Britain during February than in the month before, according to the latest Board of Trade returns. But the month's figure, 262,000, is 8,500 fewer than in February last year.

### Famous Airmail Stamps for Sale

A unique collection of envelopes carried on the first official airmail flights in Britain (and only the second series in the world) will be auctioned by H. R. Harmer Ltd at 41 Bond Street, London W1, next month. The flights were between Hendon and Windsor in September 1911 and were condemned as frivolous by the then *Manchester Guardian*, a judgement which *Flight* sternly refuted at the time.

The Hendon - Windsor envelopes are only a part of a large collection formed by Mr T. E. Field of covers carried on pioneering airmail flights.

# AIR COMMERCE

## SUBSONIC BOOM

PAN AMERICAN'S repeat order for Boeings—ten 707-320Bs for delivery in 1965 and five more on option for delivery in 1966—caused no great stir, yet it was of significance for two reasons. First, the world's largest international airline—which inaugurated the big-jet era with its order for Boeing 707s and Douglas DC-8s in October 1955—has decided that the Boeing is the better aircraft for its purposes; secondly, a repeat order of this magnitude—equivalent to BOAC's initial entire 707 fleet—means £48m of new business for Boeing who, as recently reported, are now making a profit on every jet transport. In the 30 days of April no fewer than 24 Boeings were delivered: six 707-320Cs, eleven 727s, and seven KC-135s.

Hardly a week now goes by without a repeat order for both Boeings and DC-8s from one airline or another, and it seems that these aircraft will be rolling off the Seattle and Long Beach production lines probably well into the supersonic seventies.

Of particular interest is Pan American's estimate that their mixed-traffic Boeing 707-320Cs, of which seven are in service out of 13 ordered (four more by June and two by next winter), are "flying at the lowest ton-mile cost of any all-cargo aircraft ever operated." Cost per ctm, PAA estimate, works out at 7s 8d—approximately half that of the DC-7F. During January and February of this year these PAA cargo jets increased the airline's transatlantic freight business by nearly 25 per cent, and on the Pacific by 180 per cent. These are big increases for operations on the Pan American scale, the world's largest airline freight business. The Boeing 707-320Cs are being worked at a utilization averaging ten hours a day.

As the No 1 transatlantic passenger carrier, Pan American reports traffic increases following the introduction of the 15 per cent lower fares from April 1 as very large indeed; this has been the experience of most of the other transatlantic carriers, including BOAC. In the month of April, PAA's transatlantic passenger traffic shot up 55 per cent westbound, from over 13,400 in April 1963 to over 21,100, and 46,600 altogether compared with just over 30,000 a year ago. Preliminary figures show record traffic for May, and advance bookings indicate a 30 per cent increase in June and July.

Most transatlantic airlines are reporting similar big increases, which are indeed a vindication of the CAB's intervention a year ago when IATA airlines proposed to increase transatlantic return fares.

For both Boeing and Pan American, who made a net profit of no less than £12m in 1963, the jet revolution may be said to have paid off.

## CONCORD TO COST $250m?

ACCORDING to the *Sunday Telegraph*, the longer-range version of the Concord will involve the British and French Governments in a total cost of £250m compared with the original estimate of £170m. Any increase will of course be shared on a 50-50 basis.

Asked whether an official estimate could be given, a Ministry of Aviation spokesman said last week: "As the Minister has stated in the House, there will certainly be an increase in cost, but revised figures cannot yet be quoted. The firms are revising their development cost plans and officials will then have to examine carefully the firms' estimates."

**SSTs for KLM** Delivery positions on three BAC-Sud Concords and on three American SSTs were reserved by KLM on May 14.

**BEA Fare Increases?** While BEA may be compelled "in the face of rising costs" to increase fares, the corporation's chairman, Mr A. H. Milward, says in *BEA Magazine*: "Our aim must be to reduce fares whenever economically possible." He estimates that the average British wage-earner has to work nearly four times as long as his American counterpart—30 hours compared with eight hours—to buy a 300-mile air ticket.

**Mr A. H. Milward,** BEA's chairman, has been appointed by the ARB to fill the vacancy on the Board caused by Lord Douglas's retirement.

**DC-9s for Swissair** At a Board meeting on May 13 Swissair confirmed an order for ten Douglas DC-9s for delivery between June 1966 and December 1968.

**StarLifters for Tiger** On May 12 Flying Tiger placed a £28m "firm order" for eight Lockheed AL-300B StarLifters, paying a $500,000 deposit. This civil version of the C-141 has a 104ft-long hold and a 110,000lb payload. As reported last week, Slick has also ordered StarLifters.

**TWA Want Nairobi** TWA has asked the CAB to extend its New York - Cairo route to Nairobi, arguing that this point would integrate far better with TWA's proposed East African route than with Pan American's West African route.

**Another Irish Boeing** Aer Lingus has ordered a second 707-320C for May 1965 delivery, costing £3.3m including spares and "certain development costs." The first -320C joins the airline's three 720s next month.

**BOAC's Management** From June 1 a new 11-man BOAC management team, headed by Sir Giles Guthrie, will meet weekly to implement board policy. They are: Mr Keith Granville, new deputy chairman, with a special interest in international relations and commercial matters; Mr Gilbert Lee, who takes over from Mr Granville the chairmanship of BOAC-AC; Mr Ross Stainton, the new commercial director; Mr David Craig, senior general manager; Mr Derek Glover, financial director; Capt D. Peacock, flight operations director; Mr Charles Abell, chief engineer; Mr John Gorman, new personnel director; Mr Winston Bray, planning director; and Mr Robert Forrest, secretary and solicitor. A five-man group—Messrs Granville, Craig, Stainton, Abell and Capt Peacock—will meet daily under Sir Giles. All 34 members of the management will meet monthly.

*Capt Peter Gibbs, director of operations for Ansett-ANA, studying the flight deck of the Short Skyvan at Queen's Island. Capt Gibbs has visited Shorts with other members of the Ansett staff to discuss Skyvan performance and progress. The airline has shown interest in the aircraft from the time when plans for its development were announced, and Mr Ansett recently mentioned a requirement for ten*


*The six Doves and three Herons of Morton Air Services, a British United airline, continue to operate in Morton colours, and a new five-times-weekly service between Exeter and Swansea opened this month. Brighton's west pier provides the background to this new picture*

**Heathrow Guide** The MoA has published an informative brochure about London Heathrow, a handy-sized booklet available free at the airport to all passengers.

**Ethiopian-Alitalia Agreement** As from June 5, Ethiopian Airlines and Alitalia will each operate a weekly service in pool between Rome and Addis Ababa.

**Market Prices** The current issue of Aircraft Exchange's market report quotes a DC-6B, only 13,500hr since new, at $350,000. Requests continue to be received by the Exchange for lease offers of DC-4s.

**UK-Bulgaria Link?** Mr Lazar Belouhov, director-general of TABSO, the Bulgarian airline, has been having talks with the Ministry of Aviation about the possibility of a direct London - Sofia air service.

**Eagle's Gibraltar Refusal** The ATLB has refused Eagle's application to operate an inclusive tour service to Gibraltar on the grounds that it would result in material diversion from BUA and particularly BEA services.

**African Caravelle Tour** With Gen Andre Puget of Sud-Aviation on board, a Caravelle has been touring 17 African countries, calling at the following places: Dakar, Nouakchott, Bamako, Abidjan, Accra, Lome, Lagos, Cotonou, Libreville, Brazzaville, Leopoldville, Bangui, Douala, Yaounde, Fort Lamy, Ouagadougou, and Conakry.

**Eagle Steps It Up** British Eagle's services linking London with Edinburgh and Glasgow were increased on May 11, following ATLB approval, from once daily to twice daily frequency. Mr Harold Bamberg, Eagle's chairman, said: "At last we can provide a more competitive service. We have fought very hard indeed and it has cost us a lot of money to win an extension of our licences."

**Super VC10 Correction** Brian Trubshaw, chief test pilot of BAC's Weybridge division, handled the first flight of the Super VC10 on May 7, and not Jock Bryce, as incorrectly stated in last week's issue. Other crew-members were W. Cairns, co-pilot; R. Mole, flight engineer; and Bob Bishop and Jeremy Slater, flight test engineers.

**Dr Bo Lundberg** has been awarded the Monsanto Aviation Safety Award for 1963 by the American Aviation/Space Writers Association. In particular the association recognized the significance of Dr Lundberg's recent Guggenheim Memorial Lecture which set out a statistical method for the identification and reduction of the risks in flying.

**Mr J. E. Barnes**, Secretary of the Air Transport Licensing Board, is appointed Assistant Secretary, Aviation General Policy, in the Ministry of Aviation. The present holder of this post, Mr E. W. G. Haynes, has been promoted to Under-Secretary and moves out of the civil aviation sphere. New secretary of the ATLB is Mr Cyril Lark, formerly an Assistant Secretary on the Establishment side of the Ministry.

**Air France and Warsaw Claims** A district judge at Atlanta, Georgia, ruled on May 7 that the Warsaw Convention applies to 32 suits brought by surviving relatives of 130 people who were killed when an Air France Boeing 707 crashed at Paris Orly on June 1962. The plaintiffs had argued that Air France, because they were guilty of alleged wilful negligence, were liable for higher damages. The suits may now go to trial.

**EAL's Three-year-old Air Shuttle** services, launched in April 1961, are "very healthy," according to the airline. This unique experiment in mass air transport, using obsolescent piston-engined airliners (the Shuttle fleet now comprises 22 95-seat Super Constellations and eight 90 or 95 passenger DC-7Bs), has handled 5.3 million passengers, 2.7 of them in the past 12 months, and now accounts for eight out of every ten passengers travelling between New York, Boston and Washington. The next step, now being planned, is the replacement of piston-aircraft by Electras.


*East African Airways, common airline of four sovereign African states, now flies on the fins of its aircraft the four flags concerned—Kenya, Tanganyika, Uganda, and Zanzibar. This is the tail of a Comet 4. The airline's lion emblem is retained*

AIR COMMERCE . . .

# A Peep into China

## Part 2

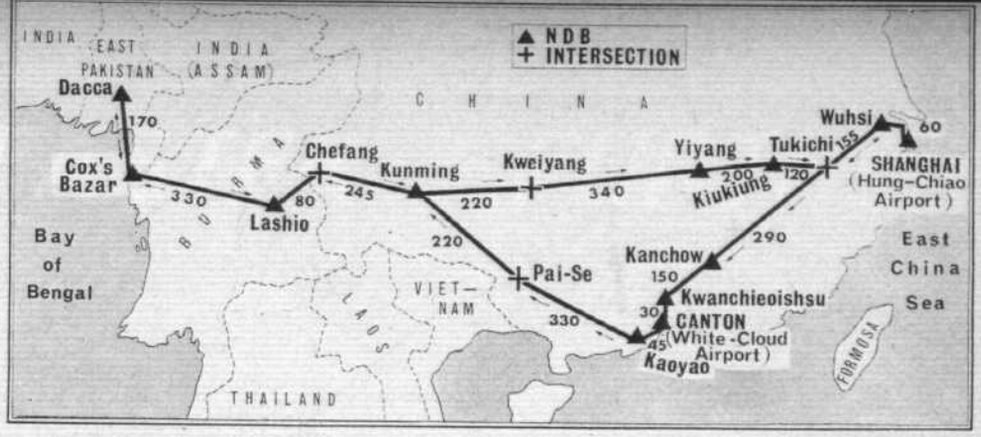
"FLIGHT INTERNATIONAL" PHOTOGRAPHS

*The first peep: paddy fields near Shanghai*

FROM the steaming heat of Dacca in mid-morning to a pleasant dry spring afternoon in Shanghai it took our Pakistan International Airlines Boeing 720B just 3hr 50min. For most of the 100 or so cool businessmen, patient travel agents and pent-up journalists accompanying Air Cdre Nur Khan and other leading PIA executives on the inaugural service it had more the air of a flight to the Moon. For so long a silent and inscrutable country, what would China really be like? Even the disappointment of finding Burma obscured by the towering cumulus of the early monsoon didn't seem to matter as, south of Assam to avoid overflying Indian territory, we headed from that fascinating-sounding place, Cox's Bazar, to Chefang—our first reporting point in China. Kunming air traffic control was called and, quick as a flash and perfectly clear, came the reply: "Welcome to China!" We were finally there, yet the people's democratic stratus looked just like the imperialist clouds behind.

Even by Far East standards *en route* radio navigation aids in China are pretty basic, and PIA are anticipating quite a lot of delays when the monsoon really gets going. Until the end of this year when the first imported VORs are due to be installed, all *en route* navigation over China is based on NDBs, with radar back-up of uncertain accuracy. But the Chinese have told PIA that their aircraft will be kept within the 25-mile-wide airways, and within five miles of track on the 60 miles from Wu-hsi into Shanghai. On the

*Next stop China: Boeing 720B AP-AMJ being refuelled at Dacca for its flight to Shanghai on April 29*




*The route to China, showing the beacons and reporting points; the numbers are the nautical-mile distances between points*

one pre-service proving flight and the inaugural, PIA pilots reported never hearing any R/T or seeing any other aircraft or contrails.

Apart from increasing the length of the single runways at Canton and Shanghai to over 10,000ft—which our sprightly Boeing seemed hardly to need—with typical hospitality the Chinese have also installed ILS at both ends of the runways. The equipment, we were told, was Chinese-built—perhaps rather surprisingly, as the VORs have been ordered from an unspecified foreign manufacturer.

The touchdown at Hung-uh'Iao Airport, like every PIA touchdown on our trip, was smooth as silk. If they bend a Boeing in China, PIA can't expect any practical on-the-spot help from the factory—in China's entry-visa department they don't know Americans.

Many people observed that China has always been a country

*CAAC's Viscounts have now been given this attractively simple paint scheme; number 410, seen here at Shanghai, took the writer to Peking. The six Viscounts are thought to be numbered alternately from 402 to 412*

difficult to describe and even more difficult to understand. One of the earliest returning travellers to try it was Marco Polo; and for his trouble he was branded the biggest liar of his time. Today the Chinese apply this description to the "imperialist" Press for completely opposite accounts—for allegedly slanderous exaggerations of poverty in modern Communist China.

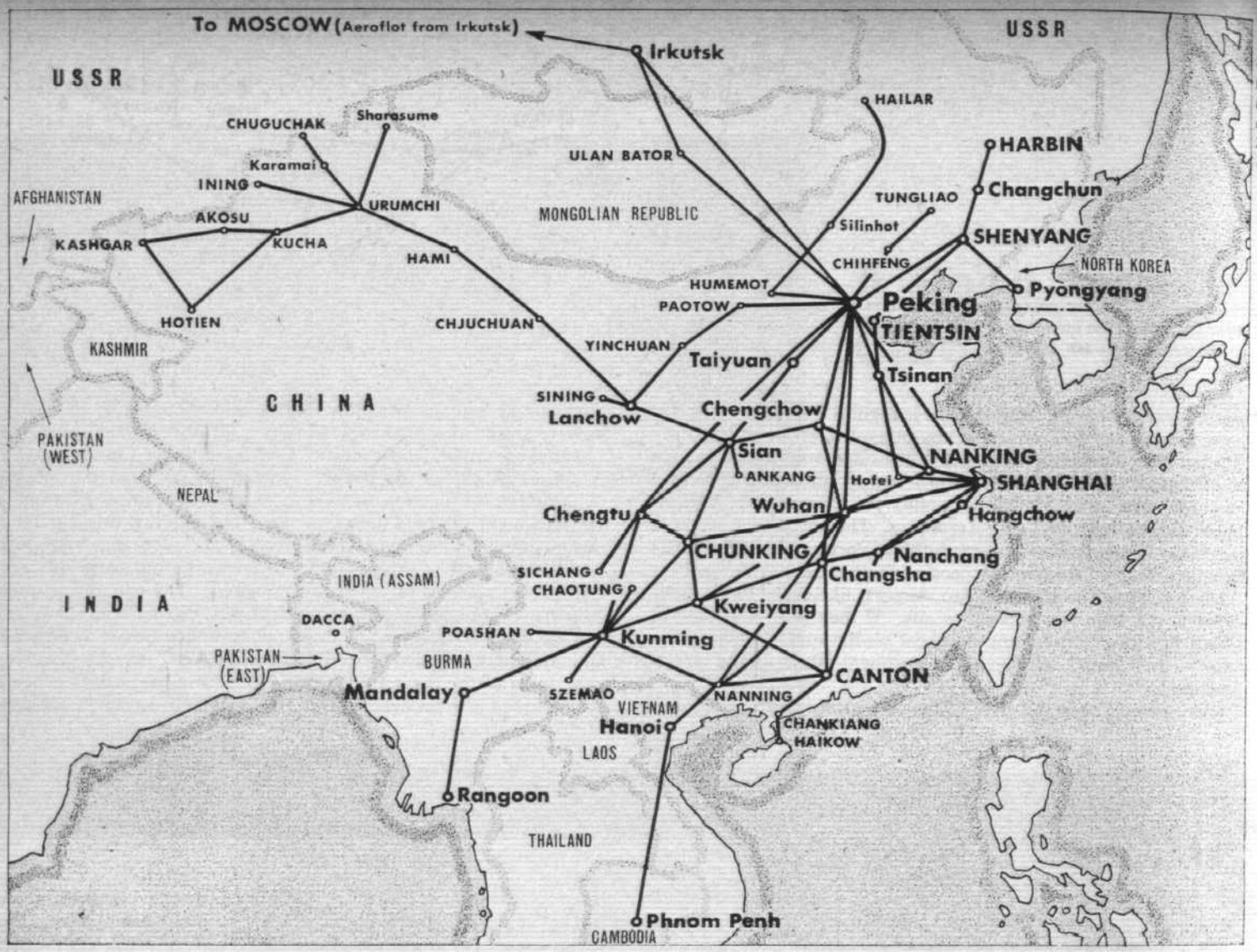
But what is it really like? On the human side the answer seems to be so much a matter of opinions; some observers have compared it to life in some of the poorer Roman Catholic countries, with magnificent public buildings replacing grandiose cathedrals; others have noted the tremendous public spirit and the cheerfulness of the people. For anyone who really wants to know, the only answer is to go there. Further, the Chinese are now going all-out to make things easy for the foreign visitor, and anyone from a "friendly" nation or organization—i.e., one that doesn't actively run down China—will be granted a visa.

The Sino-Pakistan air-link promises to be vitally important to both nations. The first Chinese approaches were for extensions of local services near their common frontier, but the more impressive final result, arrived at after only 8hr negotiations last August, may have encouraged an even more open-door policy than was originally planned. The China International Travel Service—Lüxingshe—has anticipated a flood of visitors and has boosted the number of its English-speaking staff with university graduates. Some two dozen different conducted inclusive tours are planned for the visiting capitalists. The tours vary in price from £20 to £30 for four days in and around towns like Canton and Shanghai up to 15-day tours costing from £100 to £145 taking in other citys.

The General Administration of Civil Aviation of China (CAAC) is almost as old as the People's Republic itself, and the official definition of its function is: "To serve socialist reconstruction and the livelihood of the Chinese people." In practice this not only means scheduled inter-city services with Il-14s, Il-18s and Viscounts but a whole host of mixed traffic, aerial work, and some military transport functions, to the remoter regions. The equipment used consists of unknown numbers of: Li-2s (Soviet-built DC-3s); Il-12s; An-2 (Otter-sized biplanes built under Soviet licence in China); and, we were told by Mr Shen-Tu, CAAC's deputy director, even some of the ten-seater Peking No 1 twin-engined transport. As described in great detail by Mr Ho Lo-Wen in an article entitled "China's Civil Aviation" that appeared in the December 11, 1959, issue of *Flight*, CAAC is first-and-foremost a public utility, heavily subsidized, but with safety the paramount operational consideration. It is proud of the fact it has never had a major accident involving loss of life. The CAAC Viscount which carried the inaugural party from Shanghai to Peking felt indecently spacious with only 52 seats. Four-engined safety was the answer to the enquiry whether the same job couldn't perhaps have been done more economically with a twin-turboprop.

Everyone concerned, from Premier Chou-en-Lai downwards, seems pleased with the Viscounts, and those in which the writer flew were nicely handled—reports say that even on training, which is so thorough it takes seven months, CAAC get 150 landings out of a set of Viscount tyres where other operators get only 100. The engineers, too, obviously love the aircraft; after every flight the cowlings are religiously opened and the Darts given a rub-down. The Rolls-Royce engineers are convinced these are the cleanest Darts in service; even the grease, they say, is rubbed off linkages.

The non-stop routeing of our special non-scheduled 2hr 30min flight from Shanghai to Peking was *via* Nanking and Tsinan; but, just on top at 23,000ft, we could see nothing of the great Yangtze and Yellow rivers crossed *en route*. Prudently perhaps, in view of the reliance on NDBs, CAAC only mentions the appropriate day of the week in its English language timetable of services. Peking Airport also has just one 10,000ft runway with ILS at both ends; facilities no doubt put there some time ago for the benefit of Aero-




## AIR COMMERCE

### A Peep into China . . .

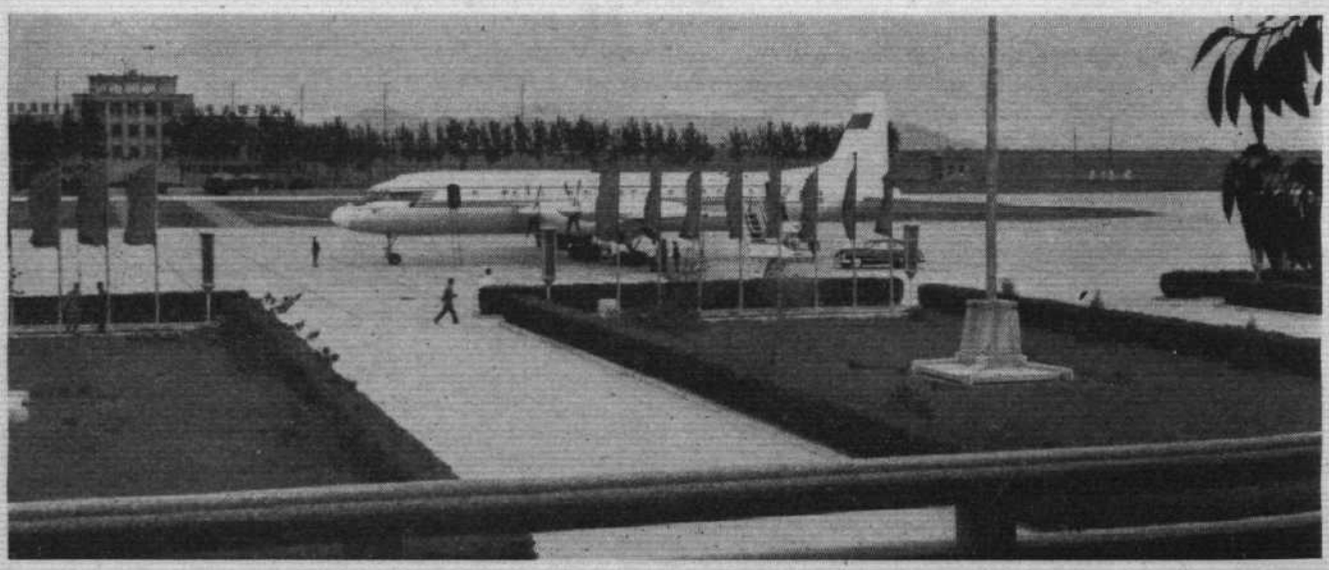
flot's Tu-104s and Tu-114s which still link Peking with Moscow.

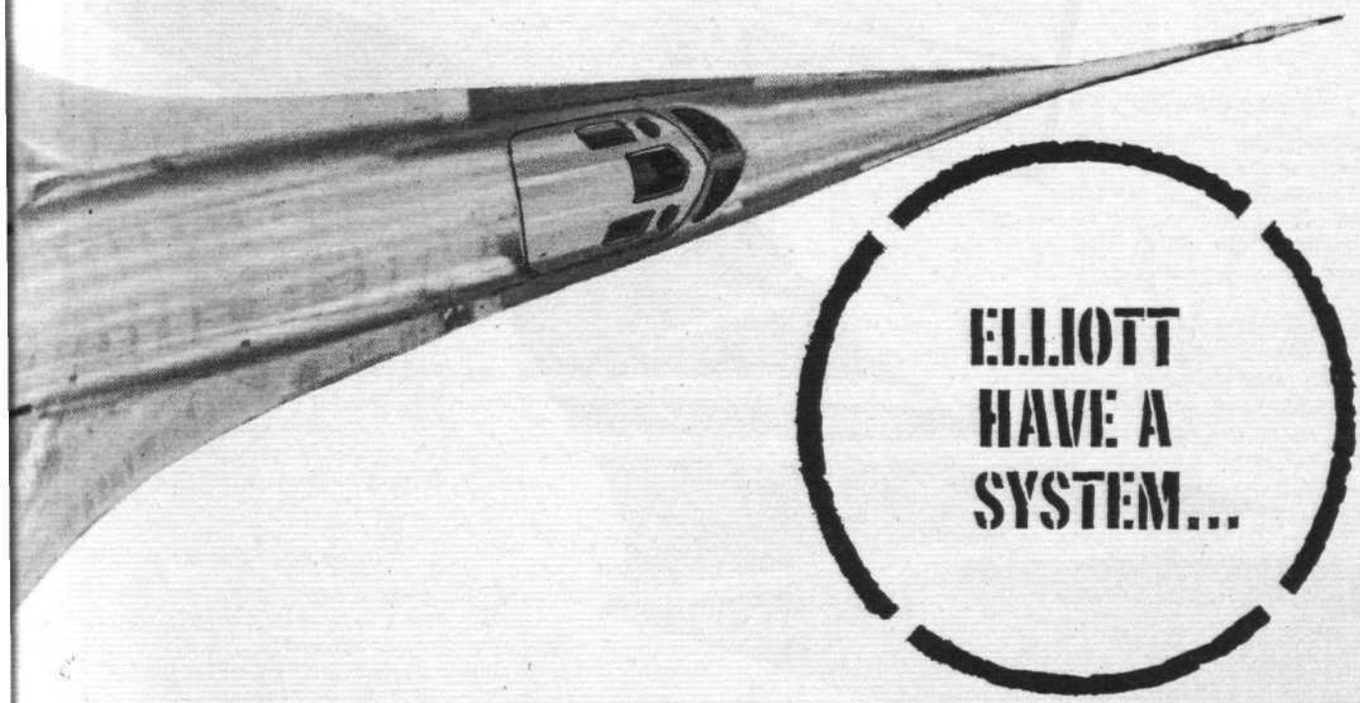
The scene on our arrival at Peking Airport seemed to typify Chinese civil aviation: a solitary unidentified Li-2 taxying out past rows of motionless Il-12s, Il-14s, An-2s, a Yungani Number 1 (Chinese-built Aero 45), and a Convair 240 (in Chinese markings). The apron itself couldn't possibly have coped with more than two aircraft doing a simultaneous turn round, and the palatial terminal building seemed positively violated by the presence of people. Anyone can buy a ticket on a CAAC service, but since it costs 158 yen for a single ticket between Peking and Shanghai, and as Mao-tse-Tung only gets 400 yen a month, it's hardly surprising that the only customers are sponsored officials and foreigners.

NEIL HARRISON

中国民航
CAAC

*Above, CAAC's domestic and international route map. The busiest scheduled routes, with daily and six weekly services respectively, are Canton to Haikow and Peking to Canton. Other sectors have only between one and three flights weekly. Below, on the ramp at Peking airport—a CAAC Ilyushin 18*





# ELLIOTT HAVE A SYSTEM...

. . . to meet all the needs of the aircraft designer and operator for flight instruments and flight control. Elliott's team of twelve divisions have a unique capability and strength which springs from gathering in one company all the techniques needed for control of flight in all its aspects.

**Autostabiliser for the Bristol type 221 research aircraft**

The Autostabiliser supplied by Elliott Brothers (London) Ltd for the Bristol 221 comprises an integrated system designed to perform two main functions:-

(a) To ease the task of the pilot in holding steady test conditions during the initial phase of the flight test programme.

(b) To provide a flexible means of varying the handling characteristics and lateral stability of the aircraft during the principal and more important part of the flight test programme.

The requirements of (a) have been met by providing automatic airspeed control and lateral autostabilisation.

Control of airspeed will be obtained by automatic positioning of the aircraft throttle lever in response to departures in airspeed from a valve which is selected in flight by the pilot. The selected airspeed may be any valve chosen from a large range. This airspeed control system makes the aircraft 'speed stable' below minimum drag speed and improves speed stability over the range in which it is operative.

The lateral autostabiliser is of the conventional type and provides additional damping in roll and yaw by deflecting the ailerons and rudder in response to roll rate and yaw rate signals obtained from standard Elliott Rate Gyros.

An airborne computer is a main unit in the part of the system designed to meet the requirements of (b). The computer will receive signals proportional to airspeed, roll rate, yaw rate, lateral acceleration, sideslip, aileron position and rudder position. Extensive use has been made of standard removable cardmodules and the internal layout of the unit is such that all parts requiring frequent change or adjustment are easily accessible after opening a hinged top cover.

The signals are passed to input or signal-shaping cards as required and are then routed, with the exception of the airspeed signal, to a programming card. By means of the programming card it is possible to select on the ground in minutes the signals or combination of signals which are to be used in the aircraft control equations. From the programming card it will be possible for the signals to pass through summing amplifiers to aileron and rudder channel servo amplifiers and thence to the control surfaces. Provision has been made for a substantial increase in the amount of information available from a given flight since any three of the above signals may be routed through the Pilot's Controller before being fed to the summing and servo amplifiers. The Pilot may then select any of five given levels of each signal or may switch out any of the three signals as required.

Examination of the aircraft lateral stability and handling characteristics in low speed flight as modified by the variety of possible autostabiliser and co-ordination control terms will be carried out after examination of the results of supporting simulation work carried out by Elliott Brothers (London) Ltd.

ELLIOTT **military aircraft controls division** A Member of the Elliott-Automation Group

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# Lagos by B.O.A.C VC10 — Care of Shell

B.O.A.C VC10 at Rome *en route* for Lagos during one million miles of intensive flight trials over projected routes. These new 120-passenger, 600 mph jetliners are entering scheduled service on B.O.A.C's West Africa route. Regular services will follow successively to the Middle East, East Africa, Central and South Africa, South America, Aden, Libya and the Far East. In all six continents B.O.A.C's aircraft fly care of Shell.

For as long as airlines have been flying—wherever airlines fly . . .

SHELL

Shell Aviation Service


*This Piaggio P.166B Portofino was recently delivered to Queensland Airlines*

## AIR COMMERCE . . .

### CONCORDS FOR AIR-INDIA?

THE first airline reaction to follow the announcement, on May 6, of the bigger and better Concord has come from Air-India. The airline's general manager, Mr B. R. Patel, on his way back to report to his Board following discussions with BAC, states: "The new performance of the Concord should be ideal for both our eastern and transatlantic routes, and it is very likely that we shall decide to place an order."

Only two months ago Air-India reserved three delivery places in the queue for the proposed American SST because the Concord at that time had insufficient range for Air-India's needs. In spite of the reported increase in the Concord's selling price from £3.5m to nearer £4.5m there are signs that the increased range and bigger payload capacity have tipped the scales in its favour and that, in view of delay in the American SST programme, many other airlines are having urgent second looks at the Anglo-French aircraft. If, as expected, Air-India orders two Concords, it will bring the total number on order to 45 aircraft. Both Air-India's pool partners, BOAC and Qantas, have ordered Concords.

### THIRD MAN OUT?

THERE now seems every chance that the US Federal Aviation Agency's 15-year rule requiring three flight crewmen on transport aircraft with take-off weights in excess of 80,000lb may be scrapped in the near future. The first real test for the ruling has come with the advent of short-range jets like the BAC One-Eleven and the DC-9 which were designed from the outset for two-crew operations and which, in their developed versions, just exceed the arbitrary weight limit.

The Agency has invited comments by July 1 on its draft proposal which is to determine the crew compliment from an evaluation of the workload imposed upon the crew members by a particular aircraft and its cockpit environment. The FAA's proposal would apply to all airliners certificated after January 1, 1964. The aircraft actually most seriously affected so far has been the Hawker Siddeley Argosy which must have two pilots and a flight engineer, whereas Viscounts are flown by just two pilots. The One-Elevens on order for American, Braniff and Mohawk have gross weights less than 80,000lb.

### A NEW LOOK AT TURBULENCE

AN investigation has been started by the Stanford Research Institute in co-operation with United Air Lines to explore the possibility of a correlation between clear air turbulence and the atmospheric electric field. The US Air Force is funding the work.

Initially, ten of United's DC-8s will be fitted with devices to measure the electric field when the pilot encounters mild to moderate turbulence.

Stanford Research Institute is providing the equipment and will analyse the results of the experiments; United is equipping the aircraft at its San Francisco maintenance base.

SRI researchers and United meteorologists believe there may possibly be a change in the electric field either associated with the turbulence or preceding it. If such a correlation does exist, the next step would be to develop a device to warn pilots in advance, allowing them to change course to avoid clear air turbulence or alter speed to minimize its effects.

The electric field measuring device consists of a sensor mounted in the tail cap of the aircraft's vertical fin, which measures the electric field in the vicinity of the fin. The information is transmitted to an electronic recorder located in the aircraft's radio equipment rack, with a tape readout provided by a pen trace. The data also registers on a micro-ammeter on the pilot's control panel. The pilot, or an observer, can monitor the meter at the time turbulence is encountered.

Results of the tests will be studied when the recorder tape is removed after 400hr of flight. This time interval corresponds to that for removal of the aircraft's flight recorder, at the routine maintenance check. The pen trace of the electric field meter will then be compared with the acceleration trace on the flight recorder which measures "g" at the time turbulence is encountered, hence showing any correlation between the two phenomena.

*The fifth BAC One-Eleven made its first flight from Hurn on May 5. Destined for British United it is the first fully-furnished One-Eleven, complete with Aviation Traders seats and galley*

## AIR COMMERCE...

### A THIRD AIRPORT FOR PARIS

ALMOST simultaneously with the decision to develop Stansted as a third airport for London, a French Government committee on which the various Ministries concerned were represented decided, on January 13 this year, to authorize the Paris Airport Authority to develop a new airport to replace Le Bourget. But whereas Stansted is already in existence as a civil airport and is used by big jets for diversions and crew training, the site of the third Paris airport, adjacent to the small village of Roissy-en-France, a few miles north-east of Le Bourget, is at present virgin farm land. To quote the official booklet, "The implantation of an airport covering about 7,500 acres is possible with the elimination of the buildings of only one farm"—and this a mere 14 miles as the crow flies from the centre of Paris.

Since Paris-Nord, as it will be known, will be built from scratch a prompt decision to go ahead was necessary. Land required for the airport will be acquired this summer, and during 1965 and 1966. Work may start towards the end of 1966, the initial phase being the construction of an east-west runway and the provision of the necessary facilities for handling a relatively small amount of traffic, in readiness to receive the first SST towards the end of 1970. Air traffic control difficulties are foreseen as a result of the co-existence of Le Bourget and Paris-Nord, but the former is expected to close towards 1975. There will be two parallel east-west runways, about 13,500ft long and capable of extension if required; the distance between these two has not yet been definitely decided but will most probably be 8,000ft. A third runway in the same direction is envisaged to increase the number of movements, while two runways running from north-west to south-east will be provided. The estimated expenditure needed to handle about 7m passengers a year is 900m francs (£66m).


*On April 29 this advertisement appeared on the front page of the Karachi newspaper "Dawn". Soon, no doubt, non-IATA will be protesting at IATA's encroachment into their business*

### TAA's FLEET

FIFTEEN different species of aircraft are now operated by Trans-Australia Airlines. The first-line fleet, as depicted in the photograph, is made up of Electras, Friendships and Viscounts, the latter being broken down as follows: three V.816s, four V.720s (two leased to Ansett-ANA) and nine V.756s. In addition there are three DC-6Bs, including two leased from ANA; three DC-4s, including one aircraft just acquired but not yet in service; 18 DC-3s (ten in New Guinea); two DHC Otters, both in New Guinea; and one DHA Drover.

The New Guinea fleet, in addition to the ten DC-3s mentioned above, including two Bristol Freighters, two Cessna 182s, one Cessna 185, one Piper Aztec, one Beech Queen Air on lease plus two on order, and one PBY5A Catalina.

TAA also have two Hiller H.12E helicopters and one Bell 47J2.

As discussed in these pages for April 23, pages 637-8, TAA are shopping for new short-range jet equipment, the choice being between the BAC One-Eleven and the DC-9. The inclination for the past six months has been towards the BAC One-Eleven; although there is less to choose between the two in terms of delivery date, price of the DC-9 is considerably greater. TAA's first-line Electra replacement will of course be the Boeing 727, an order for a third having been confirmed this month by the Australian Government.

### BEA'S CARGO POLICY

IN a recent issue of BEA's flying staff journal *Intercom*, the corporation's flight operations director, Capt J. W. C. James, writes an especially informative article about BEA's cargo planning and policy:—

"Cargo is in the air—literally—and more and more of it is being carried by air—profitably. Its future as a vital and ever-growing part of the air transport business is clearly assured, and that goes for BEA as much as for any other airline. Because of this we have decided to increase our Argosy freighter fleet from three to five aircraft. However, instead of just adding two more freighters to our existing fleet, we are going to trade in our present three Argosies and replace them with a fleet of five new Argosy 200s.

"Outwardly the Argosy 200 looks exactly the same as our present aircraft, but its improved performance, lower maintenance costs and better cargo carrying capacity—all of which add up to greater

*TAA's first-line fleet comprises nine Fokker Friendships, 16 Vickers Viscounts and three Lockheed Electras. See accompanying note*


*The Boeing 720B operated by Lebanese International Airways is on lease from Saudi Arabian*

efficiency—convinced us that it would be wise to make the change to a complete new freighter fleet at this time. This will also enable us to effect some improvements in the control cabin, notably in respect of radio facilities.

"One of the most important features of the new Argosy is the possibility of introducing a larger size of freight pallet. This will increase the volumetric capacity of the aircraft by as much as 35 per cent, and thus substantially reduce the number of occasions on which the Argosy payload is restricted purely by volumetric limitations. Also, the use of the larger pallet, of the same size as that used on several other international freighter aircraft, will help to achieve more efficient freight handling, which is one of the essential ingredients for economically successful freighter operations.

"It is a fact—although perhaps a surprising one—that the air freight business is profitable to BEA because of the amount of freight that can be carried, you might say, as a 'by-product' of passenger services. At present, the revenue earned from cargo carried in Argosies does not cover the costs, so our freighter fleet in itself does not operate on a profitable basis. However, the specialized freight carrying facilities we are able to offer with the Argosies does in fact attract a great deal of other cargo business, which can be profitably carried in passenger aircraft. Thus, under present circumstances, the two methods of carrying cargo by air in BEA are interdependent to quite an extent.

"Provided that certain objectives can be achieved, however, there is no doubt that our freighter fleet can and will become profitable on its own account. An increase in the size of the freighter fleet from three to five aircraft is one of the first essentials. This will not only meet the ever-growing demand for cargo capacity, but will also make possible improved regularity, more flexibility in scheduled and charter operations, and more efficient aircraft utilization. Another essential, as previously mentioned, is a reduction in costs by improved methods of cargo handling.

"The subject of BEA's freight policy has recently been thoroughly investigated, plans have been drawn up—one part being the decision to increase the Argosy fleet—and work is now in hand to expand and develop our freighter operations with the aim of making them not only self-supporting, but profitable.

"At the moment, expansion of our freight business is restricted by the size, layout and position of the present Cargo Unit in the central area at Heathrow. Nevertheless, our freight people are justifiably proud in pointing out that the BEA air cargo unit at Heathrow is already the largest of its kind in the world, and the only one offering complete air-cargo services and facilities on a continuous basis—24hr a day—365 days a year.

"A new permanent cargo centre is to be built by the Ministry of Aviation on the south-west side of the airport, in what is now known as No 3 maintenance area. This will be designed to achieve tremendous improvements in cargo handling efficiency, such as by direct loading and unloading of aircraft without the use of intermediate transport vehicles, maximum use of mechanization and streamlined handling procedures. Unfortunately for us, this new cargo centre will not be ready until about 1967-8, so in the meantime, BEA and BOAC are collaborating in developing an interim cargo base in the BOAC No 1 maintenance area. This will be in operation by the end of this year, and will not only provide BEA with much needed extra space for expansion, but also improved cargo handling facilities, and the possibility of reorganizing our cargo methods to achieve greater efficiency.

"Apart from such basic considerations as I have outlined, the development of our Argosy freighter operations into an economically successful enterprise will require the continued understanding, co-operation and enthusiasm of our flying staff. Fortunately, there have always been those amongst you who seem to prefer freighter flying, and such crews have always shown an admirable spirit of enthusiasm and a practical interest in the various aspects peculiar to this type of operation. I believe that air freighting will have to develop more and more into a specialized operation if we are to succeed in a big way—which is exactly what we mean to do. That is why we have decided to set up a separate Argosy Flight once we have the five new aircraft, and this will come under the management of Capt H. A. Hooper. It will of course be a small flight, at least to begin with, but that in itself may well be a very good thing. It should help to ensure that the Argosy pilots will be able to play their full part in the successful development of our freighter policy, which is becoming an increasingly important part of our business."

*This Constellation was due to be auctioned at Schwechat airport, Vienna, at the end of last month following its impounding by the Austrian authorities, who alleged that they were owed £14,000 by the owners, Aero Transport. This company was in the news in Britain three years ago when a Constellation flown by a Falcon Airways crew was banned from operating into Britain. Aero Transport have since operated charter and inclusive-tour flights from Austria to Mediterranean resorts*

# Straight and Level

IS the British public not grown up or adult enough to be told, so that they can discuss it, how much extra the longer-range Concord is going to cost them—i.e., you and me, mate, the taxpayers? Is it £35? £35,000? £350,000? More like £35,000,000, says one Sunday newspaper.

The worrying thing isn't the money itself, though it is rather a lot. It is that the Ministry of Aviation says it hasn't yet got an estimate.

● Public subsidy of aviation is now so vast that there is a tremendous market for ideas on how it can be reduced. Here is a new one. Shame.

I quote from a speech made some little while ago by the administrator of the American FAA, Mr Najeeb Halaby, on the subject of Uncle Sam's SST:—

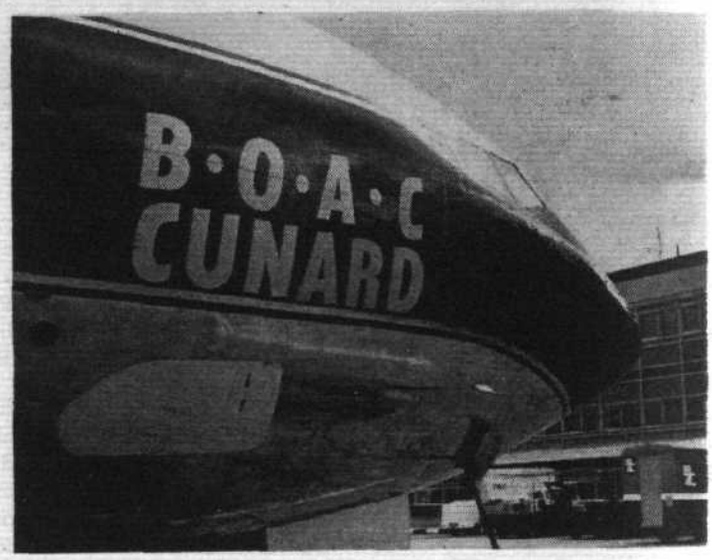
"*If our government takes all the risks the character of the aircraft industry would move towards some kind of nationalization, a trend none of us would willingly accept in view of our traditions, our convictions, or the remarkable record US industry has compiled free and on its own.*"

He went on to say that if the US aircraft industry refused to take any risk at all on the SST it was questionable whether the taxpayer should be called upon to do so. "If industry refuses to back our horse" he says, "we might well judge that in spite of our past expectations, we had a loser."

● Warning that BEA's £3m profit last year may be substantially down this year, Mr Anthony Milward says that the Trident's introductory costs could amount to £10m.

This is more than double the cost of introducing the Vanguard, which was BEA's most troublesome new aircraft to run in.

*Quote from this column for April 9: "My guess is that all we shall ever see of BOAC-Cunard are some tiny letters over the aircraft door . . ."*




The Trident was designed exactly to BEA's specifications for an ultimate competitive European jet. As it goes into service I think perhaps BEA ought to be talking about how much more money it is going to earn rather than how much more it is going to cost.

* * *

**Our BEA fare increases correspondent,** commenting on reports that the corporation is planning to increase European as well as domestic fares, writes: "This is absolutely splendid news!"

● BALPA, the British pilots' trade union, claims that independent-airline pilots who fly the same sort of aircraft types on the same sort of scheduled routes as BOAC and BEA pilots should be paid the same sort of salary—and not up to £1,000 less per man.

The independents say they cannot afford it. I think they can—in fact, between you and me and the instrument panel most independent airlines are making an absolute mint of money.

So long as they all refuse to publish audited revenues and costs in as much detail as do BOAC and BEA you can count on it they're doing very nicely thank you.

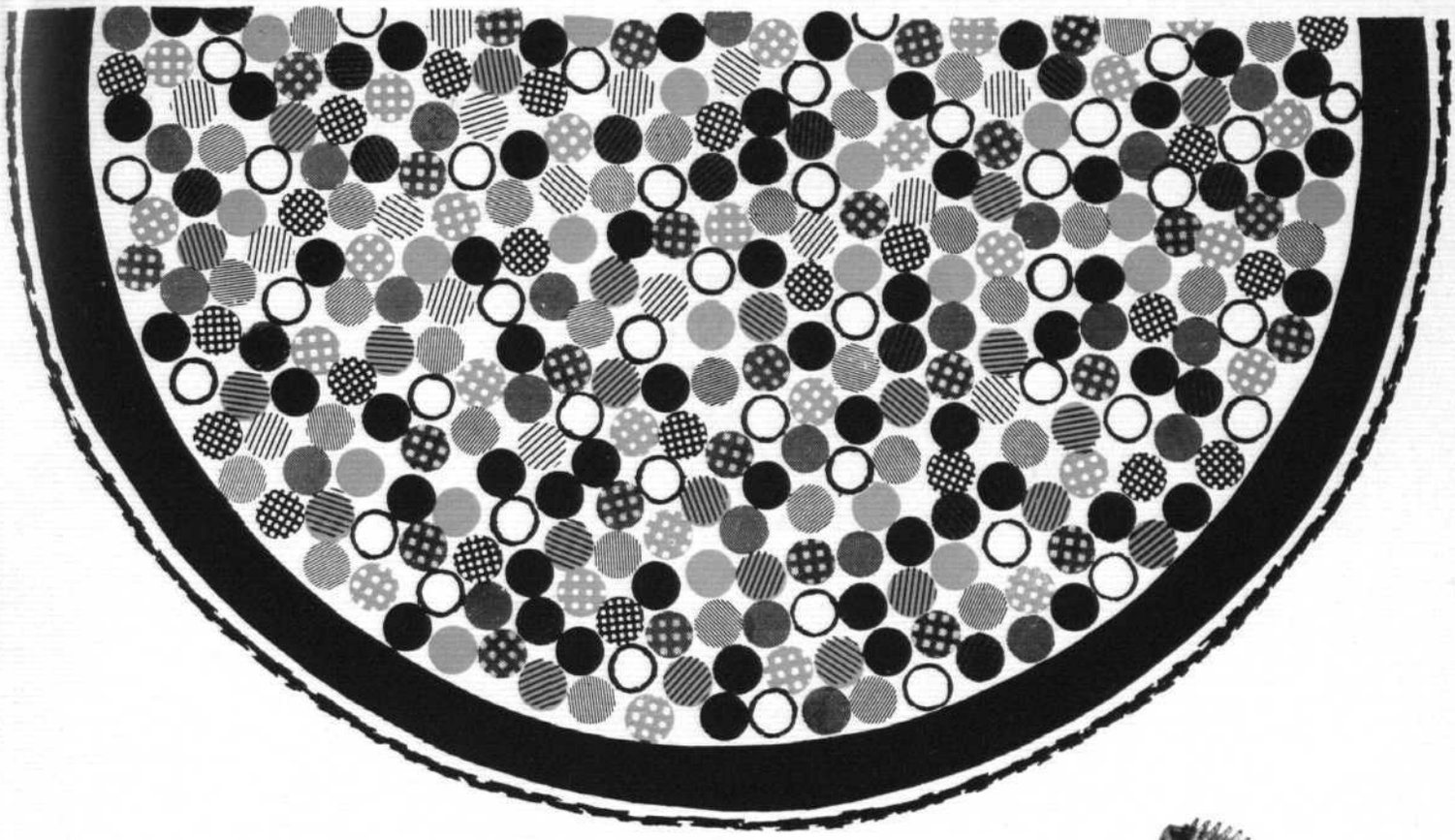
● *Stewardess No 1:* "Look there's that kind old grey-haired man again."
*Stewardess No 2*: "Which one?"
*No 1*: "That one. You remember. He gave us a tip last time."
*No 2*: "He didn't, did he?"
*No 1*: "Yes, it came in second."

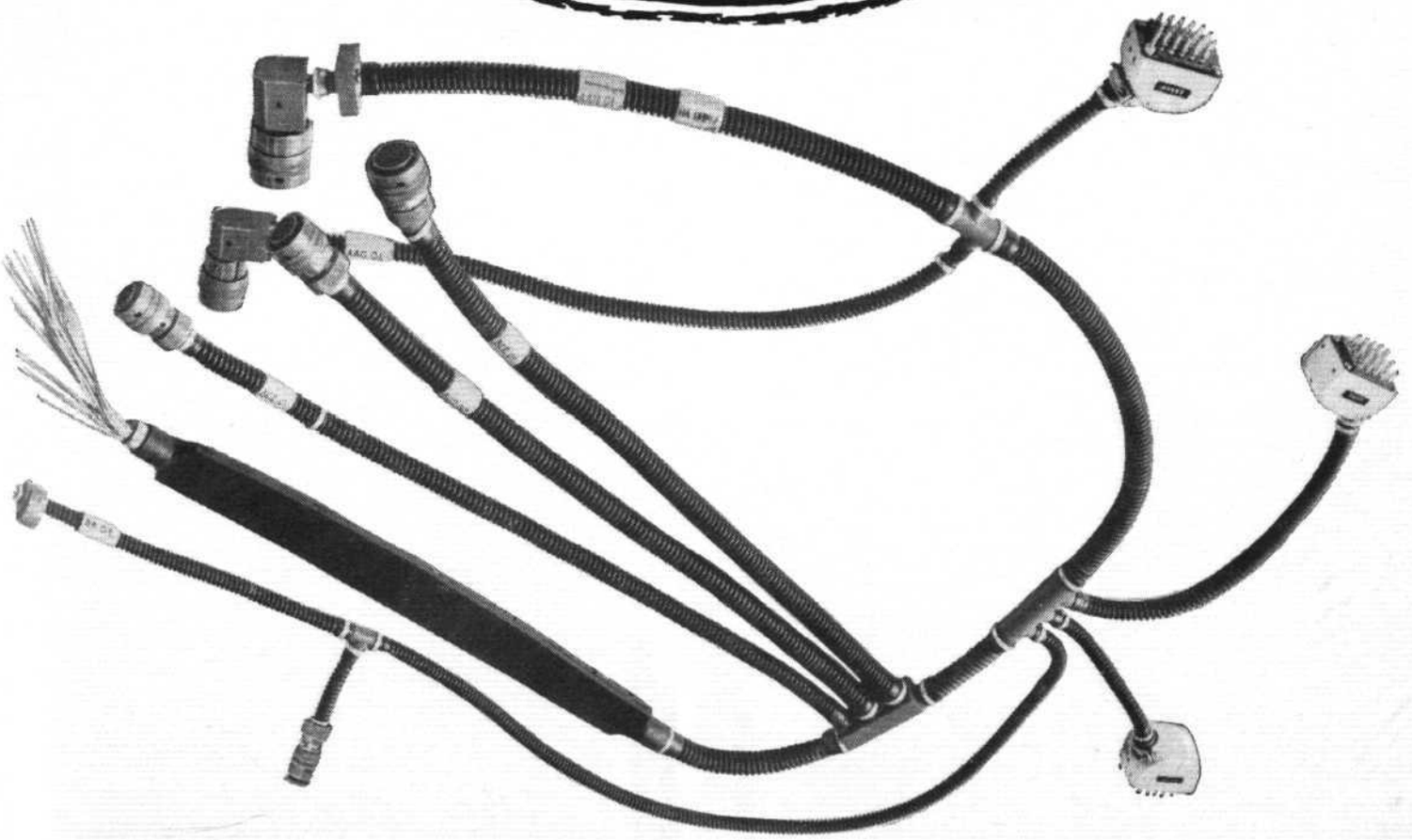
ROGER BACON

*Are you . . .*


*. . . all right?*

*Left, Mr A. G. Reynolds on the Martin Handasyde hangar at Brooklands, October 1910, "timing the flyers" in the Neill Cup competition. Right, Latham's Antoinette on the same hangar, Whit Monday, 1911*





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# SUPER frelon

The SUPER FRELON, developed by SUD AVIATION, is a three-turbine helicopter of 26,500 lbs gross weight.

It can carry, in addition to crew, 30 passengers over 270 n.m. at 130 knots, and incorporates all latest refinements.

Its triple-turbine concept, outstanding performance and ease of handling, make it ideal for all civil and military missions, under all weather conditions, by day and by night.

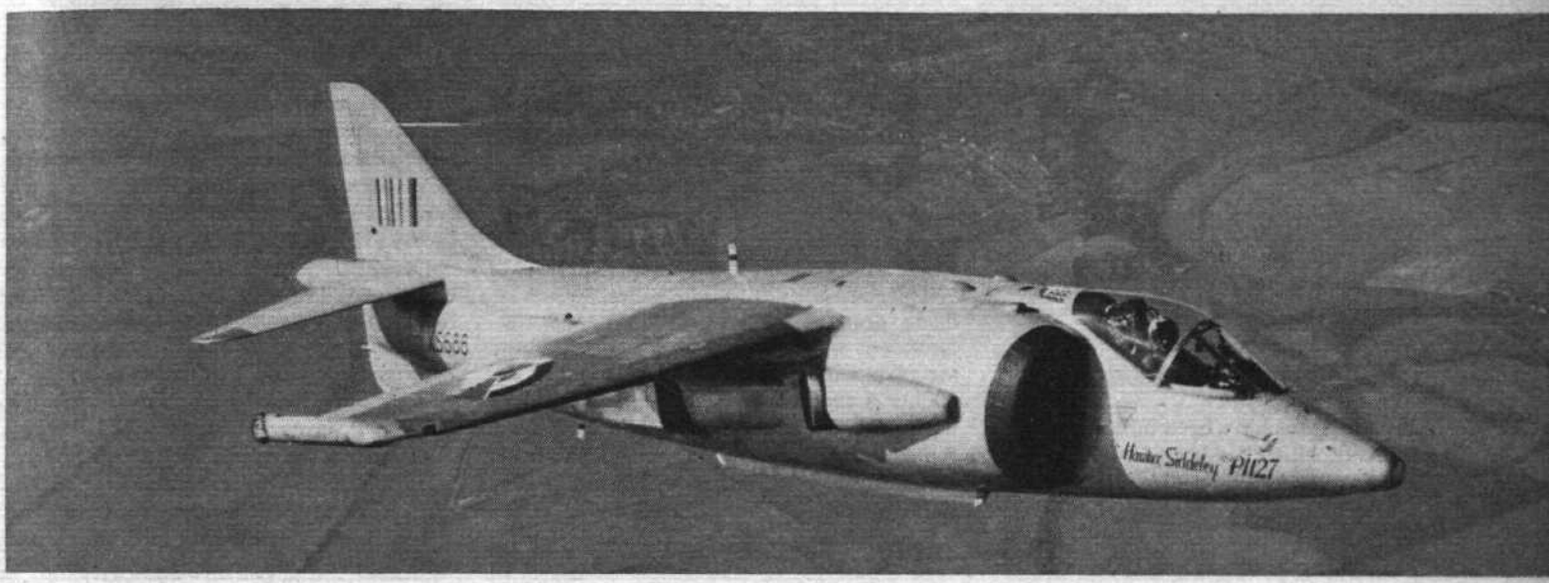
On July 22 and 23, 1963, the SUPER FRELON set 3 international records :

- Speed record over a 3-km course, at limited altitude, with 341.18 km/hr (approximately 212 m.p.h.)
- Speed record over a 15 to 25 km course, at unrestricted height, with 350.29 km/hr (approximately 218 m.p.h.)
- Speed record over a 100-km closed circuit, with 334 km/hr (207 m.p.h.)

# SUD AVIATION

37, BOULEVARD DE MONTMORENCY - PARIS XVI[e] - 224. 84. 00

# VTOL




Hawker Siddeley P.1127

# AIRCRAFT 1964

SURVEY COMPILED BY JAMES HAY STEVENS

**AS the practical helicopter completes its first quarter-century it is possible to see an apparent parallel with the aeroplane's development over a similar period. In both cases cruising speeds fairly soon reached 100 m.p.h., but then remained there while loads increased from a handful to some three-dozen passengers. Then there came a performance jump to 150 m.p.h., which the new helicopters are also now making, without sacrificing payload. Two hundred miles an hour (brought by the low-wing monoplane with retractable undercarriage) is now in sight with the latest free-turbine helicopters with autostabilization and off-loaded rotors. Rotor drag would seem to be the factor restricting further rises in speed and payload/range. From here on the VTOL aeroplane becomes the more efficient vehicle. But who can say whether the tilt-wing or the tilt-propeller (with or without ducts) will prevail in the medium-performance bracket? Or at high speed, will it be direct jet lift (supplementary lift jets, deflected or tilted thrust), or fan lift, or induced lift? The technology is here, the different compromises between weight, bulk, complexity and fuel consumption are many—and there are nearly as many proponents. In these pages we describe all major VTOL aircraft of which details are known.**

## GREAT BRITAIN

### Beagle Aircraft Ltd

*75 Victoria Street, London SW1*

**Beagle WA.116** This one-man autogyro, based on the Bensen Gyro-Copter, was largely redesigned by Wg Cdr K. H. Wallis, who was determined to achieve a stable aircraft which could be flown "hands and feet off," with an unstallable rotor and handling characteristics akin to those of an aeroplane. The effectiveness of this development has been proved by fixed-wing pilots, who have flown solo without even a preliminary ground taxi run. The Wallis prototype G-ARRT was taken over by Beagle Aircraft and the hand-made structure engineered for factory production.

Control is by conventional aeroplane-type stick and rudder pedals, there being no torque to overcome, since the rotor rotates freely in flight. The 72 h.p. Enfield/McCulloch flat-four engine drives a fixed-pitch pusher propeller and is also used to spin-up the rotor through a flexible drive. The airframe is made mainly of light-alloy tubing, with wooden rotor blades and fabric-covered fin and rudder surfaces. The tricycle undercarriage has brakes on all three of the identical wheels to hold full engine

Beagle WA.116

## VTOL AIRCRAFT 1964...

power for rotor spin-up. A light streamlined nose can be fitted.

Seven WA.116s have been built for initial trials, one of which has been bought by the British Army, and they are operating on Permits-to-Fly. A programme has been started to develop the engine to ARB Civil Airworthiness Standards so that a full C of A can be obtained. Beagle Aircraft is doing market research and stimulating interest in the civil WA.116: one was exhibited in Bulawayo earlier this year and another will be shown at the British Exhibition in Sydney later this year.

*Rotor dia, 20ft 2in; length, 10ft 3in; height, 6ft 1in; empty weight, 258lb; max weight, 550lb; max speed, 65kt; normal cruise, 50kt; min level speed, 12kt; min descending forward speed, zero; climb, 1,000ft/min; endurance, over 2hr; max operating wind speed, 43kt.*

### Hawker Siddeley Aviation Ltd

*18 St James's Square, London SW1*

**HS.681** The Coventry factory of the Avro Whitworth Division of HSA has been given a full development contract for this V/STOL military transport to replace the Beverleys and Hastings of the RAF. The project (which was originally called the Whitworth Gloster AW.681 and met a RAF operational requirement) was the subject of political contention and delay (partly over alternative Bristol Siddeley or Rolls-Royce engines) for some two years until, in the Defence White Paper this spring, it was announced that the HS.681 will be built with four Rolls-Royce Medways of some 17,500lb thrust. These engines will be fitted with thrust deflectors (developed from the R-R reversers) and the moderately swept high-aspect-ratio high wing will be fitted with the latest high-lift devices—presumably powerful flaps plus boundary-layer control. In this form the HS.681 is a short-take-off tactical transport. With the addition of lift-jet pods on the wing the aircraft will be able to achieve VTOL with an appreciable payload.

The specification to which the HS.681 is being designed is very exacting, and the aircraft is said to have a payload of about 40,000lb, with a range of some 1,500 n.m. at 500kt. A capacious fuselage, with rear loading under the high tail, will take most current and projected military vehicles and there will be the usual provision for air drops, paratrooping and casualty evacuation.

**P.1127** The origin of this, the original vectored-thrust VTOL aeroplane, goes back to an idea propounded by Michel Wibault for the use of the Bristol Orion to drive lift fans. By 1956 this idea had gained US MWDP support and was in the capable hands of Dr Stanley Hooker of Bristol Aero Engines; he produced a special powerplant proposal by May 1958, which got a MWDP contract (for 75 per cent of the cost) by March 1959—and the first Bristol Siddeley Pegasus was on the bench in September.

In 1957 Sir Sydney Camm of Hawker Siddeley discussed the engine with Dr Hooker and, as a company-financed PV, the design of the P.1127 went ahead in parallel with engine development; prototype construction started early in 1959 and the first hover took place on October 21, 1960, with transition in September 1961. In January 1963 Hawker Siddeley announced that a technical collaboration agreement had been reached with the Northrop Corporation for VTOL aircraft development.

Six prototypes of the P.1127 have been built for the MoA by the Hawker Blackburn Division of HSA. These have been used for extensive development flying at the RAE, in the RAF and at the company's airfield at Dunsfold. Trials included deck landings on, and take-offs from, HMS *Ark Royal*. Nine further aircraft are being built with joint British, American and German funds and a three-nation squadron will be formed at West Raynham this year. With this squadron the operation and logistics of VTOL tactical flying will be intensively evaluated.

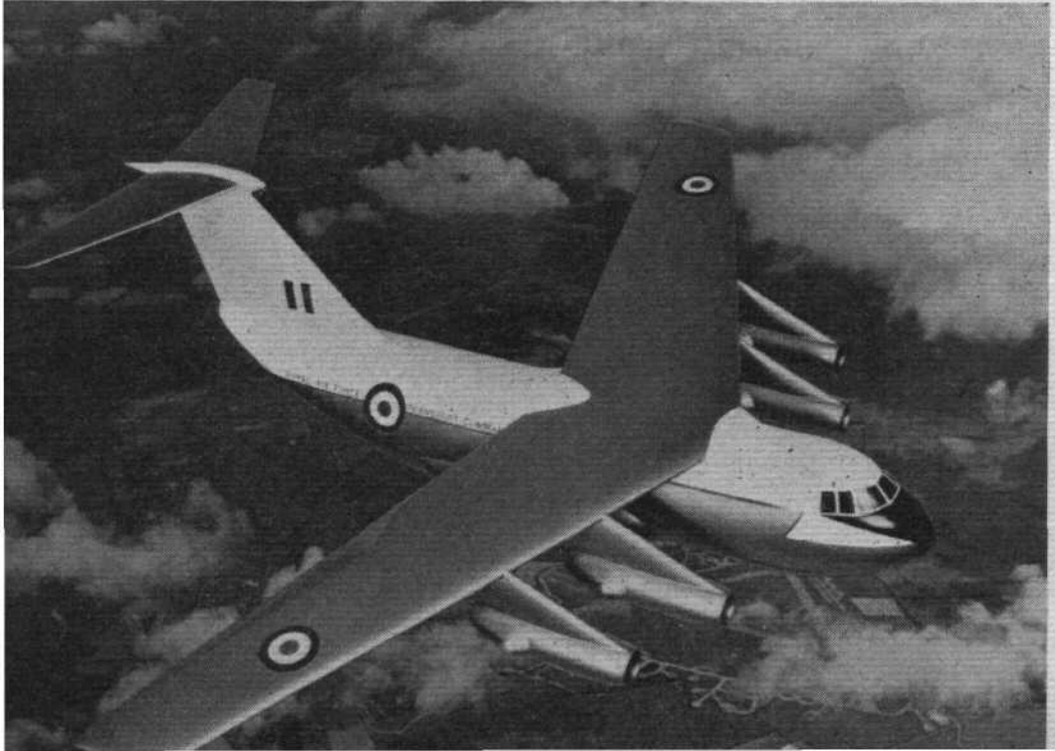
Designed from the start not as an experimental prototype but as a fully operational strike/reconnaissance fighter to replace the Fiat G.91 or the Hunter, the prototype P.1127 had a 13,500lb-thrust engine, while the development aircraft have a later Pegasus delivering greater thrust. Performance is similar to that of the Hunter, Mach 1 can be exceeded in a shallow dive, and recently it was stated that the ferry range, using conventional take-off, is 2,000 n.m. Much is made by the vectored-thrust proponents of the advantages of STOL take-off when the aircraft weight exceeds the thrust. the ability to do engine power checks with nozzles horizontal, and the use of short ground rolls at take-off and landing, where debris might be blown up and ingested by the engine.

In the P.1127 the conventional stick and rudder bar operate the wing-tip, nose and tail jet valves (shutters) when the ailerons, elevator and rudder are deflected. The control jets are supplied by compressor bleed air and they are directed downward, although the tail jet also swivels to give a yawing moment when the rudder is deflected. A lever alongside the throttle gives deflection of the by-pass fan and turbine efflux nozzles. As the nozzles are rotated downward they provide an upward thrust component evenly balanced about the c.g., and this has the effect of reducing the wing loading. Fully deflected, all the lift is provided by the thrust and the aircraft can then move around like a helicopter, e.g., it can travel forward by tilting the nose down to get a propulsive component. For deceleration into jet-supported flight the nozzles are turned slightly beyond the vertical and the nose is lifted. The P.1127 is normally flown without autostabilization throughout the range from hovering to wing-supported flight and back again.

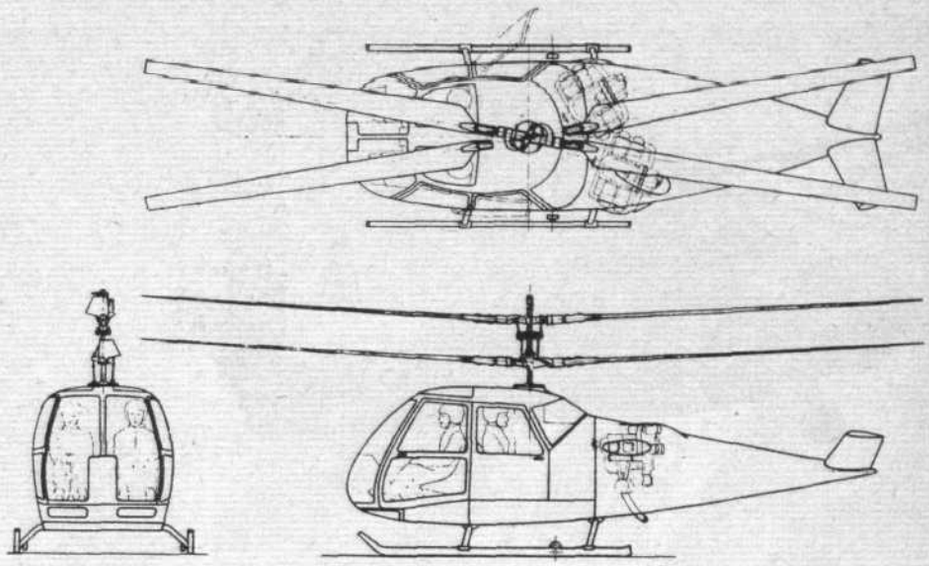
For the tripartite squadron the P.1127 has been slightly modified: the tailplane has marked anhedral, the wing trailing edge is swept back, the nose has been extended, the fuselage over the wing is slightly humped and the engine air intakes have been altered to tidy the boundary-layer bleed and improve cockpit entry. The inflatable intake-lips, which ensure a good air mass flow at zero and low speeds, have been retained. Large underwing containers of fuel or military stores can be mounted on a pylon under each wing.

*Span, 23ft 4in; length, 42ft; height, 10ft 9in; tail span 11ft 10in.*

*Hawker Siddeley HS.681 (artist's impression)*



**P.1154** This supersonic development from the P.1127, with the 30,000lb-plus thrust Bristol Siddeley BS.100, was to have replaced the ground-attack Hunters in the RAF and the Sea Vixens and Scimitars of the Royal Navy; but, because it was not possible to better a proportion of 60 per cent common parts, the Navy persuaded the MoA to cancel its participation. Throughout, the programme has been bedevilled and delayed by political and Service indecision. The P.1154 was confirmed in the 1963 *Statement on Defence* as being on order for the RAF and the RN and parts for the prototype were made during last year; but this year the Minister of Defence's only indication of progress was that development had been sanctioned for the RAF alone, without stating how many were on order—there is as yet no production order. A new feature in the P.1154 will be the use of plenum-chamber burning (similar to reheat, but in the ducted-fan outlet) with the BS.100 to give a M2-plus performance and for overload VTO.



Rotorcraft Grasshopper

### Rotorcraft Ltd

*3 Bedford Square, London WC1*

**Grasshopper** Rotorcraft Ltd is a marketing company jointly owned by the Mitchell Engineering Group and Servotec Ltd, the latter being the ARB design-approved company which, under the leadership of Mr J. S. Shapiro, is developing this twin-engined light helicopter. The aim is to sell a two-seater with twin-engined safety which will have a practical range of 200-250 miles at 100 m.p.h. A first prototype with 65 h.p. Walter Mikron engines flew in March 1962 and a more elaborate cabin machine with 105 h.p. Walter Minor engines in November.

These aircraft were intended to prove the aerodynamics and mechanics of the co-axial contra-rotating rotor system. This type of rotor has the advantages that all the engine power goes into the lifting system and that the weight and cost of a tail-rotor drive are eliminated. It is claimed that economics extend from reduced first cost to lower maintenance costs, while the simplicity means a safer fail-safe construction and good flying and handling characteristics. The use of two engines geared individually to the contra-rotating drive ensures independent operation in case of failure and level flight can be maintained on one.

The two-bladed rotors are semi-rigid and are suspended on see-saw hinges, pitch being changed by rotation about a torsion hinge. To obtain yaw control the collective pitch of the two rotors is altered in the opposite sense, thereby unbalancing the torque and causing the aircraft to turn by reaction.

In the prototype Grasshoppers the cabin was aft and the engines forward of the rotor, under a bonnet. The definitive model has a more conventional glazed cabin, which can carry up to four, with the two engines mounted horizontally aft and coupled to the rotor by a right-angled bevel drive. Rotor blades are of wood and the fuselage is mainly stressed skin, apart from the framework of the glazed areas. Butterfly tail surfaces in the downwash are used for yaw and pitch stability and trim. The landing gear consists of fixed skids, with energy absorption in the supporting legs, and retractable ground handling castor wheels. The 100 h.p. Rolls-Royce Continental O-200A, the 125 h.p. O-240-A, or the 125 h.p. Franklin 4A-235 are offered.

*Rotor dia, 27ft; length, including rotor, 27ft; fuselage length, 18ft; height, 8ft 10in; skid track, 6ft 3in; 100 h.p. (125 h.p.) engine, max weight, 2,460lb (2,880lb); empty weight, 1,312lb (1,420lb); max speed, 102kt (108kt); max rate of climb, 1,085ft/min (1,185ft/min); typical range, 175 n.m. (220 n.m.).*

### Short Brothers and Harland Ltd

*Queen's Island, Belfast, Northern Ireland*

**SC.1** This was the first British jet-lift aeroplane to fly, and it was the first multi-engined one in the world. The programme followed directly from the Rolls-Royce Flying Bedstead and was closely connected with Dr A. A. Griffith's proposals for a supersonic jet-lift bomber/airliner. The development programme, both of the airframe and of the engines, has suffered throughout from a very restricted budget. Nevertheless, the first SC.1 has been flying for four years and for the past two has been used at RAE Bedford, for basic research into the desirable control characteristics of this type of aircraft. It was this SC.1 which was assessed by American pilots from NASA and French pilots from the CEV at Brétigny and Marcel Dassault. The second SC.1 was modified to take a new type of autostabilizer as a step toward developing a fully-automatic vertical blind-landing system.

In the original SC.1 system the autostabilizer monitored the thrust of the control jets, but it was primarily a damper and the pilot had to deal with gusts and turbulence. The new system incorporated attitude gyros, so that the aircraft was, in effect, a stabilized platform. The new system, like the original one, was triplicated, so that a failed line would be "out-voted" and the aircraft would be safe. However, on October 2, 1963, after tethered testing and 81 free flights, this SC.1 crashed off a turn at low altitude and the pilot was killed, although the aircraft was repairable. The fault was traced, through the flight recorder, to a vertical-reference gyro. The fault was signalled correctly; but when the pilot tried to cage the system it ran away and the autostabilizer followed the false reference and rolled the SC.1 into the ground. The caging fault, which could only occur under a very limited range of conditions, has been eliminated.

Layout and construction of the SC.1 are familiar (a detailed description was given in *Flight International* for June 10, 1960), but it may be worth recalling that the aircraft is powered by four 2,130lb-thrust Rolls-Royce RB.108 lift jets, with a fifth for propulsion. It is not a high-speed aeroplane but one intended for hovering, transition, stability and control research. Nevertheless, the delta wing, with a 10 per cent thick section and 54° sweep, is representative of the slow-flying behaviour of a high-speed aircraft.

*Span, 23ft 6in; length, 29ft 10in; height, 10ft 8in; gross wing area, 211.5 sq ft; fuel capacity, 220 Imp gal; max take-off weight, VTO, 7,800lb; conventional, 8,050lb; max landing weight, normal, 6,800lb; emergency, 7,800lb; max level speed, 200kt; max dive speed, 300kt; cruise, 190kt.*

### Westland Aircraft Ltd

*Yeovil, Somerset*

**Belvedere** The Bristol Helicopter Division of Westland Aircraft completed the contract for 26 twin-engined, tandem-rotor Belvederes for the RAF in 1962. Three squadrons, No 26 at Aden, No 66 at Singapore and No 72 in England, are equipped with it, and the type has seen arduous active service in many theatres. The aircraft is classed as a "helicopter, cargo" and can fly on either of its 1,650 s.h.p. Napier Gazelle Mk 101 free turbines. Up to 30 passengers—more normally, 19 troops, 12 stretcher cases or 6,000lb of cargo—can be carried. Flying controls are powered and there is provision for an autopilot, while night flying instrumentation is standard.

*Rotor dia, each, 48ft 11in; fuselage length, 54ft 4in; height, 17ft 3in; max (overload) weight, 20,000lb; empt, weight, 11,635lb; max cruise, 120kt; max-endurancy cruise, 65kt; max rate of vertical climb, s.l., 480ft/mine hover ceiling outside ground effect, 6,000ft; max range; normal tankage, 385 n.m.*

*Westland Wessex Mk 52 (Iraqi Air Force Mk 2)*

## VTOL AIRCRAFT 1964...

**Wessex 1, 3, 31** The Wessex comes from the Yeovil Division and these mark numbers are the Service definitions of the original S-58 modification with a single Napier Gazelle free turbine. The HAS.1 (helicopter, anti-submarine) is powered by the 1,450 s.h.p. Gazelle Mk 161 and has been operational with the Royal Navy since the summer of 1961. The Wessex HAS.3, with the 1,850 s.h.p. Gazelle NGa.18, has been developed as a possible replacement for the HAS.1—probably by re-engining at overhaul as was done with the Whirlwinds. For the 27 Royal Australian Navy aircraft, with the 1,540 s.h.p. Gazelle 162, the designation Wessex 31 was allocated.

With a payload up to 4,000lb, the anti-submarine Wessex carries sonar dunking equipment in the fuselage and two homing torpedoes slung one on each side. Alternatively, the cabin will take 16 fully-equipped troops or eight stretcher cases; while in the Commando role four Nord SS.11 teleguided missiles on booms, and a complement of marines, are carried. The missiles can be fired by a marine sitting alongside the pilot or they can be unhooked after landing and deployed with the raiding party. The Wessex is fitted with auto-stabilization and autohover equipment for all-weather operation.

*Westland Scout*

Royal Navy units with the Wessex HAS.1 are No 815 Sqn in HMS *Ark Royal*, No 814 Sqn in HMS *Hermes*, No 824 Sqn in HMS *Centaur* and No 845 Sqn in HMS *Albion*. The aircraft can be adapted from the anti-submarine to the Commando role in a very short time, simply by removing the electronics and bolting on the weapon booms.

*Wessex HAS.1: rotor dia, 56ft; length, 65ft 10in; height 14ft 3in; max weight, 12,600lb; empty weight, 7,600lb; max speed, 115kt; max vertical climb, s.l., 750ft/min; hover ceiling, o.g.e., 5,000ft; max range, normal tankage, 300 n.m.*

**Wessex 2, 5** The HC.Mk 2 is the version which is being delivered in quantity to the RAF and, like the Royal Navy's Mk 5, it is powered by the Bristol Siddeley Coupled Gnome H.1200. This is the twinned anglicized version of the General Electric T58 and has a potential output of 2,500 s.h.p. Since the rotorhead is limited to an input of 1,550 s.h.p. the difference in capacity is available to maintain power under hot and high conditions. If one engine stops, the power of the other will increase automatically up to the emergency rating of 1,350 s.h.p.

In the Royal Navy, the Wessex 5 is to replace the Whirlwinds for assault duties in the Commando carriers *Albion* and *Bulwark*. Deliveries began in December 1963.

*Wessex HC.Mk 2: dimensions as Mk 1; max weight, 13,500lb; empty weight, 8,050lb; max speed, 108kt; max rate of vertical climb, s.l., 430ft/min; hover ceiling o.g.e., 10,800ft; max range, normal tankage, 280 n.m.*

**Whirlwind** Main production, at the Yeovil Division, of the British version of the S-55 is now concentrated upon the turbine-powered models, although the piston-engined Series 2 with the 750 h.p. de-rated Alvis Leonides Major 755 can still be supplied. Something like 500 Whirlwinds have now been built. The Series 3 is powered by the 1,050 s.h.p. Bristol Siddeley Gnome H.1000 free turbine (torque-limited to the rotorhead capacity) and can be supplied either as a new airframe or as an engine installation modification—the original piston-engine gearboxes and transmission of the Series 1 (R-1340) and Series 2 (Leonides Major 755) remain.

Major production contracts for the Series 3 are for the RAF. The HAR.Mk 10 (helicopter, air rescue) aircraft of Coastal Command are already a familiar sight in their yellow paint, and with their distinctive booming drone, around the coast resorts of Britain. Many of these helicopters are converted Series 1 or 2 airframes. In Transport Command the same mark is camouflaged and is used to carry supplies and assault troops for the Army. After successful preliminary trials with mountings for four Nord SS.11 teleguided missiles an evaluation is being made to decide whether if it would be truly advantageous to arm the assault helicopters, or whether this would detract from their efficiency as transports.

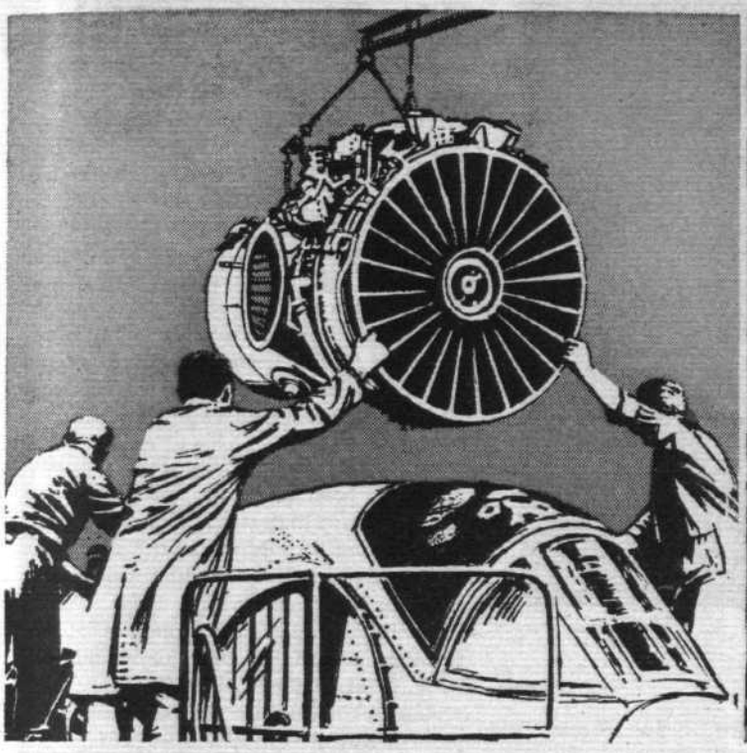
Half a dozen Whirlwind Series 3, one with a VIP interior, are operated by the Ghana Air Force, and Bristow Helicopters is a civil operator of the type.

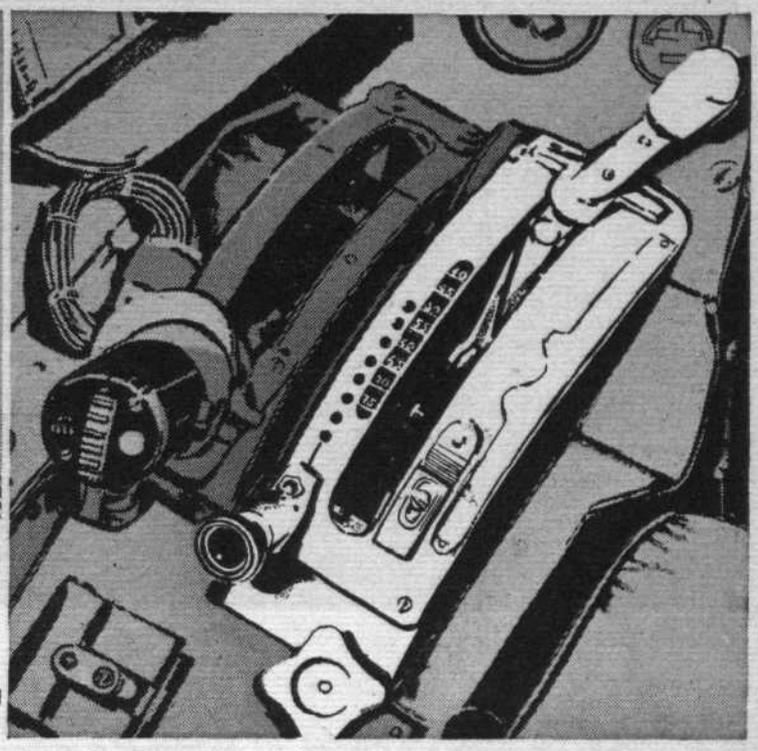
*Whirlwind Series 3: rotor dia, 53ft; fuselage length, 44ft 2in; height, 13ft 3in; max weight, 8,000lb; empty weight, 4,950lb; max speed, 95kt; cruise, 90kt; max rate of vertical climb, s.l., 265ft/min; hover ceiling o.g.e., 7,000ft; range, 275 n.m.*

**P.531 Scout/Wasp** The Fairey Aviation Division is now completely responsible for the development and production of this helicopter—which was designed by Saunders-Roe, also now a division of Westland Aircraft but engaged entirely upon hovercraft and rockets.

Versions of the P.531 have been flying since July 1958, and the initial production model with the Bristol Siddeley Nimbus free-turbine since August of the following year. In the Army it is known as the Scout AH.Mk 1 and in the Royal Navy as the Wasp AS.Mk 1, and there are considerable differences in the airframes as well as the equipment. The land-based version has a skid undercarriage, with retractable handling wheels; a fin built into the crank of the tail boom; a low-set tailplane with small end-plates; and a tail-rotor skid. In the ship-based version (intended mainly for use from platforms on frigates) an elaborate undercarriage with four units carrying castoring wheels has been fitted to meet the difficulties of touching down on a heaving deck; there is no fin on the tail boom; the tailplane is mounted high and is on the starboard side only; there is no tail-rotor skid; and the end of the tail boom folds.

The structure of the Scout/Wasp is mainly of light alloy, with a stressed-skin fuselage "bath" containing the fuel tanks, upon which are mounted the flight deck superstructure and the horizontal fire deck which carries the engine. The stressed-skin "bath" has strong frames, or bulkheads, for the undercarriage, rotor pylon and tail boom. This last is a semi-monocoque tube. The four-bladed constant-speed main rotor has metal blades with torsion-bar suspension and a conventional hub with drag and flapping hinges. The rotor blades can be folded. The tail rotor is two bladed. The engine is a Bristol Siddeley Nimbus Mk 101 free turbine, which is torque-limited to 685 s.h.p. for the Wasp and 710 s.h.p. for the Scout. It is mounted horizontally, with the air intake at the base of the rotor pylon and the bifurcated exhaust aft. Power is taken from the free turbine by a spur reduction gear and transmitted forward by a shaft under the engine to a right-angled reduction gear at the foot of the rotor pylon. The vertical rotor shaft is in a casing which is





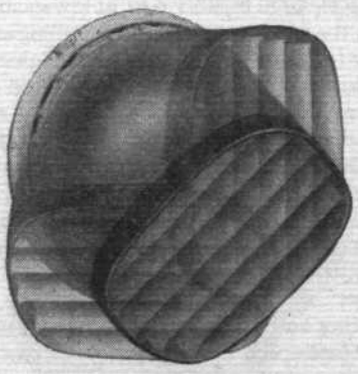
# Simplified V/STOL installation and control

## with Bristol Siddeley vectored thrust engines

Bristol Siddeley vectored thrust engines provide the simplest and most practical power systems for all V/STOL aircraft. The total thrust can be directed vertically for VTOL, at any required intermediate angle for STOL or in-flight manoeuvres, and horizontally for normal flight and for braking.

**Single Engined V/STOL Aircraft.** A high-performance V/STOL aircraft, requiring a very high thrust in normal flight, can be powered by a single engine and thus benefit from the resulting lower manufacturing cost, simplified maintenance and higher rate of serviceability.

**Forward Facing Intake.** Vectored thrust engines have air intakes facing forward in the orthodox way. They therefore avoid the problems and complications inevitable when separate lift and propulsion engines are used.



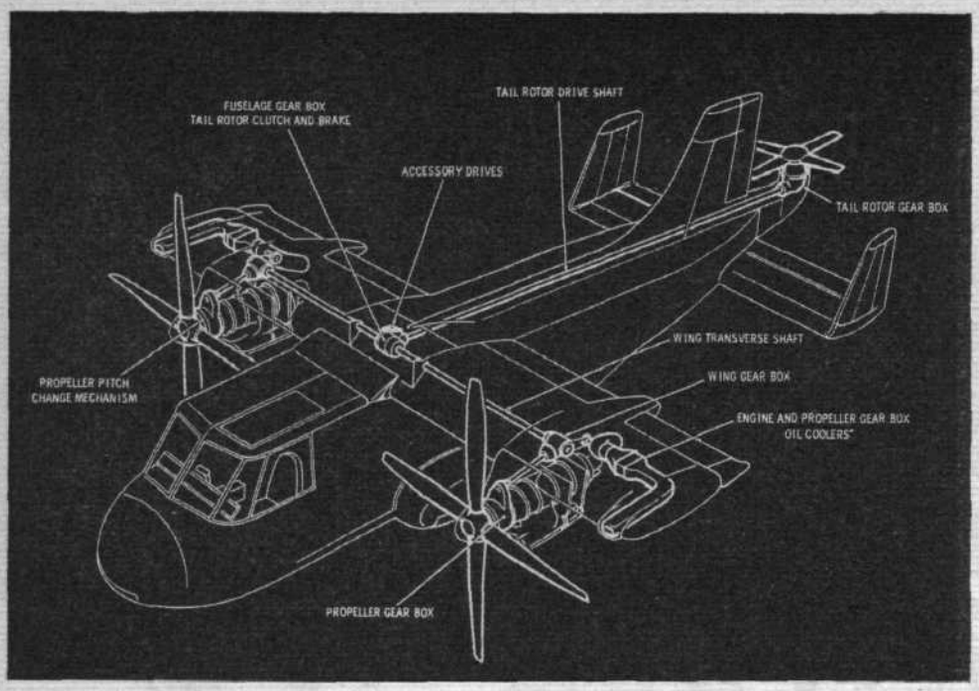
**Fixed Centre of Thrust.** Whatever the angle of the nozzles, the resultant thrust always passes through the same point. This can be arranged to coincide with the aircraft centre of gravity.

**Simplicity of Control.** Control of the engine thrust direction can be effected by a single lever control. This facilitates transitions and in-flight control and simplifies pilot training.

The Bristol Siddeley Pegasus, powerplant of the Hawker Siddeley P 1127, has been flying since October 1960 and has effectively demonstrated the advantages of vectored thrust engines over all other forms of V/STOL power.

Bristol Siddeley Engines Limited. Central Office: Mercury House, 195 Knightsbridge, London SW7, England.

BRISTOL SIDDELEY
SUPPLY THE POWER




*Canadair CL-84*

## VTOL AIRCRAFT 1964 . . .

braced to the engine deck by a system of tubes.

In the army version the Scout can carry up to four or five troops, two stretchers, or freight. Present British policy does not require fixed armament, such as missiles or machine guns, but these can be fitted. The naval Wasp can carry depth charges or homing torpedoes and anti-submarine search equipment. The RAN has taken delivery of several Scouts, one is used by King Hussein as a VIP transport, and the South African Navy is operating Wasps.

*Rotor dia, 32ft 3in; fuselage length, 30ft 5in; height, 8ft 10in; max weight, 5,300lb (Wasp overload 5,500lb); empty weight, Wasp, 3,384lb, Scout, 3,084lb; max speed, Wasp, 105kt, Scout 115kt; rate of vertical climb, s.l., Wasp 600ft/min, Scout, 730ft/min; hover ceiling o.g.e., Wasp 8,800ft, Scout 10,200ft; range, Wasp, 260, n.m., Scout, 275 n.m.*

## CANADA

### Avian Aircraft Ltd

*Georgetown, Ontario*

**2/180 Gyroplane** This two/three seater autogyro has been developed by a specially formed company on relatively little capital, but the moving spirit, Frank Rixen, is confident of continued progress. A first prototype flew in the spring of 1960 but was wrecked when taxying. A second flew on February 16, 1961 and in January of the following year the first of three pre-production demonstrators flew. By the end of 1963 over 300 hours' flying had been done and C of A tests should be completed early in 1965, after which production should follow.

The Avian is a sleek little aircraft with a truncated fuselage whereon the tail surfaces have been replaced by an annular duct shrouding a fixed-pitch pusher propeller. The structure is of welded steel tube and light alloy. The flat-four 180 h.p. Lycoming O-360-A is used to spin up the rotor, through a vee-belt and shaft drive, sufficiently to give a jump-start take-off. The three-bladed rotor has blades with steel tube spars, wood core and glass-fibre covering. To give the jump-start technique there is a collective-pitch lever, so that the rotor can be accelerated to 300 r.p.m. at low incidence, then the pitch is increased by pulling up the lever (which also declutches the engine) and the aircraft jumps off with the stored rotor energy. Normal rotor speed is 240 r.p.m. and the best performance is obtained at mid-incidence. The stick controls pitch and roll by tilting the freely rotating rotor, with pedals actuating a rudder in the propeller duct. A slender fixed tricycle undercarriage is fitted. Anticipated improvements are a larger diameter rotor, to reduce disc loading and improve climb, and a Hartzell constant-speed propeller, so that more power would go into the rotor spin-up with prospects of a 50ft jump.

Canadian and US military authorities have had demonstrations of the Avian and independent pilots have spoken of it as an "exhilarating" aircraft. The company considers there is a market for several hundred Avians at $17,000-$20,000.

*Rotor dia, 33ft; fuselage length, 16ft 2in; height, 8ft 11in; max weight, 1,800lb (overload 2,200lb); empty weight, 1,200lb; max speed, 113kt; cruise, 87-95kt; min level speed, 22-26kt; climb, 400ft/min; normal range, 335 n.m.*

*Avian Gyroplane*


### Canadair Ltd

*Cartierville Airport, Montreal, PQ*

**CL-84** The research programme behind this VTOL/STOL aircraft dates from 1956 and it has been financed jointly by Canadair and the Canadian Department of Defence Production. By early 1963 Canadair felt sufficiently confident in the results of their model and rig tests to submit a design study of the CL-84, suggesting that the research aircraft should also be a practical prototype for a utility transport and combat support aircraft. The scheme was approved and two prototypes are being built at a cost of $10m —a quarter of which is being subscribed by Canadair. One is scheduled to fly in mid-1965, but the other will be a set of components for use as spares or for assembly as a second aircraft.

The CL-84 is a tilt-wing aeroplane with a box-like fuselage and low-aspect-ratio, parallel-chord high wing. This wing, which can be tilted through about 90° for vertical flight, carries two underslung nacelles with large-diameter propellers. The engines, 1,150/1,400 s.h.p. Lycoming T53 free-turbines, are coupled by a cross-shaft in the wing, from which shaft an extension drives a contra-rotating horizontal balance-and-control airscrew in the tail. The wing is rotated for vertical flight by a screwjack which lifts the leading edge from the top of the fuselage, and a slat across the centre section smooths the airflow over the tail.

In VTOL the three rotor/airscrews will be under constant-speed control and the aircraft will be guided by varying the incidence of the blades with power compensation. The wing is also fitted with full-span slotted flaps, and for STOL performance these will be used with partial tilting of the wing to obtain high lift coefficients through deflecting the slipstream (in a similar manner to that found in the Breguet 941). The tail rotor will also be used to counteract the unbalancing pitching moments as the wing tilts, which reach their maximum value during transition at about 30kt. The flaps will be used, with full-span leading-edge Krüger flaps, to give roll control. The latest sketches of the CL-84 show that the original single fin has been replaced by three fins and that the tailplane has been lowered in relation to the wing.

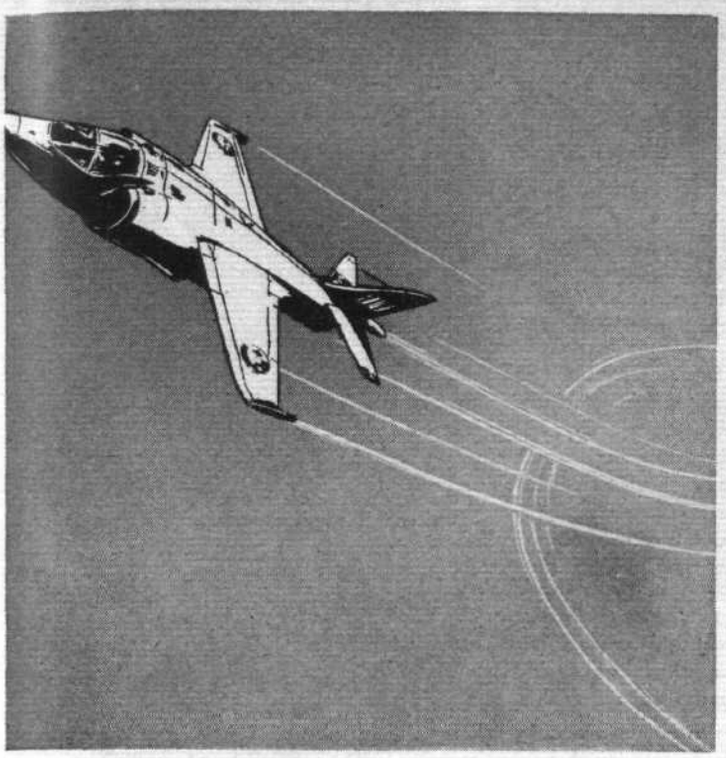
Considerable hopes are being pinned on the CL-84 system for a wide range of military and civil duties, with particular emphasis on tactical support, anti-submarine work and city-centre transport.

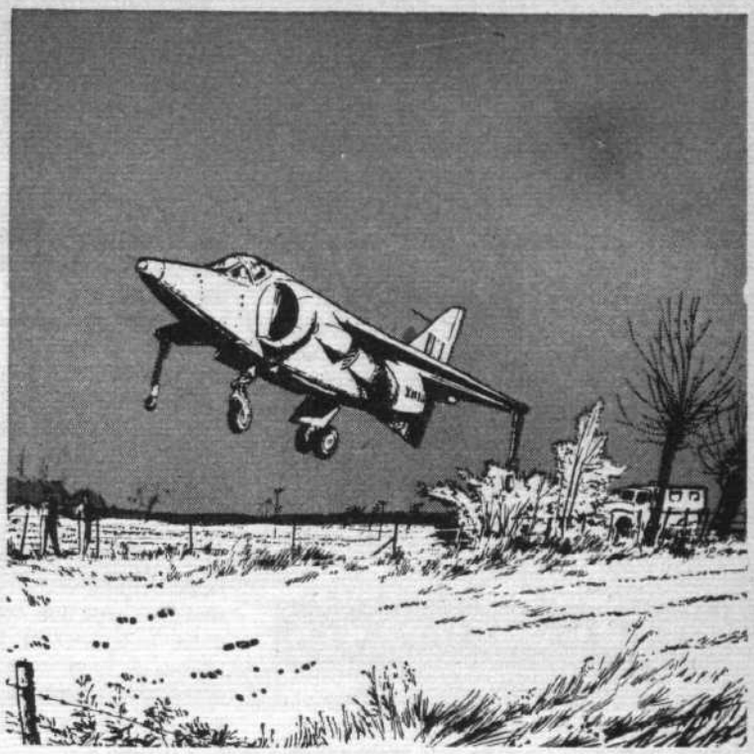
*Span, 33ft 4in; length, 45ft 6in; "rotor" dia, 14ft; max weight, VTOL 12,200lb, STOL 14,700lb; payload, VTOL 3,400lb, STOL 5,900lb; max speed, 285kt; cruise, 150-200 kt; normal range, VTOL 290 n.m., STOL 260 n.m. (STOL is defined as clearing 50ft in 500ft; all performance figures include 1,600lb fuel).*

### Joseph Pidek

*1165 West 14th Avenue, Vancouver 9, BC*

**J.P.2-B** This is a light two-seater helicopter which has been designed and built by an ex-Polish Air Force pilot. The main idea is to have a simple twin-engined helicopter with controls similar to those of a fixed-wing aeroplane. A prototype powered by two 50 h.p. Ariel motor cycle engines was being tested in the summer of 1963. The helicopter has a steel-tube fuselage with a light fairing and cabin; a three-bladed wood and glass-fibre main rotor; and a two-





# Better performance for V/STOL aircraft

## with Bristol Siddeley vectored thrust engines

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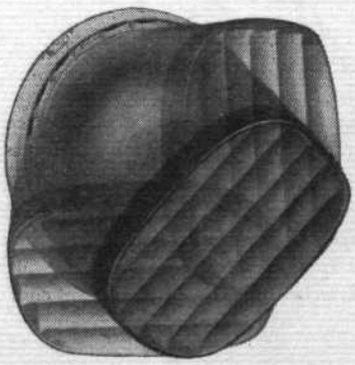
**Performance.** In fighters, all the thrust needed for VTOL can be used in normal flight. This allows for greater acceleration, faster rates of climb and greater speeds at high altitude than are possible with alternative V/STOL engine systems in which only part of the installed thrust is available. In other aircraft, the use of vectored thrust engines as the main powerplant reduces the number of separate lifting engines required and thus the dead-weight carried in normal flight.

**Manoeuvrability.** By directing the thrust of the engine at an angle to the line of flight, manoeuvres can be made more rapidly than is possible with aerodynamic aircraft controls only.

**Short Take Off and Landing.** By simply vectoring the thrust of the engine to the extent required, a significant overload of fuel or weapons can be carried wherever a short run is available.

**Thrust Reversal.** By directing the engine nozzles forward, 100% thrust reversal can be achieved.

The Bristol Siddeley Pegasus, powerplant of the Hawker Siddeley P 1127, has been flying since October 1960 and has effectively demonstrated the advantages of vectored thrust engines over all other forms of V/STOL power.



Bristol Siddeley Engines Limited. Central Office: Mercury House, 195 Knightsbridge, London SW7, England.

BRISTOL SIDDELEY

SUPPLY THE POWER

Dassault Balzac V-001



bladed glass-fibre tail rotor. Testing of the J.P.2-B has been suspended and a modified version of the control system, together with some other components, has been mounted in the Pi.4, which is at present being prepared for two 150 h.p. gas turbine engines. The designer is not prepared to release details until his patents have been granted.

*Rotor dia, 22ft 10in; fuselage length, 23ft; height, 7ft; weight empty, 760lb; max speed, 104kt; max rate of climb, 1,000ft/min; range, 350 n.m.*

## CZECHOSLOVAKIA

### Omnipol

*Washingtonova 11, Prague 3*

The only information obtainable is that no helicopters are in production and that no VTOL aircraft are contemplated. The 4/5 seater HC-3 and Z-35 Heli-Trener prototypes were briefly described in the 1963 Survey.

## FRANCE

### Generale Aeronautique Marcel Dassault

*46 Avenue Kleber, Paris XVIe*

**Balzac V-001** This application of VTOL by using a battery of separate lift-jets, as pioneered by Rolls-Royce, is an ingenious adaptation of the original Mirage III prototype airframe. The fuselage centre has been enlarged to hold eight 2,200lb-thrust Rolls-Royce RB.103 turbojets, mounted in coupled pairs fore and aft of the mainwheel recesses and pointing slightly aft and outward from the vertical. The engines are not swivelled to assist acceleration and deceleration; instead, extendable louvred intake and outlet devices assist the airflow and the efflux, while the aeroplane is tilted to provide accelerating and decelerating thrust components. Under VTOL conditions stability and control are maintained through duplicated wing jets (at about three-quarter semi-span), nose and tail jets, supplemented by tail side-jets for yaw, using similar auto-stabilizing equipment to that in the Short SC-1.

The original SNECMA Atar engine was removed and the smaller and lighter Bristol Siddeley Orpheus was substituted. Rolls-Royce co-operated with the installation and made model and full-scale mock-up wind tunnel tests on the air intakes and ducting.

Originally the Balzac was operated from a grille over a pit to get rid of the exhaust and avoid ingestion. Later a light platform with deflector cascades was used and, finally, deflector doors under the belly were tried successfully. The lift engines can now be run to half thrust with efflux deflected aft for control-jet checks, then opened up to full power and the brakes released. When the doors are fully opened the aircraft accelerates to 40kt and jumps vertically into the air.

The Balzac project was started in February 1961 and the first hovering flights were made in October 1962, with the first transitions during the following March. Many hundreds of successful flights were made before the aircraft crashed in an accident closely resembling the one which befell the SC.1—suggesting that there may be something in the rolling instability of the sharply swept thin delta wing which accentuates a temporary loss of control. The Balzac is repairable, but the whole programme has been static for several months.

*Span, 24ft; length, 43ft; gross lift thrust, 17,600lb; max VTOL weight, 15,200lb.*

**Mirage IIIV** The first of two prototypes should have been flying this spring; but at the time of going to press it seems that the programme has been finally abandoned because of its excessive cost. This is in spite of 1963 announcements that the Mirage IIIV would be the next fighter for the Armée de l'Air, that it would be in squadron service during the sixties, and that no attention would be paid to the NATO NBMR-3 specification.

The IIIV was to have been considerably larger than the standard fighter, with a necessarily broad (and unwaisted) fuselage to contain eight 4,400lb-thrust Rolls-Royce RB.162 lift jets. Propulsion was to have been by a 20 000lb-thrust Pratt & Whitney TF.105 turbofan built and developed by SNECMA to take an afterburner. The performance envelope was to have been of the order of Mach 1.15 at low altitude and 2.3 at height.

### Societe des Engins Matra

*49 Rue de Lisbonne, Paris VIII*

**Bamby** Upon his return from Spain to France in 1962 Jean Cantinieau took up his light helicopter work with Matra. Flight trials of the Bamby helicopter began in 1963. It has a conventional layout of bulbous fuselage, tail boom, three-blade main rotor and skid undercarriage, but also displays some unusual features. A 180 h.p. Lycoming is mounted vertically, and the tail rotor is replaced by a compressed-air nozzle which is fed from a fan driven by the engine exhaust.

*Rotor dia, 24ft 3in; max weight, 1,565lb, empty, 1,036lb; max speed, 86kt, cruise, 70kt; hover ceiling i.g.e., 10,000ft; endurance, 2hr.*

### Sud-Aviation

*37 Boulevard de Montmorency, Paris XVIe*

**SE 3130 Alouette II** At the end of March, 909 examples of this ubiquitous helicopter, which received its Type C of A on May 2, 1957, had been sold in 31 countries and the 886 already delivered had totalled 770,000 flying hours. Production continues at two per month. The Alouette is familiar throughout the world; but, briefly, it is a five-seater with a glazed cabin and a girder fuselage; undercarriage with rigid skids and retractable handling wheels; and a conventional rotor system with Redux-bonded all-metal three-bladed main and two-bladed tail rotors. The engine is the 406 h.p. Turbomeca Artouste IIc single-shaft turbine derated to 300 h.p. All the usual light helicopter duties, from missile launching to crop spraying, have been successfully performed by military and civil Alouette IIs.

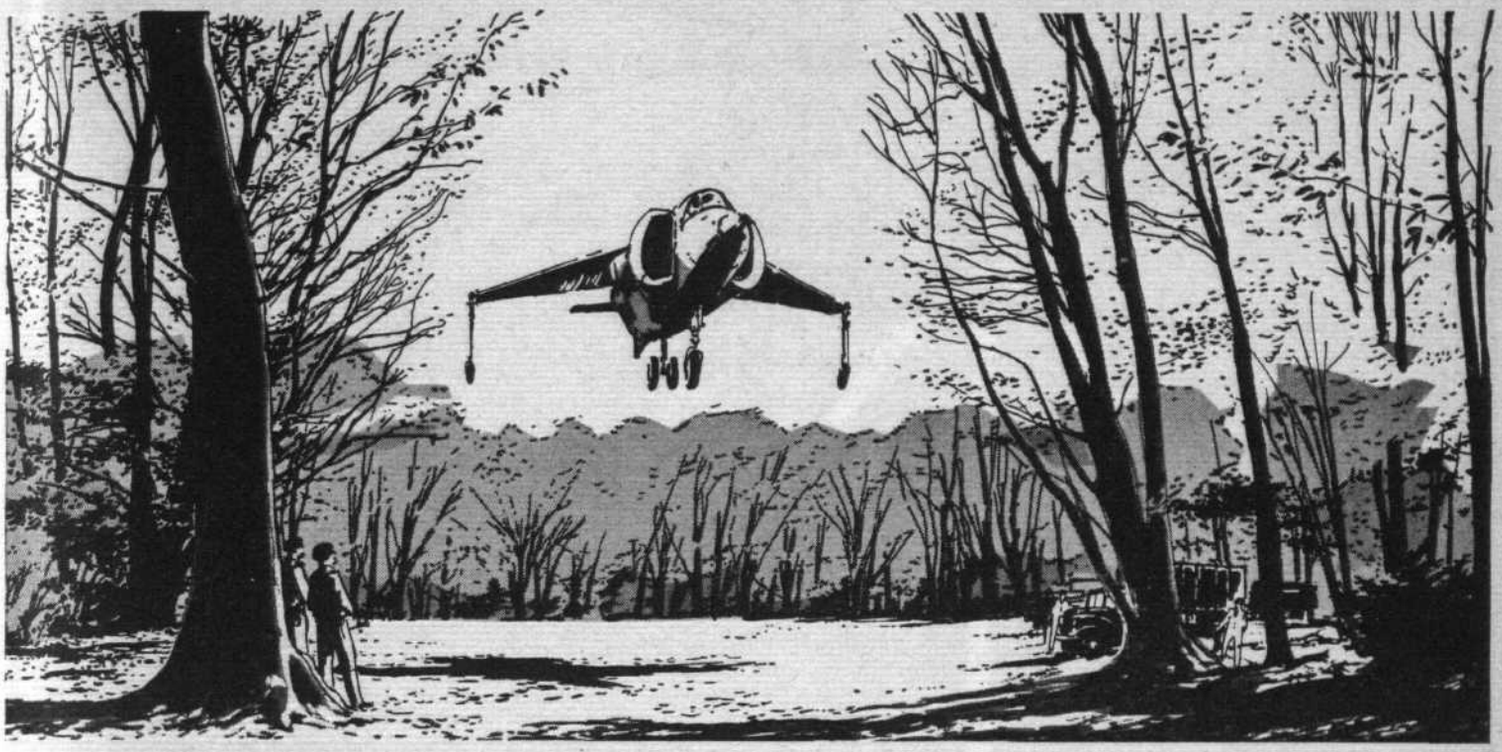
*Rotor dia, 33ft 6in; fuselage length, 31ft 6in; height 9ft; max weight, 3,530lb, empty 1,960lb; max speed, 95kt, cruise 92kt; max rate of climb, 1,000ft/min; hover ceiling o.g.e., 4,300ft; range, 275 n.m.*

**SA 3180 Alouette-Astazou** This model, as its name implies, has been fitted with the Astazou IIA, derated from 530 s.h.p. to 360 h.p. like the Artouste of the Alouette II. As a result, the fuel consumption is reduced from 30 to 23 Imp gal/hr, so that the range is much greater. Airframe and equipment are identical with those of the SE 3130, save that the Alouette III rotor transmission is used, to the advantage of overhaul life and serviceability. First flight was on July 31, 1961 and the first 15, delivered to the Armée de Terre and the Gendarmerie, have flown over 6,000hr. The Type C of A was granted on February 18, 1964, and production is now three per month, with the first export deliveries having been made to West Germany.

*Rotor dia, 33ft 6in; fuselage length, 31ft 6in, height, 9ft; max weight, 3,530lb, empty, 1,970lb; max speed, 105kt, cruise 92kt; max rate of climb at max weight, 840ft/min; hover ceiling o.g.e., 3,500ft; range, 485 n.m.; max sea level endurance, 5hr 25min.*

**SE 3160 Alouette III** The production model of this much-refined version of the

*Sud-Aviation Alouette III with four Nord AS-11 missiles and two reserve rounds*



# Simplified ground support for V/STOL aircraft

## with Bristol Siddeley vectored thrust engines

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**Engine Maintenance.** Since the vectored thrust principle requires the minimum number of installed engines, the need for spares and servicing personnel is minimised and the highest possible rate of serviceability is readily achieved.

**Engine Checks.** Pre-flight engine checks and testing can be carried out with the nozzles horizontal, so avoiding any difficulties with ground erosion, the ingestion of debris or the recirculation of exhaust gases into the engine intakes.

**Operation from unprepared sites.** Since the vectored thrust engine reduces ground erosion problems to a minimum during ground running and at take off, any unprepared site can be used.

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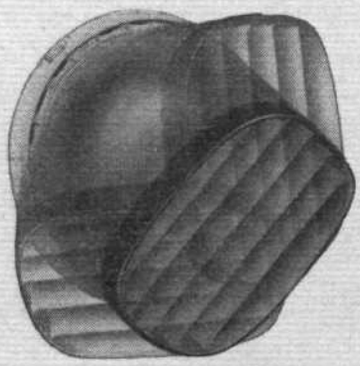

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BRISTOL SIDDELEY
SUPPLY THE POWER


Sud-Aviation SA 330 (full-scale mock-up)

## VTOL AIRCRAFT 1964 . . .

Alouette flew in July 1961. By March this year 170 of the initial production run of 300 had been delivered and orders were 222 for 17 countries. Production is currently eight per month, with flying hours totalling 36,000.

In the Alouette III the girder tail boom is replaced by a light-alloy semi-monocoque and the cabin and engine bay are of good streamline form, with transparent plastic and detachable light-metal panels over the tubular framework. The skid landing gear has been replaced by a tricycle wheel undercarriage which can be fitted with floats or skis. Normal accommodation is for a pilot (to starboard) and six passengers. Maximum power is 550 s.h.p., provided by a derated 870 h.p. Artouste IIIB single-shaft turbine. Engine installation, transmission and rotor system are similar to those of the well-proven Mk II, apart from strengthening to take the extra power and a slight increase in main rotor diameter.

It is a versatile helicopter and the broad fuselage can be arranged to carry two stretchers comfortably athwartships, with an attendent (facing aft) alongside the pilot. A rescue hoist, freight sling (for 1,650lb) and various weapon loads, including RP pods and booms for four Nord AS-11 missiles (with two spare rounds carried at the boom root) can be fitted. An all-weather version with a Sikorsky-Hamilton three-axis autopilot started flight tests in April. This aircraft has height and speed locks, autohovering (with automatic transition to hovering up to 75kt), fine adjustment of hover point controlled by the winch operator, and Doppler navigation.

The Alouette III is in service with the French Army and Navy and a large number will be built under licence in India. There is a current programme to extend the overhaul life, and an Army Mk III, with another of the makers' test flight, are now on tasks of 600 hours' flying in five months.

*Rotor dia, 36ft 1in; fuselage length, 33ft 4in; height, 10ft 2in; max weight, 4,630lb; empty, 2,390lb; max speed, 113kt; cruise 102kt; climb, 540ft/min; hover ceiling o.g.e., 1,800ft; max range 385 n.m. and max endurance 4hr, both at 3,750lb gross weight, and 10,000ft.*

**SA 3164 Alouette III-Armèe** A belligerent version of the SE 3160 which is due to fly next month. It will be armed with, for counterfire, a 20mm gun in the nose on the helicopter's axis with freedom of movement only in azimuth; and, for offence, Nord AS-11 or AS-12 teleguided missiles mounted on booms. Conversion to the normal SE 3160 versions is rapid.

**SA 3210 Super Frelon** This aircraft will be the subject of a detailed description in these pages in the near future. Developed from the smaller SE 3200, the two prototypes of this large three-engined helicopter, which flew in December 1962 and May 1963, had flown 388hr by the end of March and had gained three speed records at between 180 and 200kt over 3km, 15/25km low altitude and the 100km closed circuit. The first of four pre-production aircraft due this year flew in January. An unspecified number has been ordered for the Centre Expérimental du Pacifique and a second order for the French Navy (about 30) is being discussed. The West German Government was interested in the development of the SA 3210, but—in view of the Weser licences for the S-61—now appears to be reviewing the situation very carefully.

The Super Frelon's outstanding feature (as was that of its predecessor) is the use of three engines, Turbomeca Turmo III C3 free-turbines of 1,350/1,500 s.h.p. They are mounted on a fireproof deck formed by the cabin roof, the two front ones facing forward and the rear one aft, and are coupled to a main reduction gearbox in the pylon casing of the six-bladed all-metal main rotor. The five-bladed tail rotor is driven by a multi-section shaft which incorporates two reduction gears. Sikorsky participated in the design and manufacture of the rotor system and Fiat in that of the gearboxes.

The large fuselage is of light-alloy construction, with a planing bottom and watertight bulkheads under the main and flight decks. There is a rear-door loading ramp aft, a sliding door forward and an emergency door aft. The tail boom is a semi-monocoque of conventional design and the tricycle undercarriage has twin wheels of the same size, with brakes, on each leg.

With a cabin volume of 777 cu ft the SA 3210 can carry 30 armed men, 28/31 passengers and steward (with toilet and baggage), or two vehicles up to the size of jeeps. For casualty evacuation 18 to 21 stretchers plus attendants can be carried. There is provision for an 850lb-capacity rescue hoist at the forward door and the hull (or the sling) payload capacity is 4.5 metric tons (9,920lb). The naval version carries ASW, sonar dunking, homing torpedoes and other stores. A stripped crane version with a short-haul lift of 6 tonnes is being designed.

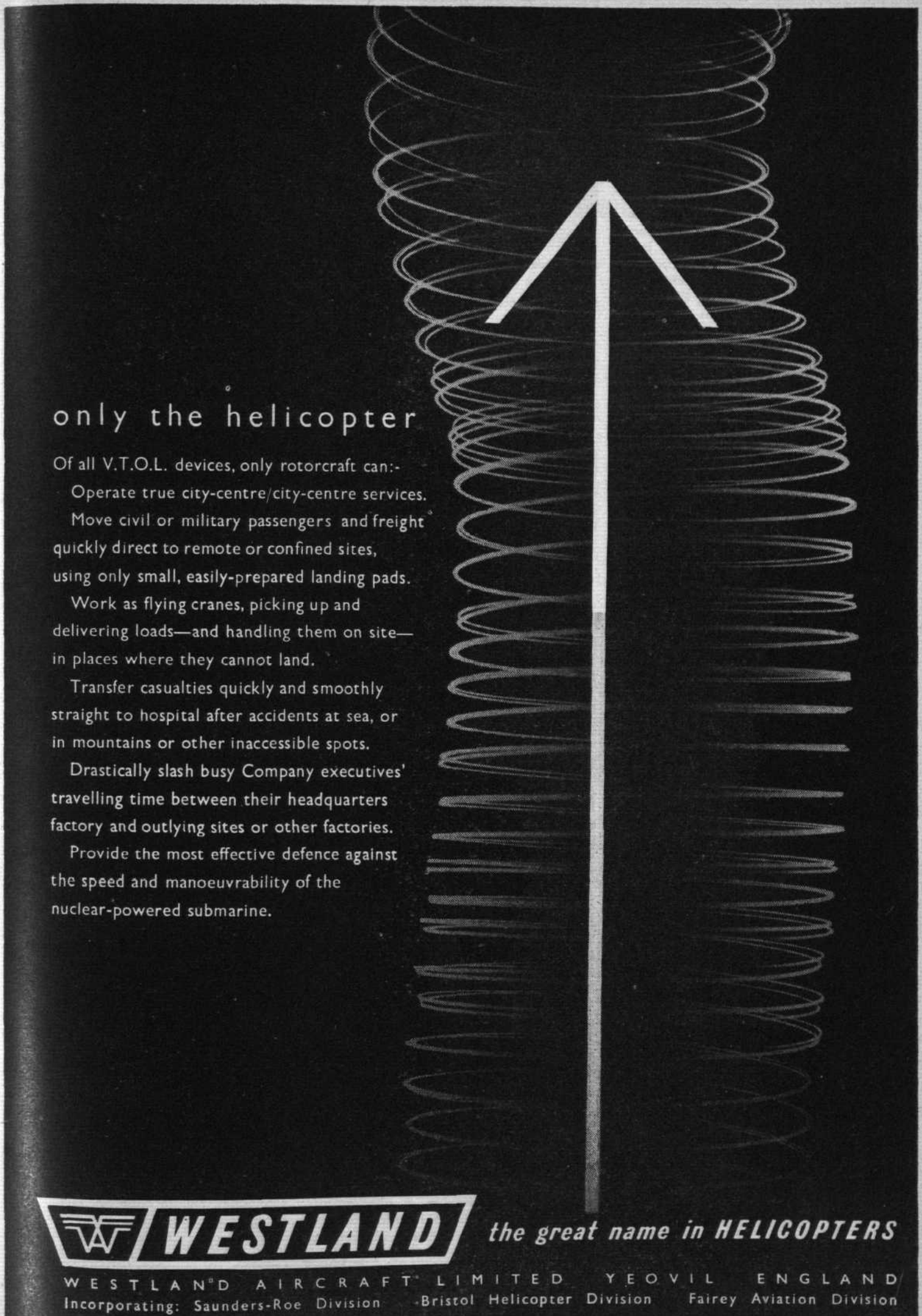
Because of the power reserve built into the Super Frelon, the rotor absorbs only 3,300/3,650 h.p. out of a potential of 4,050/4,500 h.p. in the three engines, so there is genuine three-engined safety. Furthermore, the power reserve permits take-off at the normal weight of 24,250lb at 12,300ft under ISA conditions and 6,650ft at ISA + 22.

*Rotor dia, 62ft; fuselage length, 56ft, height 22ft; max weight, 26,450lb; empty, 14,660lb; max speed, 135kt, cruise 120kt; max rate of vertical climb, 1,180ft/min; range, 250 n.m., ferry 730 n.m.; endurance, 4hr.*

Sud-Aviation SA 3210 Super Frelon

**SA 330** This twin-turbine aircraft, called a *helicoptère de manœuvre*, or medium assault helicopter capable of carrying 12 troops, a controller and two pilots, has been designed to a French Army requirement and two prototypes plus five trial aircraft have been ordered. A mock-up was shown at last year's Paris Salon and the first flight is scheduled for the beginning of next year. The design aims were: to have the smallest aircraft for the task; all-weather capability; the safety of twin engines; and high performance, coupled with versatility, easy maintenance and transportability. The SA 330 was originally designed to have two Bastan VII single-shaft turbines and in this form was slightly smaller and had rather lower weights and a higher performance.

Of conventional layout, with a four-bladed main and five-bladed tail rotor, the SA 330 has Turbomeca Turmo III C4 free turbines of 1,300 s.h.p. mounted in the roof ahead of the rotor. The tricycle undercarriage is retractable, the mainwheels folding into stubs on the fuselage sides; all three wheels protrude slightly for emergency landings. The main fuselage is wide, about 6ft, and the rear fairing to the cranked tail boom forms additional light stowage space. There are sliding doors 4ft 5in square in each side, as well as a separate crew door. Twelve armed men can sit back-to-back on a double-sided central collapsible bench from which they can debouch through the two doors. The seats fold up for stowage in the rear fairing when cargo is to be carried. The ambulance layout is for six


only the helicopter
Of all V.T.O.L. devices, only rotorcraft can:-
Operate true city-centre/city-centre services.
Move civil or military passengers and freight quickly direct to remote or confined sites, using only small, easily-prepared landing pads.
Work as flying cranes, picking up and delivering loads—and handling them on site—in places where they cannot land.
Transfer casualties quickly and smoothly straight to hospital after accidents at sea, or in mountains or other inaccessible spots.
Drastically slash busy Company executives' travelling time between their headquarters factory and outlying sites or other factories.
Provide the most effective defence against the speed and manoeuvrability of the nuclear-powered submarine.
WESTLAND
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WESTLAND AIRCRAFT LIMITED YEOVIL ENGLAND
Incorporating: Saunders-Roe Division Bristol Helicopter Division Fairey Aviation Division

stretchers and six walking casualties, the latter using half of the troop seats.

*Rotor dia, 59ft 8in; fuselage length, 48ft 7in, height 16ft 11in; max weight, 14,100lb, normal 13,230lb, empty 7,165lb; max speed, 147kt, cruise 135kt; rate of vertical climb, 1,100ft/min; hover ceiling o.g.e., 12,500ft; range, 310 n.m.; max endurance, 2hr 45min.*

**S-58 Bastan** Following upon the manufacture under licence of 150 H-34 army type and HSS-1 navy type S-58 helicopters for the French and Belgian forces, a turbine conversion was built and was flown on October 5, 1962. Powered with the 1,900 h.p. Turbomeca Bi-Bastan, a coupled version of the single-shaft turboprop, the conversion included lengthening the nose by 2ft 3in to maintain the c.g. position with the lighter engine. As this is a shaft turbine, the exhaust is in the nose and the engines are reached by opening clamshell doors. The aircraft underwent full flight trials, but there is no current information about its status.

*Rotor dia, 56ft; fuselage length, 49ft 3in, height 14ft; max weight, 13,290lb, empty 8,025lb; max speed, 113kt, cruise 86kt; hover ceiling, 6,900ft; range, 215 n.m.; endurance, 3hr.*

## GERMANY W

### Alfons Siemetzki

*7951 Kirchdorf a.d., Iller*

**ASRO 4** At the recent Hanover Show the first example of this new turbine-powered helicopter was displayed statically. A two-seater, it is powered by a 100 s.h.p. BMW 6012 turboshaft mounted behind the rotor gearbox. Production price is put at "about 68,000DM" (some £6,100). Few details of the ASRO 4 have been disclosed, but pilot and passenger are seated side-by-side in a cabin enclosed by only four pieces of transparent plastic (front, roof and two doors). The airframe is fabricated from steel tubes and has a light-alloy skin, and the main rotor has three blades. Herr Siemetzki is doing his utmost to minimize costs.

### Bolkow-Entwicklungen

*Ottobrunn bei Munich*

**Bö46** Three experimental aircraft have been financed by the West German Ministry of Defence to test the Derschmitt articulated rotor. This consists of a rigid five-armed centre portion to which are hinged plastic blades that are free to move 40° fore and aft of the normal radial position. This is intended to overcome compressibility effects on the forward-moving blade as well as tip stall of the retreating one, and wind tunnel models have exceeded 260kt. To attain the flight envelope for full-scale tests of this rotor, the two-seater Bö46 has a slender streamlined fuselage, with a derated Turmo IIIB free turbine driving the main rotor and the six-bladed tail rotor. A vertical fin and rudder, tailplane and elevator are fitted for high-speed trim and control. A rigid skid undercarriage is a precaution against ground resonance. Two 880lb-thrust Marboré II turbojets in pods alongside the fuselage will propel the vehicle into the 200kt-plus speed range. Flight tests started in January. At Paris in 1963 a model was shown of the P.310, a 24-seater "Rotodyne" with intermeshing Derschmitt rotors and turboprops at each wingtip.

*Rotor dia, 32ft 10in; max weight, 4,400lb.*

**Bö103** Developed from the Bö102 Heli-Trainer, this was built for the German Government to test a glass-fibre reinforced plastic single-blade rotor. It flew in September 1961 with an Agusta GA 70/V engine of 82 h.p. Projects have been announced for the Bö103B with a 90 h.p. BMW shaft turbine and the Bö103C with the 100 h.p. NSU-Wankel engine, but their status is unknown. The following data are for the prototype.

*Rotor dia, 21ft 10in; max weight, 860lb; empty, 595lb; max speed, 54kt; endurance, 2hr.*

**Bö105** The German Government has loaned 60 per cent of the £1.6m estimated for the development of this four/five-seater. It will have a new rigid rotor with plastics blades, which has already run for 100hr in reduced scale, powered by an 80 h.p. engine. The resilience of the blades replaces the conventional flapping hinges, while drag loads are taken by the rotorhead. Power will be supplied by two 250 h.p. BMW 6022 turboshaft engines.

*Rotor dia, 30ft 10in; fuselage length, 26ft 8in; height, 10ft; max weight, 3,550lb; empty, 1,820lb; max speed, 128kt, cruise, 113kt; climb 2,000ft/min; hover ceiling o.g.e., 10,800ft; max range, 270 n.m.*

### Dornier-Werke GmbH

*Friedrichshafen*

**Do31** Two prototypes of this jet-lift VTOL freighter are being built to the order of the German Government, with Dornier leading the ERNO group of companies. It is a stubby high-wing monoplane with two 15,500lb vectored-thrust Bristol Siddeley Pegasus turbofans in underwing pods. In addition, two removable packs of four 5,500lb-thrust Rolls-Royce RB.162 lift jets will give lift-off. Control, which has been tested on a "bedstead," will be unusual: bleed air from the propulsion engines to upward and downward nozzles at the tail for pitch, differential throttling of the lift engines for roll, and swivelling of the front and rear lift engine nozzles in opposite directions for yaw.

The Do31 will have a wing with double-slotted flaps and without the lift jets it will still be a STOL aeroplane, with lateral control at low speed by spoiler-assisted ailerons. The fuselage will have side doors and a tail-loading ramp.

A tough specification calls for this typical performance: to carry 3 to 4 tonnes for two 270 n.m. stages without refuelling, from a first take-off (at ISA + 15) in 500ft to clear 50ft, plus a second take-off and two landings vertically. In the event of failure of any one engine at any time, the aircraft must be able to continue the take-off or of making a controlled landing, assuming a 50ft obstacle surrounding the take-off area.

Construction of the two Do31E prototypes is well advanced, and the first should fly in little over a year. Originally there was to have been a somewhat different production version produced wholly by Dornier, but an agreement recently signed between the German Defence Ministry and the British Ministry of Aviation calls for a joint study by Dornier and Hawker Siddeley Aviation. By October a definitive design acceptable to both countries should have been agreed, and features of it are likely to include: pressurization; two Rolls-Royce or R-R/MAN turbofans with deflection (10,000lb thrust class); inboard lift pods of the type evolved for the de Havilland 129, with RB.162s mounted on their sides and

*NASA model flight test of Dornier Do31*

*Dornier Do32 being assembled on its opened box trailer*

fitted with deflectors; and downwards-only puffer jets at nose and tail, with yaw/roll hover control by the lift-engine cascades.

*Span, 64ft; length, 70ft 6in; height, 25ft 3in; wing area, 602 sq ft; aspect ratio, 6.8; take-off weight, VTOL, 51,800lb; cruising speed, 404kt.*

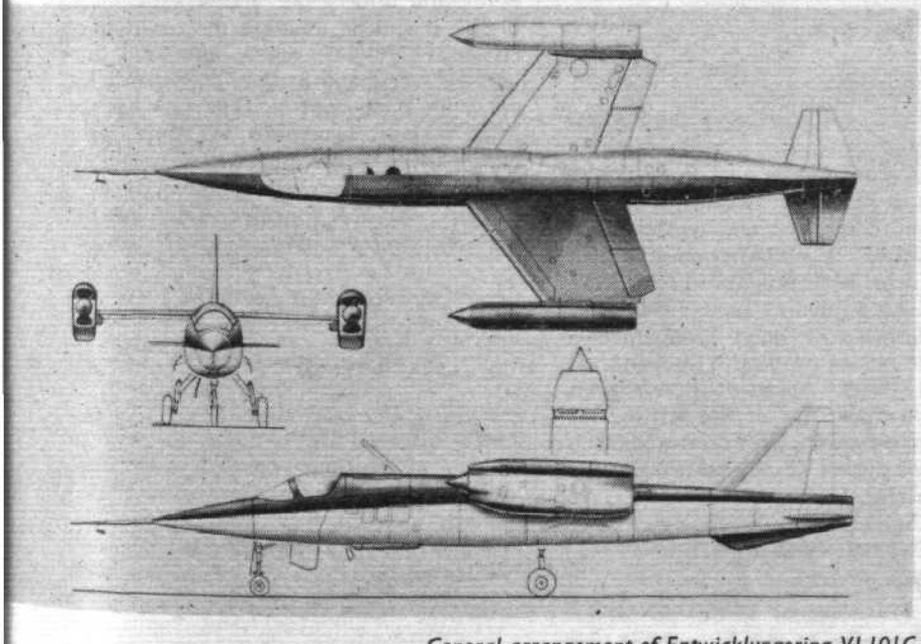
**Do32** This is a tip-jet driven single-seater helicopter which has been flying since June 1962. It is foldable and can be transported on a small box trailer, 11ft × 2ft 9in × 3ft 4in. A batch of 15 is being laid down for sale at a price of £4,450.

The Do32 is of robust construction and rather unusual layout for its class. An L-shaped built-up light-alloy girder supports the welded-steel-tube rotor pylon, BMW 6012L turbocompressor engine and rectangular tail surfaces. To the base of the L is bolted the tripod undercarriage, on the forward leg of which is mounted the pilot's seat, rudder pedals and radio. The two-bladed rotor is very simple, because the tip-jet drive almost eliminates torque and also renders drag hinges superfluous. There are thus only flapping hinges, the collective and cyclic-pitch mechanisms, plus the gas delivery connecting pipes. Control is by hanging stick plus the rudder in the downwash. A particular feature is the use of a high-kinetic-energy rotor which, with a wide r.p.m. range of 370-500, virtually eliminates the dead area—there is actually as much as 5sec in which to reduce pitch and achieve autorotation.

An accord with Ryan may lead to development of the Do32 for drone operation. A two-seater model, the Do32Z, is being developed for sale at an estimated price of £7,600. This latter will be a considerable modification, as it will be powered by a 250 h.p. BMW 6022 turboshaft engine. Seating will be in tandem and the aircraft will be foldable. It will not fly before the end of 1965.

*Rotor dia, 24ft 7in; fuselage length, 11ft 3in; height, 6ft 3in; max weight, jump take-off 710lb, normal 595lb, empty 325lb; max speed, 65kt; cruise, 54kt; max rate of climb, at 38kt, 780ft/min; range, 50 n.m.; endurance, 50min.*


*Bölkow Bö46 with Derschmitt articulated rotor*



*General arrangement of Entwicklungsring VJ 101C*

*Model of Entwicklungsring VJ 101D*

**Entwicklungsring Sud**

*Museumsinsel, Munich*

**VJ 101C** Preliminary design of this advanced VTOL research aircraft started in 1959 and the first vertical take-off was made in April 1963; by August conventional take-offs and landings were made, with the first transition on September 20 last—nine months ahead of schedule. There are two prototypes—the X-1, which will be used for tests up to Mach 1.4 (in a dive); and the X-2 (due to fly in a few months), which, with afterburning engines, should get well into the Mach 2 regime. This programme was originated by the Federal German Defence Ministry and was entrusted to a consortium of design teams from Bölkow, Heinkel and Messerschmitt, which at the instigation of the government is being formed into a company that could undertake development to a production fighter, although at this stage it is strictly a research project.

The VJ 101C bears a general resemblance to the F-104 (which is largely built by Heinkel), with its long slim fuselage, thin wing, angular tail surfaces and narrow-track undercarriage; but, as a VTOL aircraft it has several unusual fundamental features. The mounting of paired jets in rotatable wing-tip pods for both lift and thrust, plus two lift jets in the front fuselage, gives unique "three-point suspension." Furthermore, this triangulation of the lift-jets means that adjustment of the main thrust can replace compressor air bleed for pitch and roll stabilization and control, while yaw is obtained through differential swivelling (± 3°) of the pods. This not only eliminates the complexity of the control-jet piping, but leaves more of the potential gross thrust for lift. Another advantage of this system is that the propulsion engines can be chosen for their power and efficiency in this field and installed in the most suitable high speed cowling, without losses from deflectors or bifurcated jet pipes. Asymmetric-failure risk is met by an automatic device which both opens up to full power the remaining engine of a pair which fails and throttles back the other pairs. The weight/thrust margin on the X-1 is just sufficient to give sustentation on five engines at maximum take-off weight.

Rolls-Royce RB.145 engines developed in co-operation with MAN are used at all six stations. The published static thrust of the RB.145 is 2,750lb dry, or 3,650lb with reheat. The installations for the VJ 101C were designed and tested in the full-scale tunnel at Hucknall. The twin pods have a fixed-shock conical intake, plus annular auxiliary intakes to avoid choking during

*Model of FW 1262 V/STOL strike fighter*

## VTOL AIRCRAFT 1964 . . .

VTOL. The afterburning engines in the X-2 have the stabilization and control systems operating the reheat instead of the main thrust of the pod engines—the fuselage lift jets do not have afterburners. The other main difference in the supersonic aircraft is increased fuel capacity in the fuselage.

By using a jump-start technique—opening up to full thrust in less than 5sec—it is possible to avoid ingestion of hot gases, which reduce thrust as well as containing dangerous debris, since the intakes are safe when the aircraft has risen 4ft. This technique enables the VJ 101C to be flown off the runway, immediate forward acceleration leaving the concrete unharmed.

Clean stall is at about 140kt and the aircraft is initially decelerated by lowering the undercarriage and wing flaps and opening the lift engine doors at 220kt. The pods are turned to 45° at 165kt and 50 per cent power is used to maintain level flight down to 90kt—in which condition a conventional landing could be made. Thrust is increased and the nose raised to decelerate to 50kt, when the pods are turned to 90° and transition is complete.

Entwicklungsring are studying the complete logistics for a fighter force of aircraft similar to the VJ 101C, since Germany's aerodromes are particularly vulnerable.

*X-1 span, 21ft 9in; length, 43ft; height, 13ft 6in; VTOL weight, 13,250lb; gross lift thrust, 16,500lb; max level speed, Mach 1.05.*

**VJ 101D** Although having a designation so similar to that of the preceding aircraft, the 101D is an entirely new design, undertaken by EWR-Süd for the German Ministry of Defence as a purely national project. Decision to develop a fully operational production model has not yet been taken, but this 1,500 m.p.h. strike fighter would be a natural replacement for the F-104G and complementary to the Mach 0.95 VAK-191. Propulsion would be provided by two Rolls-Royce/MAN RB.153 turbofans, each rated at some 7,000lb dry and fitted with a deflector upstream of a reheat pipe raising propulsive (dash) thrust to some 12,000lb. Ahead of these engines would be a single row of five RB.162 lift jets, bringing total lift up to some 38,000lb (assuming a figure of around 5,000lb for the RB.162/31).

### Merckle Flugzeugwerke GmbH

*7101 Oedheim, Wurtt*

**SM 67** Development of this helicopter, which was similar to the Alouette II, has been abandoned.

### Vereinigte Flugtechnische Werke GmbH

*Werftstrasse 180, Bremen*

**WF-S-64** VFW was formed at the end of 1963 by a merger of Weser Flugzeugbau and Focke-Wulf and has taken over the programme for joint development of this helicopter with Sikorsky, which was a major activity at Weser. The two German-built prototypes of this crane have flown about 400hr, but the German Government is not decided about a contract.

**FW 260** A design project for an 85-seater VTOL transport with four propulsive turbojets and two six-jet lift pods was shown as a model at the 1963 Paris Salon.

**FW 1262** A German/Italian agreement has been signed for the joint development of a subsonic tactical fighter (to replace the G.91) to a German specification VAK-191. The work will be shared with Fiat and the target for the first flight is 1968. The aircraft is to be powered by a deflected-thrust Rolls-Royce RB.153 or RB.193, or by a Bristol Siddeley BS.94, plus two RB.162 lift jets in the fuselage. Deflector doors on these engines will be used for ground running and to give emergency propulsion should the main engine fail.

## ITALY

### Aer Lualdi & C SpA

*95 via Panama, Rome*

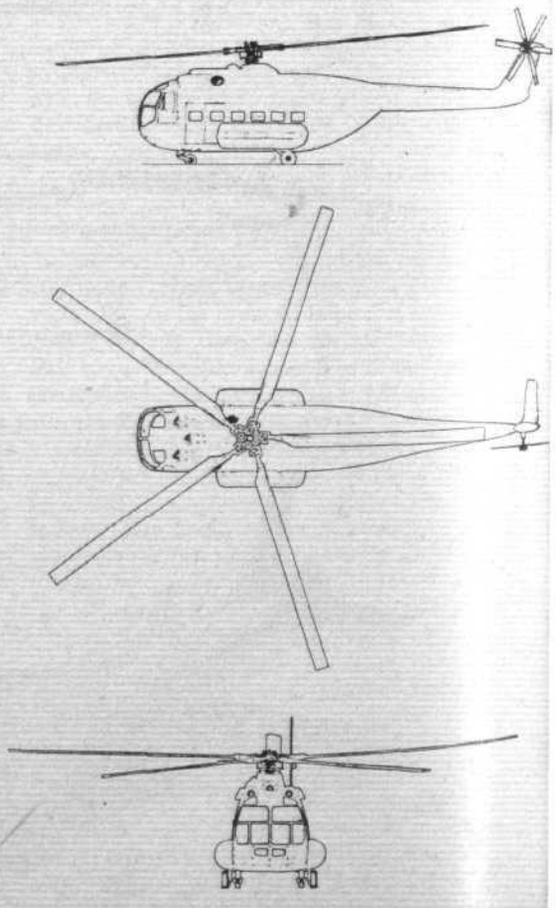
**L.59** No reply could be obtained from the makers of this small four-seater helicopter, one of which was sold to the Italian Army in 1961 and which was described in the 1963 Survey.

### Costruzione Aeronautiche Giovanni Agusta

*Cascina Costa, Gallarate*

**Agusta-Bell 47** The following models and variations of this highly successful light helicopter are catalogued; 47G-2A1, 47G-3B1, 47-G4, 47-J2A and the 47J-3B1. The G-2A1 has the 220/250 h.p. Lycoming VO-435-A1 engine, tubular skeleton tail boom and three-seater bubble cabin. The G-3B1 is similar, but has the turbosupercharged TVO-435 engine with 270 h.p. take-off rating and hydraulic assistance for collective pitch control. The G-4 has the 260/270 h.p. Lycoming IVO-540, high-inertia rotor blades and a max weight of 2,950lb. Of the more streamlined "Ranger" J series, the J2A four/five seater has the high-energy servo-assisted rotor and the

*General arrangement of Agusta AZ 101G*



VO-540 engine; while the J3B1 is even sleeker, has four seats and has the TVO-435 engine. The data are for the 47J-3B1.

*Rotor dia, 37ft; fuselage length, 32ft 5in; height 9ft 6in; max weight, 2,950lb; max speed, 91kt; cruise, 70-80kt; max rate of climb, 905ft/min; hover ceiling o.g.e., 12,200ft; range, 180 n.m.; endurance, 3.5hr.*

**AZ 101G** This three-engined heavy-duty helicopter is now in the final stage before flight testing. The prototype was built to the order of the Aeronautica Militare. It is a conventional type with "box" fuselage and cranked tail boom, five-bladed main and six-bladed tail rotors. Three 1,250 s.h.p. Bristol Siddeley Gnome H.1000 free turbines are mounted side-by-side in the cabin roof ahead of the rotor pylon. A short four-wheel undercarriage is fitted. Fuel is carried in blisters along each side of the bottom of the fuselage. The fuselage floor is close to the bottom skin, while the flight deck is considerably raised. Under the tail is a ramp door and nose doors below the flight deck can be removed so that long loads can be laid through the fuselage projecting at each end.

A crew of two pilots and a flight engineer is proposed. Among the payloads quoted are 11,000lb freight or slung loads, 35 civil passengers for 245 n.m., 35 equipped troops for 55 n.m., 18 stretchers and six attendants, internal freight loads up to 10,000lb in the 883 cu ft hold, or a 2½-ton truck plus 20 equipped troops.

*Rotor dia, 63ft 4in; length, 59ft; height, 20ft 1in; max weight, 24,900lb; empty, 12,570lb; max speed, 124kt; cruise, 108kt; max rate of climb 1,230ft/min; hover ceiling, full load, i.g.e., 8,000 ft; max range, 240 n.m.*

**A 104 Helicar** A prototype only was built of this light two-seater, which has a neat bubble cabin, tube tail boom, skid undercarriage and Bell-type rotor. The prototype was certificated with a 120/140 h.p. piston engine.

*Rotor dia, 26ft 1in; fuselage length, 20ft 10in; height, 7ft 10in; max weight, 1,410lb; empty, 840lb; max speed, 90kt; cruise, 73kt; max rate of climb, 810ft/min; hover ceiling o.g.e., 2,950ft; max range, 180 n.m.*

**A 105** Originally numbered A 104T, this is a derivative powered by a 270 s.h.p. TAA (Turbomeca Astazou Agusta) 230 single-shaft gas turbine intended for general utility, agricultural and military duties. Replacing the vertically-mounted flat-four piston engine by the horizontally-placed gas turbine has lengthened the main body, but as this area is about the c.g. and the engine is slender, the space along each side of the (enlarged) fuel tank is available as platforms for some 450lb freight, weedkiller or other payload.

*Rotor dia, 27ft 7in; fuselage length, 22ft; height, 7ft 10in; max weight; 2,205lb; empty, 1,065lb; max rate of climb (max weight), 810ft/min; hover ceiling (max weight) o.g.e., 1,800ft; max range (max weight) at 6,500ft, 170 n.m.; max endurance (max weight), 2.3hr.*

**AB 204-B** This highly successful European version of the US Army general-duty helicopter continues to sell well. It has been adopted by the forces of Italy and Sweden, by the Royal Netherlands Navy and by a number of commercial operators, including Scancopters in Scandinavia, Heliswiss of Switzerland and Agipoil of Italy for off-shore oil operations in the Middle East. The Bristol Siddeley Gnome H.1000 free-turbine of 1,050 s.h.p. is normally fitted, but as alternatives the 1,250 s.h.p. H.1200 or the Lycoming T53 can be mounted. Data for the AB 204-B with the H.1200 are given.

*Rotor dia, 44ft; fuselage length, 38ft 5in; height, 12ft 5in,; max weight, 8,500lb: empty, 4,100lb; max speed (6,500lb), 120kt; cruise (8,500lb) 104kt; max rate of vertical climb (8,500lb), 880ft/min; hover ceiling (8,500lb) o.g.e., 5,600ft; range, 205-270 n.m.*

**AB 205** Derived from the 204-B and powered by the BS Gnome H.1200, with the T53 as an alternative, this helicopter can carry the pilot and 12 passengers, or six stretchers with an attendant. The AB 205 has been flight tested and is ready for production, though no orders have been announced.

*Rotor dia, 48ft; fuselage length, 41ft 9in; height, 13ft 5in; max weight, 9,500lb; empty, 4,800lb; max speed (7,500lb), 120kt, cruise (9,500lb) 96kt; max rate of climb (9,500lb), 1,200ft/min; hover ceiling i.g.e., (9,500lb), 5,000ft, o.g.e. (8,500lb) 3,000ft; range, 225-365 n.m.*

### Conte Ettore Manzolini di Campoleone

*Via Francesco Siacci 4, Rome*

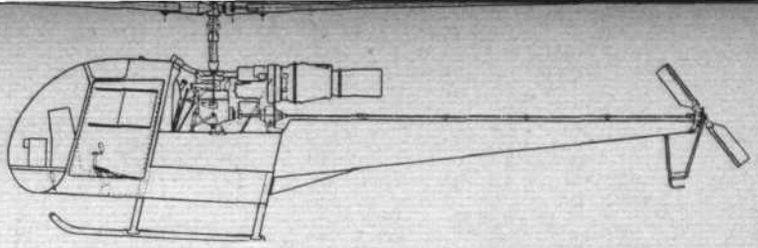
**Manzolini Libellula** Count Manzolini has been perfecting his contra-rotating co-axial rotor helicopter since 1952. The single-seater Libellula II received its C of A in October 1962 and the first of four slightly larger Mk III two-seaters is about to fly. A feature of these aircraft is an upended in-line engine, a 100 h.p. Walter Minor in the Mk II and a 140 h.p. M332 in the Mk III, with a long trumpet exhaust to give ejector cooling. The structure is tubular, with skid undercarriage, and there are twin fins and rudders with a small tail-plane. Data are for the Libellula III.

*Rotor dia, 32ft 10in; fuselage length, 16ft 5in; height, 10ft 7in; max weight, 1,875lb; empty, 1,280lb; max speed, 81kt; cruise, 44kt; max rate of climb, 1,000ft/min; range, 160 n.m.*

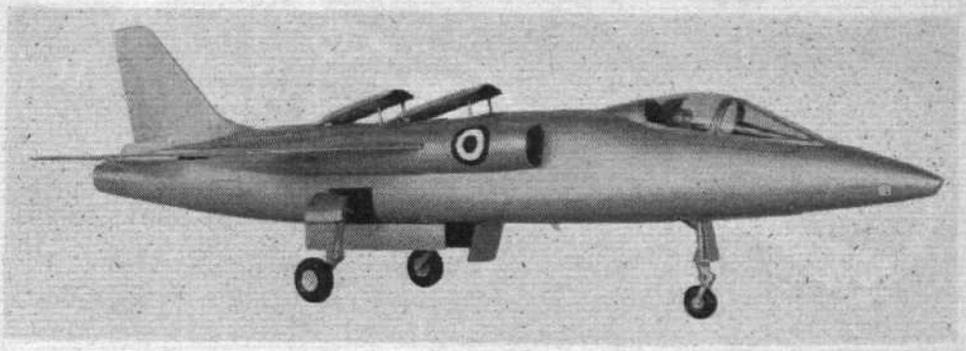
### Societa per Azioni Fiat

*Corso Giovanni Agnelli 200, Turin*

**G.95/4** Designed around the NBMR-3 requirement for a V/STOL tactical fighter, this work has had Italian Air Force finance though there is no contract for an aircraft. The design work has been extended to extensive model and rig tests, including an RB.108 "bedstead" with which Rolls-Royce have helped. The aircraft is a shoulder-wing monoplane with four RB.162 lift-jets in the fuselage and a Rolls-Royce/MAN RB.153 for propulsion. The work on this project seems likely to be used to inspire the FW1262 submission for the German VAK-191 requirements, and the

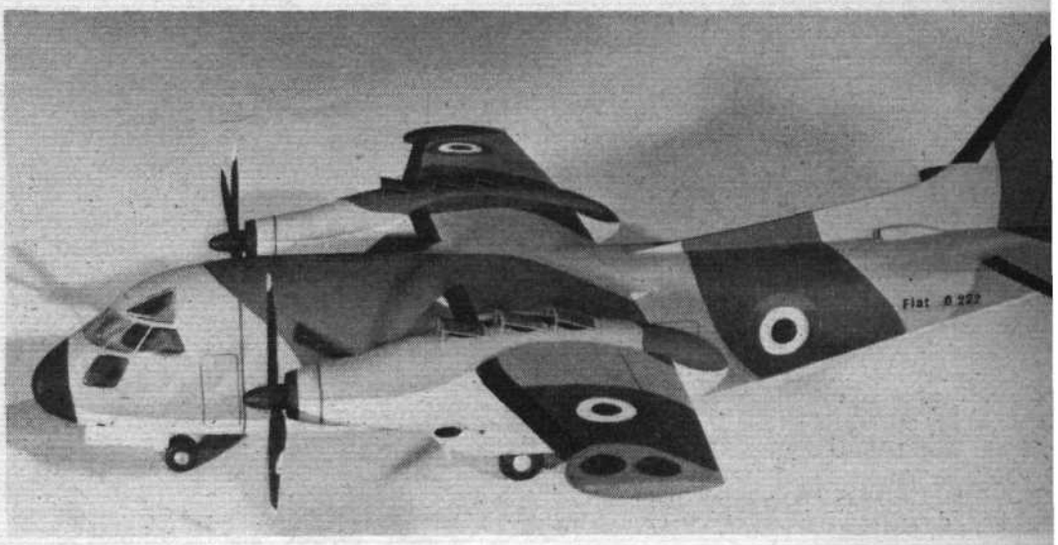


*Elevation from three-view drawing of Agusta 105*



*Fiat G.95/4 (model)*

*Fiat G.222 in its latest form (model)*




Rotorcraft Minicopter

## VTOL AIRCRAFT 1964 . . .

G.95/4 will presumably be superseded by the joint VAK-191.

**G.222** Design work on this V/STOL tactical transport continues with government funds, but without a prototype contract. The project has, however, been made a major study and work is being done on it by Aerfer, Finmeccanica, Macchi, Piaggio and SIAI. Artist's impressions and models have made the G.222 familiar over the past few years, but at the Hanover Show a new model showed some changes. The high wing, Rolls-Royce Dart turboprops and rear loading ramp remain, but the fuselage is now cylindrical, indicating pressurization. Three Rolls-Royce RB.162 lift jets are indicated in each of the main engine nacelles, with twin control fans (not jets) in the enlarged wing-tips and flattened fuselage tail.

## JAPAN

### Fuji Jukogyo Kabushiki Kaisha

*18 2-chome, Marunouchi, Chiyoda-ku, Tokyo*

**Fuji-Bell 204B** The Fuji Heavy Industries company has been producing the 204B for the Japanese Ground Self-Defence Force since 1962 under licence.

### Kawasaki Kokuki Kogyo Kabushiki Kaisha

*38 Akashi-machi, Ikuta-ku, Kobe*

This company has built more than 200 Bell 47 helicopters under licence and also has an agreement with Boeing-Vertol for the assembly and manufacture of the 107.

**KH-4** This is a four-seater developed from the Bell 47G-3B and fitted with the 260 h.p. Lycoming TVO-435-A1A engine, which is being produced at the rate of one a month. Instrument layout, control system and fuel capacity differ from the original.

*Rotor dia, 37ft 2in; height, 9ft 4in; max weight, 2,850lb; empty, 1,800lb; max speed, 91kt; cruise, 76kt; max vertical climb, 245ft/min; hover ceiling i.g.e., 18,000ft; range 215 n.m.*

### Shin Mitsubishi Jukogyo Kabushiki Kaisha

*No 10 Oye-Machi, Minatu-ku, Nagoya*

Overhaul work on US forces' Sikorsky S-55s in 1954 led to licence manufacture of this helicopter in 1958. This in turn led to other licence agreements, and several S-61 and S-62 helicopters have now been assembled from American parts.

## POLAND

### Motoimport

*Przemyslowa 26, Warsaw*

The only information obtainable is that insufficient of the SM-1 and SM-2 versions of the Russian Mi-1, described in our 1963 survey, have been built for them to be offered for sale.

## SOUTH AFRICA

### Rotorcraft SA (Pty) Ltd

*408 Greenmarket Place, 54 Shortmarket, Cape Town*

**Minicopter Mk 1** This single-seater autogyro was designed by Llew Strydom and first flew in September 1962. Five more were built in 1963 and it is in production, though there is no news about operators. It has been tested at Bloemfontein, 4,450ft, at approximately ISA + 35° with a 180lb pilot and fuel for one hour, when it achieved a 114ft take-off, 6ft landing run and 750ft/min climb.

The aircraft is particularly neat of its type, with a cruciform frame of Cr-Mo steel tube and aluminium. Upon this cross are mounted the triangulated tubular rotor pylon; the steel-tube engine mounting, the engine being positioned roughly half way up the pylon; the seat and flying controls, held between pylon and main frame. The instrument panel and the lever-action, steerable nose wheel are at the front of the cross; the doughnut main wheels with their 5in drum brakes are at the tips of the cross tube; and the tailplane, all-moving rudder and a tiny bumper wheel are on the rear tube of the cross. The standard aircraft has a neat Perspex and glass-fibre plastic fairing with open sides, which can be quickly removed to increase the payload. The engine is a 72 h.p. McCulloch O-100-1 driving a 46in pusher propeller and having a flexible shaft drive with a slipping-belt clutch and Bendix sprocket and ring gear for rotor spin-up. The rotor has two blades made of birch laminates with glass-fibre covering on bonded steel and hickory spars. There are adjustable trim tabs near the tips of the 8in-chord blades. Control is by conventional stick and pedals for the cyclic pitch and rudder, with the rotor speed-up lever and throttle to the left of the seat. Normal fuel is 4 gal, with a tank capacity of 8 gal.

*Rotor dia, 21ft 5in; fuselage length, 9ft 10in; height 6ft 11in; max weight, 550lb; empty, 300lb; max speed 87kt; cruise, 48-61kt, min horizontal, 14kt, take-off, 18-20kt; max climb, 1,200ft/min; range, 95-17 5m.n.*

## SPAIN

### Aerotecnica SA

This company, which was developing the unusual Cantinieau light helicopter, suspended operations in 1962 and the inventor went to the Société des Engins Matra in France.

## SWEDEN

### Svenska Aeroplan AB

*Linköping*

The main Swedish aircraft manufacturer built 30 Sud Alouette II helicopters at Norrköping from French components for the Swedish armed services in 1962. This was followed by the introduction of the Alouette III into Scandinavia. An agency is also held for Hughes helicopters.

## USA

### Adams-Wilson Helicopters Inc

*Box 6042, Lakewood, California*

**Model 101 Hobbycopter** Over 700 sets of plans, and many parts kits, of this home-build single-seater have been sold since it flew in November 1958. The aluminium-tube framework is bolted together, the two main rotor blades are solid spruce and the tail rotor is all metal. A British 40 h.p. Triumph 650 c.c. motorcycle engine, with a chain drive to the rotor gearbox and belt drive to the rotor shaft, is fitted.

*Rotor dia, 21ft 6in; length, 14ft; height, 6ft; max weight, 555lb; empty, 355lb; max speed, 52kt; cruise, 35-39kt; service ceiling, 8,000ft; range, 48-105 n.m.*

### Lester J Bannick

*101 North 32nd Street, Phoenix, Arizona*

**Model T Copter** A private-pilot enthusiast, Lester J. Bannick built and flew this single-seat autogyro, and now markets it and kits of parts. It has a simple open framework of thin tubes forming a cross, and a triangulated rotor pylon. Wheels are mounted at the nose and the tips of the cross. The engine is a 65 h.p. Lycoming driving a pusher propeller with a flexible spin-up drive to the two-bladed rotor. A 125 h.p. two-seater is being developed.

*Rotor dia, 25ft; fuselage length, 7ft 4in; height, 7ft 4in; max weight, 800lb; empty, 350lb; performance NA.*

### Bell Aerosystems Company

*Buffalo 5, New York State*

**X-14A** Although it has been hovering since February 1957, and did its first transitions in May 1958, the single Bell X-14A is still contributing to the NASA research into VTOL control, stability and transition at the Ames Research Center, Moffet Field, Calif. As the X-14 it was, in fact, the first aircraft ever to make a vertical take-off, transition to wing-born flight and landing in a horizontal attitude. Pilots report that it is particularly stable and unaffected by gusts when hovering, and the fact that it is the only jet-lift two-seater adds to its research value. Two GE J85 turbojets exhaust aft for propulsion and downward under the c.g. by cascade deflectors for lift, with intermediate positions for transition. Bleed nozzles are mounted at the wingtips and tail to give three-axis control in vertical flight. The original historic flight and early trials were made with Armstrong Siddeley Vipers.

*Span, 34ft; length, 25ft; height, 8ft; max speed, 140kt.*

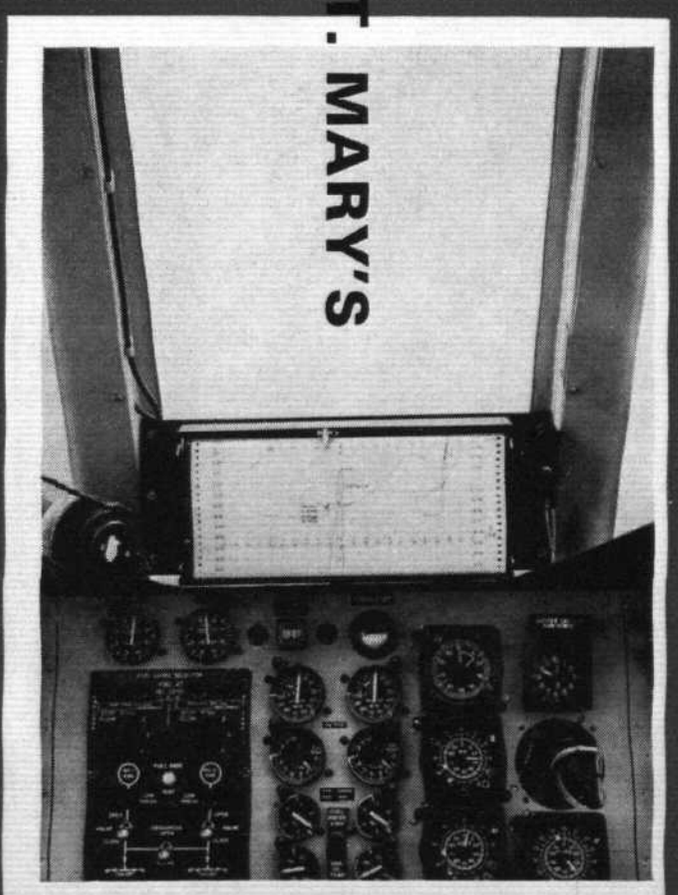
PENZANCE

ST. MARY'S

# DECCA

for the BEA scheduled service

BEA have fitted Decca Navigator in the Sikorsky S-61 N helicopter which is operating the hourly scheduled service between Penzance and St. Mary's every day throughout the summer. In 1947 BEA first fitted Decca in an aircraft and, in the succeeding 17 years, has acquired over a million flying hours with Decca in a variety of aircraft.



## THE DECCA NAVIGATOR

The Decca Navigator Company Ltd London

Military men are asking: shouldn't tomorrow's fighters be designed so they can take off and land in any old cow pasture?

A dozen different V/STOL (Vertical and Short Take Off and Landing) "test beds" have proved that planes can be built to do just that. But a major study was needed to find out if an advanced version would work as an actual weapons system.

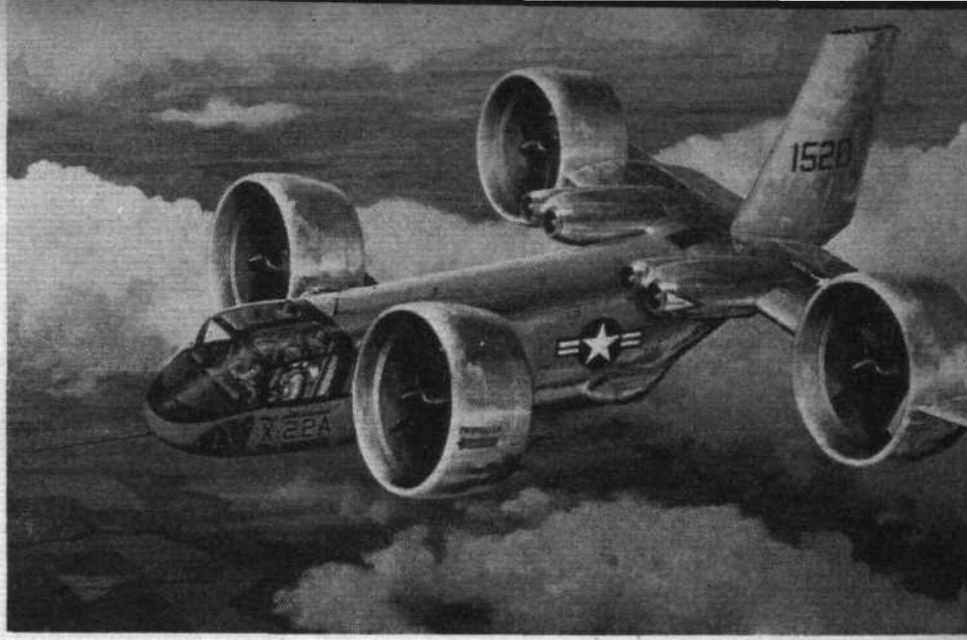
Because of our experience with the F-105 and other advanced weapons systems and some 10 years worth of V/STOL aircraft background, the contract for this study has been awarded by the Air Force to **REPUBLIC AVIATION CORPORATION.**
Farmingdale, N.Y.

# The enemy is zeroed in on every military airfield in the free world.

# Except this one.

VTOL AIRCRAFT 1964 . . .

Bell OH-13X-2 Sioux Scout




Bell Aerosystems X-22A (artist's impression)

**X-22A** Although this experimental VTOL aircraft started as a US Navy contract it is being continued under Tri-Service supervision. The objective is to explore the possibilities of ducted propellers for lift and propulsion. The X-22A has been laid out as a small transport, with two pilots and a cabin for six or a payload of 1,200lb.

A chunky fuselage carries two fans forward, with a small wing aft, in the roots of which are mounted four 1,250 s.h.p. GE T58 free-turbines and, outboard of these, two more ducted fans. There is also a large fin for directional stability in forward flight. The ducted fans swivel to the vertical for lift, the rear ones taking the outer sections of the wing with them. The ducts round the four-blade propellers increase their efficiency under VTOL conditions and provide lifting surfaces in forward flight. Unlike most advanced projects, there have been few significant alterations in this layout since first details were revealed, other than cockpit changes due to service needs. Partial deflection of the ducted fans will give STOL, to meet a requirement (at an unstated weight) for 50ft to be cleared in 600ft. The flight target date is March 1965.

*Span, 39ft 2in; length, 36ft 4in; height, 16ft 4in; max weight approx 15,000lb; empty approx 10,500lb; max speed, 325kt; cruise, 250kt; hover ceiling o.g.e., 6,000ft; endurance, with 10 min. hover, 2hr.*

### Bell Helicopter Company

*PO Box 482, Fort Worth 1, Texas*

**Model 47G-4** Nearly 3,000 Bell 47 helicopters have been built since the type C of A was granted in 1946, and the 47G Trooper is now the basic version with the openwork fuselage. The new 47G-4 model has a cabin 5ft wide internally, with new bucket seats, and the 260 h.p. Lycoming VO-540-B1B3 with a high-inertia rotor which gives improved hot weather performance, efficient operation from sea level to 11,000ft, more payload and greater range.

*Rotor dia, 37ft 2in; fuselage length, 31ft 7in; height, 9ft 4in; max weight, 2,950lb; empty, 1,777lb; max speed, 91kt; cruise, 79kt; max climb, 630ft/min; hover ceiling, o.g.e., 4,500ft; max range, 280 n.m.*

**Model 47G-3B-1** This differs from the 47G-4 in having a Lycoming TVO-435-B1A with the AiResearch T-11 exhaust-driven supercharger which maintains the rated power of 270 s.h.p. up to 15,000ft.

*Max weight, 2,950lb; empty, 1,794lb; max speed, 91kt; cruise, 81kt; max climb, 850ft/min; hover ceiling o.g.e., 12,750ft; max range, 240 n.m.*

**OH-13S Sioux** Military version of the 47G-3B, of which the US Army has ordered over 280, with deliveries continuing into 1965. The total of the OH-13 series bought by the US Army is now over 1,650.

**47J-2A** This new Ranger, with covered engine and tail boom, is an advance over the 1963 47J-2, with greater rotor inertia and improved special executive interiors. In utility form the three-seat rear bench can be folded up to give space for freight or two stretchers. The engine is the 260 h.p. Lycoming VO-540-B1B3.

*Rotor dia, 37ft 2in; fuselage length, 32ft 5in; height, 9ft 4in; max weight, 2,950lb; empty, 1,762lb; max speed, 91kt; max cruise, 90kt; max climb, 800ft/min; hover ceiling o.g.e., 4,000ft; max range, 250 n.m.*

**Wing Ding** A 25ft-span wing has been fitted to a Bell 47G as part of the company's research into V/STOL problems. It has flown successfully but no data or results have been released.

**OH-13X-2 Sioux Scout** This aircraft, which flew last September, was evolved from the 47, incorporating Wing Ding experience, to explore the possibilities of an armed Army light helicopter. It has a well-streamlined fuselage, much narrower than usual, seating the pilot above and behind the observer. Beneath the latter is a power-operated twin-machine-gun turret. A stubby, tapered high wing off-loads the rotor, so improving climb and manœuvrability. Lateral-slot intakes supply combustion and cooling air to the 260 h.p. Lycoming TVO-435. The skid undercarriage has streamlined legs.

**UH-1B Iroquois** For three years this general-purpose ten-seater (Model 204/205) has been in production for the US Army. It was originally powered by the 950 s.h.p. Lycoming T53-L-5, but is now fitted with the 1,100 s.h.p. T53-L-11. The Iroquois is of stressed-skin construction, with a wide fuselage and typical two-bladed Bell rotor and rigid skid undercarriage. It is in use with the RAAF and is on active service for close-support in Vietnam. Armament evaluation is being carried out by the US Army with 16 Iroquois each armed with six Nord AS.11 on booms, or 48 2.75in rockets, or the Ford 40mm-grenade launcher. The civil Model 204B gained its C of A in April 1963.

A research version of the UH-1B, the Bell 533 achieved a speed of 182kt in level flight during measured trials last January 17. The aircraft was modified by the addition of two Continental J69 turbojets each giving 1,260lb thrust and only 780 s.h.p. was taken from the T53 engine driving the rotor. Tip speed of the advancing rotor blades reached Mach 0.95. This aircraft has been streamlined and has a tilting rotor pylon. A future development will be to fit winglets to unload the rotor for higher speeds.

*Rotor dia, 44ft; fuselage length, 39ft 8in; height, 14ft 7in; max weight, 8,500lb; normal, 6,500lb; empty UH-1B, 4,370lb; 204B, 4,600lb; max speed, 120kt; economical cruise, 6,500lb, 110kt, 8,500lb, 104kt; max climb, 6,500lb, 2,350ft/min, 8,500lb, 1,600ft/min; hover ceiling, 6,500lb, 12,500ft, 8,500lb, 2,400ft; range 200-220 n.m.*

Bell Model 533 (UH-1B Iroquois with two 1,260lb-thrust J69 turbojets)

Bell OH-4A, entrant for the LOH contract

Bensen B-11 Gyro-Copter


## VTOL AIRCRAFT 1964 . . .

**UH-1D Iroquois** This is a US Army version of the Bell 205, and has a larger fuselage and increased tankage.

**UH-1E Iroquois** A US Marine Corps version for assault duties, over a hundred of which have been ordered. Delivery started in February.

**UH-1F Iroquois** The US Air Force version of the Bell 204/205; it differs considerably from the Army and Marine models, and is fitted with the General Electric T58-3 free-turbine of 1,250 s.h.p. Fifty-one are on order and their principal role will be to supply the thousand-odd SAC missile sites in the USA. It has an 11-seat fuselage, a larger rotor and is heavier than the earlier UH-1 helicopters.

*Rotor dia, 48ft; fuselage length, 39ft 8in; height, 12ft 6in; max weight, 8,600lb; empty, 4,427lb; max speed, 120kt; hover ceiling i.g.e., 18,700ft; max range, 295 n.m.*

**OH-4A** This is the Bell 206, which was designed to compete for the vast US Army LOH contract. Five helicopters had to be delivered by each competitor for field evaluation due to be completed by June. On April 28 the Model 206 was given its FAA Type C of A. This helicopter is an entirely new design, although the characteristic two-bladed rotor with dynamic counterweights is retained. A 250 s.h.p. Allison T63-A-5 free-turbine is mounted on top of the cabin aft of the rotor, the slender tail boom is mounted high and there is a short skid undercarriage, the tail rotor being protected by the high-aspect-ratio fin. The fuselage seats two side-by-side and there is a twin-machine-gun turret on the starboard side. The only official indication of performance is that tanks can be installed in a few minutes to give a ferry range of 600 n.m.

### Bensen Aircraft Corporation

*Raleigh-Durham Airport, Raleigh, North Carolina*

**B-8 Series Gyro-Glider** This is the basic unpowered autogyro designed by Igor B. Bensen and produced by him, as complete aircraft, kits and plans, since 1953. Despite many detail improvements, the initial design has remained unchanged through both gliders and powered models. The essential airframe is a square-section light-alloy tube cruciform, on the centre of which is mounted the rectangular-tube rotor pylon and at the extremities of which are the nosewheel, main wheels and tail unit. A light tubular seat, controls and a two-bladed laminated-plywood rotor complete the aircraft; either a hanging or conventional stick can be fitted. A 20-25 m.p.h. car tow is sufficient to get airborne. There is a two-seater trainer version, a twin-float model and another two-seater having a dinghy hull to which the rotor system is attached. Something like 8,000 of the whole series, including the powered Gyro-Copters, have been sold whole or in kit form.

**B-8M Gyro-Copter** The strengthened airframe is fitted with a 72 h.p. McCulloch flat-four two-stroke engine driving a pusher propeller. A spin-up rotor drive is available, and the standard fuel tank holds 5 Imp gal. A new modification, which can be fitted retrospectively, is an offset-gimbal rotor head which makes the aircraft so stable that it can be flown hands-off indefinitely and in gusts; complete circuits can be flown on the rudder alone.

*Rotor dia. 20ft; fuselage length, 11ft 4in; height, 6ft 3in; max weight, 500lb; empty, 247lb; max speed, 74kt; cruise, 52kt; min level, 12kt; landing, 6kt; max climb, 2,000ft/min; service ceiling, 16,500ft; range, 87-260 n.m.*

**B-9 Little Zipster** This is a true helicopter with a contra-rotating rotor system driven by a 60 or 70 h.p. outboard-motor engine. The rotor drive is through a differential which allows the upper 22ft rotor to revolve at a different speed from the lower 20ft one. The rotors are typically Bensen: rigid, with control by tilting the whole head from a hanging stick with a handlebar grip having a twist-grip throttle. Two specimens are under development.

**B11 Gyro-Copter** This model is, in effect, an auxiliary-powered autogyro, the rotor being turned by a 118 c.c. go-kart engine mounted at the top of the rotor pylon and driving the rotor through a spur gear and over-running clutch. The rotor motor can be started and used independently from the standard McCulloch propulsion engine. The rotor is slightly larger than standard, but has the usual Bensen tilting (teetering) control and the new offset-gimbal mounting. This model can be fitted with a cross-wind landing gear or with twin floats. A series of dead-stick landings has proved the safety of the rotor in autorotation. An FAA Type Certificate has now been applied for, and the type will be put into large-scale production.

*Rotor dia, 22ft; fuselage length, 11ft 4in; height 6ft 11in; max weight, 625lb; empty, 285lb.*

**B13** No further information is available about the single-seat tail-rotor helicopter kit briefly described in the 1963 Survey.

### The Boeing Company

*Vertol Division, Morton, Pennsylvania*

**107 Series** This is the standard tandem-rotor, twin-engine heavy-duty helicopter which has succeeded the Vertol 44 "Flying Banana" series. It originated from an intensive optimization programme started early in 1956, achieving the first flight in April 1958. Features which made the 107 a major advance are: the change in configuration to a capacious freighter style of fuselage; the mounting of the rotors on streamlined pylons; the adoption of two turbines on top of the rear fuselage; interchangeable steel-spar rotor blades; and the substitution of differential collective-pitch control for longitudinal cyclic pitch. In production the Lycoming T53 free-turbines of the prototype have been replaced by versions of the General Electric T58 and Bristol Siddeley Gnome. The straight-

Boeing-Vertol CH-47A Chinook

through hull, with rear loading ramp and all mechanisms clear of the cargo hold, make it a practical transport vehicle. It was the first helicopter to float without special gear. The three-bladed rotors turn in opposite directions, and are mechanically connected by a shaft along the top of the fuselage with overrunning clutch and gearbox to enable one engine to drive both rotors. A sturdy tricycle undercarriage has the main legs on the lateral sponson blisters.

The first 107 to enter service was the CH-46C of the US Army, which, powered by 1,050 h.p. engines, was equipped to take 23 troops, 15 stretchers and two attendants, or up to 5,000lb of freight. Next came large orders for the CH-46A Sea Knight Marine Corps assault transport, with 1,250 h.p. engines giving improved performance and power folding rotors. This was the first of the production Model 107-II, which has had wide success. An FAA Civil Type C of A was granted early in 1962; New York Airways put the type into scheduled service as a 25-seater, and the 107-II is also in civil operation in Japan. Military versions are flying with the RCAF (HC-113), Canadian Army (HC-113A) and Swedish Navy and Air Force (HKP-4). These last are powered by the Bristol Siddeley Gnome H.1200, and have increased fuel capacity plus the ability to lift a 10,000lb slung load.

*Rotor dia, both, 50ft; fuselage length, 44ft 7in; height, 16ft 10in; max weight, 19,000lb (CH-46A 18,700lb); empty, 10,730lb (CH-46A, 11,530lb); max speed, 146kt; cruise, 130-134kt; max climb, 1,550ft/min; hover ceiling i.g.e., 10,800ft; range, with 6,600lb payload, 100 n.m.*

**Model 114 Chinook** This is a much larger development of the Model 107, incorporating several new technical features. The design originated from a US Army competition, and it is operational with that service as the CH-47A (by a coincidence, its useful load is similar to that of the faithful C-47 Dakota). The first production aircraft were powered by the 2,200 s.h.p. Lycoming T55-L-3, but the 2,500 s.h.p. T55-L-7 is being mounted in examples now being supplied to the US Army. An a.p.u. makes the aircraft independent of ground services for engine-starting and operating the hydraulic cargo winch and other equipment. A straight-sided fuselage with a rear ramp door has been retained in the Model 114, as has the principle of streamlined rotor pylons and three-bladed rotors, but the two engines are carried externally in easily accessible pods.

A four-wheel undercarriage is mounted at the ends of the fuel-tank fairings running along each side of the fuselage. These fairings are made of metal honeycomb and are divided into watertight compartments, as is the underfloor area of the fuselage, to provide full buoyancy and water stability. A hatch in the floor allows the lifting of heavy slung loads. The 1,600 cu ft (30ft × 7ft 6in × 6ft 6in) hold can be fitted for 33 troops, 27 paratroops (who can be safely dropped, using static lines, through the open rear ramp), or 24 stretchers. The floor is stressed for 200lb/sq ft, with wheel loads of 1,000lb/sq ft, and there are 83 × 5,000lb and 8 × 10,000lb lashing points. One of the main tasks of the CH-47A is to uplift all US Army units equipped with the Pershing artillery rocket.

*Rotor dia, 59ft; fuselage length, 51ft; height, 18ft 7in; max weight, 33,000lb; normal, 27,750lb; empty, 17,130lb; max speed, 155kt; cruise, 130kt; service ceiling, 21,300ft; range, max payload, 200 n.m., with 12,000lb payload, 350 n.m.*


*Curtiss-Wright X-19A Convertiplane*

### Brantly Helicopter Corporation

*Municipal Airport, Frederick, Oklahoma*

**B-2A/B** These are the current production models of the distinctive two-seater which first flew in August 1956 and received its C of A in April 1959, the former with the 180 h.p. Lycoming VO-360 and the latter with the IVO-360. The B-2A was certified in December 1962 and a licence for it is held by the Beagle subsidiary British Executive Air Services Ltd. A new model is under test which, while retaining the three-blade rotor with flapping/drag hinges at 40-percent blade radius and the conical rear fuselage, has a larger-diameter cabin with better headroom and glazing, and a sprung tricycle undercarriage in place of skids. Data are for the B-2B.

*Rotor dia, 23ft 9in; fuselage length, 19ft 4in; height, 7ft; max weight, 1,670lb; empty, 1,020lb; max speed, 87kt; cruise, 78-83kt; max climb, 1,300ft/min; service ceiling, 11,400ft; range, 175 n.m.*

### Carson Helicopters Inc

*RR1, Box 94, Perkasie, Pennsylvania*

**Super C-4** This company specializes in re-engineering standard American light helicopters to improve their performance. A large number of Bell 47G and Hiller UH-12 helicopters have been fitted with the turbo-supercharged 240 h.p. Franklin 6VS-335A. The Super C-4 is the Bell 47G or G-2 with this engine and the cabin lengthened 2ft to seat three passengers behind the pilot.

*Fuselage length, 33ft 7in; height, 9ft; max weight, 2,450lb; empty, 1,530lb; max speed, 78kt; cruise 69kt.*

### Curtiss-Wright Corporation

*Wood-Ridge, New Jersey*

**X-19A** Following upon successful results with the X-100 convertiplane, Curtiss-Wright designed and started the construction of a larger research aircraft of practical proportions, the Model 200. The project was approved by the USAF Systems Command and two prototypes, one of which has now been statically tested, were ordered in 1962 as the X-19A. The principle of this aircraft is lift and propulsion by tilting propellers mounted at the tips of fore and aft wings. The propellers are of special design, with very wide chord reinforced-plastic blades through which an additional lift component is derived from the "radial force" developed when in the horizontal or intermediate attitude.

The aircraft tandem wings are mounted on a streamlined fuselage with a retractable tricycle undercarriage. There is a vertical fin and rudder, while the wings are fitted with control surfaces and high-lift flaps. Two 2,650 s.h.p. Lycoming T55-L-7 turbines are mounted inside the rear fuselage, and coupled to the propeller reduction gears at the wing-tips by an H-shaped shaft system. The fuselage houses two pilots and an unobstructed rear cabin. The X-19A is expected to fly soon and is scheduled for delivery to the USAF this year.

*Span, over propeller discs, 34ft 6in; length, 44ft 5in; height, 17ft; max weight VTOL, 13,660lb; STOL, 14,750lb; empty, 9,750lb; max speed, 400kt; cruise, 350kt; max climb, 4,000ft/min; range, VTOL 450 n.m., STOL 640 n.m.*

### Del Mar Engineering Laboratories

*International Airport, 6901 Imperial Highway, Los Angeles 45, California*

**DH-1 Whirlymite** No fresh information is available about this series of drone and piloted ultra-light helicopters, nor of the DH-2 variants with the Solar T62 Titan turbine. The aircraft have a tripod chassis, with two small wheels and a nose skid, from which the rotor pylon projects and on which are mounted (above the pilot's shoulder) the engine, fuel tank and tail-rotor boom. A three-bladed main rotor is fitted. The DH-1 has a 56/80 h.p. Kiekhaefer Mercury 800 six-cylinder engine.

*Rotor dia, 16ft; length, 15ft 7in; height, 7ft; max weight, 600lb; empty, 380lb; max speed, 64kt; cruise, 39-48kt; max climb, 1,250ft/min; service ceiling, 9,000ft; max range 78 n.m.*

*Brantly two-seater with enlarged cabin and tricycle undercarriage*

Enstrom F-28 three-seater

Gyrodyne QH-50C drone launching torpedoes under radio/radar control

Hiller SL 14, the current production four-seater

## VTOL AIRCRAFT 1964 . . .

### Doman Helicopters Inc

*Municipal Airport, Danbury, Connecticut*

**Doman-Ambrosini D-10** The special ideas of Glidden S. Doman on helicopter design date from 1945 and, although three prototypes of the D-10 have flown since September 1958, there has been difficulty in getting production started. The company now states that airframes are being built by Ing A. Ambrosini & C, of Milan, for assembly by Doman and that the first of these should fly in July. The aircraft has a Cr-Mo steel-tube Warren-girder structure covered by panels and fabric. The 525 h.p. turbosupercharged Lycoming IO-720 flat-six engine is mounted under the flight deck, with a diagonal drive to the rotor head. The latter is a light-weight design without the usual complex hinges, and with a sealed oil-bath containing a servo control system. The three blades are rigidly attached to the tilting hub, and the unusual rotor system is claimed to be stable and free from vibration. Fuselage design allows the covering to be stripped in order to gain 250lb for crane operations, and the side doors can be quickly removed for taking athwartships loads. A fully-sprung four-wheel undercarriage is fitted. This helicopter has been evaluated by the USAF, and the FAA certificated the development LZ-5/YH-31 on December 30, 1955.

*Rotor dia, 48ft; fuselage length, 38ft; height, 10ft 5in; max weight, 5,500lb; empty, 3,380lb; max speed, 90kt; cruise, 83kt; max climb, 340ft/min; hover ceiling i.g.e., 5,300ft; range, 280 n.m.*

### R. J. Enstrom Corporation

*Menominee County Airport, Michigan*

**F-28** The Enstrom company was formed in 1959 to build the prototype of a simple three-seat civil helicopter, which flew in November 1960. Two pre-production aircraft followed in 1962; one was destroyed in November of that year, but trials continued and a provisional C of A was obtained last year. With this in hand, series manufacture has started and the full FAA C of A is expected soon. The price has been fixed at $27,400 and operating costs comparable with an aeroplane are claimed. The F-28 has a well-streamlined fuselage with large glazed side doors and wrap-around windscreen. The centre portion has a welded tubular framework with glass-fibre and light-alloy covering, while the tail boom is a simple light-alloy-sheet cone carrying the tubular tail-rotor support. A bulkhead separates the cockpit from the engine bay, where a 180 h.p. Lycoming HO-360 is mounted facing aft, with an air-intake scoop just behind the rotor mast feeding a cooling fan which also acts as a flywheel.

A belt-drive connects the engine to a horizontal stub-shaft driving a helical bevel reduction gear at the foot of the rotor mast. Fuel comes by gravity from two 12.5 Imp gal tanks above the engine. A payload compartment aft of the engine can take up to 75lb. The rotor blades are heat-bonded from a light-alloy extruded spar and two-piece light alloy skin, which provides a high-inertia rotor giving good autorotation characteristics. The three-blade rotor has no drag hinges, but offset flapping hinges contribute to stability. Laminated-plastic bearings for the flapping hinges and the feathering axis reduce daily maintenance and have a better life than ball races. The 200 h.p. IHO-360 engine is to be offered at slight extra cost, since speed is limited by power and not by blade stall. Data are for the 180 h.p. standard model for delivery this year.

*Rotor dia, 32ft; length, 29ft 5in; height, 9ft 1in; max weight, 1,950lb; empty, 1,250lb; max speed, 100kt; cruise, 83kt; max climb, 1,335ft/min; hover ceiling o.g.e., 5,800ft; range, 205 n.m.; endurance, 3.3hr.*

### Gyrodyne Company of America Inc

*St James, Long Island, New York*

**Rotorcycle** A pioneer light helicopter, this co-axial-rotor type is in service with the USN as the YRON-1 for liaison between destroyers and other small ships. The Rotorcycle is not at present in production, but it was demonstrated at Casablanca and in Algeria this spring. The 72 h.p. Porsche and the 55 h.p. Solar Titan turbine have both been fitted; data below are for the former version.

*Rotor dia, 20ft; fuselage length, 11ft 6in; height, 9ft; max weight, 906lb; normal, 832lb; empty, 550lb; max speed, 68kt; cruise, 52kt; vertical climb, 910ft/min; hover ceiling o.g.e., 550lb, 5,100ft; 906lb, 2,900ft; range, 6-97 n.m.*

**QH-50C** This is the operational model of a series of drones developed from the Rotorcycle as part of the US Navy's DASH (Drone Anti-Submarine Helicopter), which flies off a destroyer under radio guidance and with radar tracking to launch homing torpedoes against a submarine detected by the ship's equipment. The aircraft now has the Rotorcycle rotor system, a completely redesigned skeleton fuselage, a 300 s.h.p. Boeing T50 turbine and a "straddle" alighting frame, between the bipod legs of which the torpedo is carried. Upon alighting, the helicopter is automatically locked to the deck platform.

*Rotor dia (both), 20ft; length, 13ft 1in; height, 9ft 1in; max weight, 2,300lb; empty, 1,100lb; max speed, 60kt plus; combat radius 20 n.m. plus.*

### Helicom Inc

*2901 East Spring Street, Long Beach, California*

**H-1 Commuter Jr** No information about this home-built single-seater has been forthcoming this year. It has rather more structure than most one-man craft, with a triangulated-tube boom for the tail rotor, a brief cockpit enclosure and two skid undercarriage. The engine is a 90 h.p. Continental C90 driving two-bladed light-alloy main and tail rotors.

*Rotor dia, 21ft; length, 23ft 6in; height, 7ft 10in; max weight, 950lb; empty, 635lb; max speed, 65kt; max vertical climb, 500ft/min; hover ceiling o.g.e., 6,800ft; range, 130 n.m.*

### Hiller Aircraft Company

*Palo Alto, California*

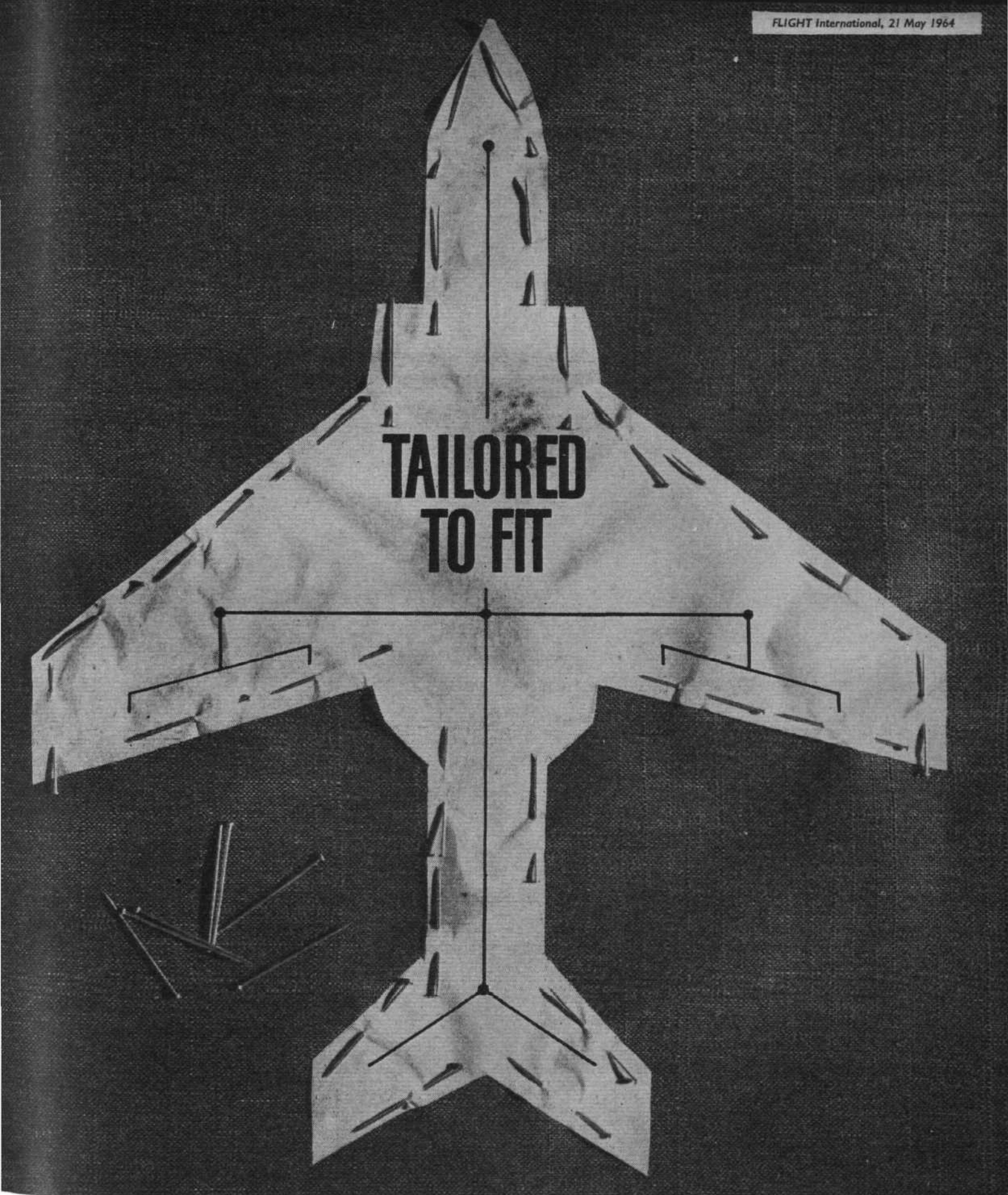
**SL 4** The latest four-seat commercial model of the distinctive Hiller light helicopters, with the light-alloy platform and tail-boom structure which has characterized them for a decade. The two-blade main rotor has high-lift blades with hydraulic power for cyclic and collective pitch. The rotor system has the new Hiller stability-augmentation device which automatically maintains aircraft attitude in pitch and roll, so that the pilot's work-load under turbulent conditions is much reduced. The engine is the 315 h.p. Lycoming TIVO-540-A2A which maintains rated power up to 15,000ft. As the L4, this machine is available with the unsupercharged 540; and the production of a three-seater model is under consideration.

*Rotor dia, 35ft; fuselage length, 29ft 9in; height, 9ft 6in; max weight, 3,100lb; empty, 1,975lb; max speed, 91kt; max climb, 1,160ft/min; hover ceiling o.g.e., 12,000ft; service ceiling, 20,000ft; range with auxiliary tanks, 420 n.m.*

**12 E** The current standard version of the "all-purpose" three-seater 360/UH-12 series, deliveries of which are now approaching 2,000, with the Hiller Rotor-Matic two-bladed rotor controlled by small servo surfaces at right angles to the main blades. Dual carburettors on the 305 h.p. Lycoming VO-540 increase high-altitude power by some 18 b.h.p. No 705 Sqn RN operates 21 of this model for training at Culdrose, Cornwall.

*Rotor dia, 35ft 5in; fuselage length, 28ft 6in; height, 9ft 4in; max weight, 2,800lb; empty, 1,760lb; max speed 83kt; max climb, 1,340ft/min; hover ceiling o.g.e., 5,800ft; range with auxiliary tanks, 435 n.m.*

**OH-23G** US Army version of the 12E, of which deliveries began last year and orders total 350. Two-thirds of the US Army's light helicopters are OH-23 Ravens.




# FAIREY HYDRAULICS

We can't show you a range of Fairey hydraulic power-controls because each one is tailor-made for the aircraft it equips. Let's just say they are fitted to over 24 different basic types—including such sophisticated newcomers as the P.1127 V.T.O.L. fighter and the Trident airliner—and that Fairey's have unequalled experience in designing and manufacturing hydraulic power-controls.

***Whatever your aeroplane or problem—civil or military, vertical take-off or straight-and-level—Fairey can provide the answer***


# RUNWAY LENGTH - ZERO

Military tactics of the future will call for strike aircraft capable of operating anywhere in the world. Hawker Siddeley have already met this need with the P.1127 which takes-off vertically, or in very short distances with heavy armament loads, from rough unprepared surfaces.

The pilot of the P.1127 can take-off from almost any surface without causing erosion or debris ingestion, since the thrust from its Bristol Siddeley Pegasus jet is directed downwards only at the moment of take-off.

The P.1127 first took to the air more than three years ago and several are now flying. Their logical successor—the supersonic P.1154—is now being developed for the Royal Air Force.

# HAWKER SIDDELEY

# V/STOL

Hawker Siddeley Aviation, 32 Duke Street, St. James's, London S.W.1. The largest aerospace group in Europe manufacturing civil airliners, civil and military transports, military strike aircraft, military trainers, business aircraft, missiles, rockets and a wide range of components and aerospace equipment. Hawker Siddeley, with world-wide sales and service facilities, also supplies transformers, switchgear, alternators and other heavy electrical plant, locomotives, marine and industrial diesel engines from 3·5 to 7,072 BHP, transport refrigeration units, land, sea and air navigation systems, light alloy products, sewage treatment plant, agricultural equipment and light and heavy general engineering products.

## VTOL AIRCRAFT 1964 . . .

In October 1963 an OH-23G established six class speed records, with a maximum of 123.77 m.p.h. (108kt).

**E4** A four-seater version of the 12E, distinguished by an enlarged vee tail, which has been mainly sold abroad.

**OH-23F** A US Army version of the E4, bought for the Inter-American Geodetic Survey in Central and South America.

**OH-5A** This completely new aircraft was one of the three designs chosen in 1961 for evaluation by the US Army as an armed light observation helicopter (LOH), to be decided this summer; the winner will reap the largest contract placed since the war, estimates varying from 3,600 to 12,000! The first of the five trial aircraft was delivered over a 2,300-mile ferry flight at an average ground speed of 150 m.p.h. The engine is the 250 s.h.p. Allison T63-A-5 free-turbine.

*Rotor dia, 35ft 5in; fuselage length, 27ft 10in; height, 9ft 4in; max speed over 130kt.*

**TL 5** A 12E stretched to seat five and to take a 578 s.h.p. United Aircraft of Canada PT6 turbine derated to 350 h.p. Developed jointly by Hiller and UAC under Canadian Army contract.

*Max weight, 3,100lb; empty, 1,770lb; max speed, 98kt; max vertical climb, 1,060ft/min; hover ceiling o.g.e., 13,000ft; service ceiling, 18,500ft; normal range, 120 n.m.*

**Ten99** This is a considerable departure from the characteristic Hiller configuration, but it retains the two-bladed auto-stabilized rotor (like the SL 4) and the tubular tail-rotor boom with inverted-vee tail. The boom is attached to the top of a box-like "observation-car" cabin, on the roof of which is a 550 s.h.p. UAC PT6B. The 100 cu ft cabin seats six, and has four side doors and rear clamshell doors. The Ten99 has been flying for two years, but as yet there is no information about certification or production. The only data released are given below.

*Fuselage length, 29ft; height, 10ft; max weight, 3,500lb; empty, 1,900lb.*

### Hughes Tool Company, Aircraft Division

*Culver City, California*

**Model 269A** Over 200 of this light two-seater have been built since October 1961, development having started in September 1955. As the YHO-2, it was evaluated by the US Army. It is a distinctive aircraft, with a "dragon-fly's head" glazed cabin, triangulated welded-tube centre structure, single-tube tail-rotor boom and sprung skid undercarriage with handling wheels at the skid tips. A 180 h.p. Lycoming HO-360-B1B drives the three-blade main and two-blade tail rotors.

*Rotor dia, 25ft; length, 22ft 3in; height, 7ft 11in; max weight, 1,600lb; empty, 910lb; max speed, 75kt; max climb, 1,450ft/min; hover ceiling o.g.e., 3,500ft; normal endurance, 2.5hr.*

**Model 369** As the OH-6A this is the third entrant for the US Army LOH competition, and is at present being evaluated. Like its rivals it is powered by the 250 s.h.p. Allison T63-A-5 turbine. This helicopter has a clean egg-shaped four-seat cabin, above which is mounted the engine, behind and close under the four-blade main rotor. A tapering monocoque boom carries the two-blade tail rotor, asymmetric tailplane and tail skid. A skid undercarriage, with streamlined legs and tip handling wheels is fitted. No data are available.

**Hughes 385** Since November 1961 Hughes have been jointly developing for the US Army a tip-drive helicopter with the designation XV-9A. It is intended to explore the economics and performance of the hot-gas cycle system in which the whole efflux of gas-turbine engines may be discharged through the hollow rotor blades to cascade nozzles at the tips without supplementary combustion. In the Hughes design a General Electric T64 (usually a shaft-drive engine) is mounted in an outboard nacelle on the tip of a stub-wing on each side of the finely streamlined fuselage. At take-off the gas from each engine is passed through a diverter valve and ducting to the hub of the rotor and thence along the three blades. In cruising flight some or all of the engine efflux will be discharged through propulsive nozzles at the rear of the powerplant nacelles. The crew of two are seated in a bubble cockpit in the nose, the undercarriage is of the fixed tailwheel type and there is a butterfly tail unit. Rotor rig testing began last year, and the first flight is expected in July.

*Gross weight, 15,300lb; max payload, 6,850lb; max speed, 150kt; other data restricted.*

### Jovair Corporation

*11920 West Jefferson Boulevard, Culver City, California*

**Sedan 4E** The tandem-rotor formula of D. K. Jovanovich has been under development for some 15 years and the 4E received a FAA C of A in 1962. It is a four-seater, with an enclosed steel-tube fuselage, a tricycle undercarriage and a 210 h.p. Franklin 6A-335. It is available for production in this form; also as the 4ES, with 225 h.p. supercharged engine; and with a stripped fuselage as the 4A, when it can be either a two-seat trainer, a single-seater with a 600lb payload or carry a sprayboom and 67 Imp gal chemical tank. Data are for the 4E.

*Rotor dia (both), 23ft; fuselage length, 18ft; height, 9ft 3in; max weight, 2,300lb; empty, 1,465lb; max speed, 78kt; cruise 69kt; max climb, 800ft/min; max payload range, 220 n.m.*

**J 2** This side-by-side two-seat autogyro has been flying since June 1962. An increased-diameter three-blade 4E rotor is driven by a 180 h.p. Lycoming O-360 installed, with a pusher propeller, between tail booms on the ends of stub wings which carry the main legs of the tricycle undercarriage. There is no news about production or certification.

*Rotor dia, 27ft; length, 16ft; height, 16ft; max weight, 1,360lb; empty, 810lb; max speed, 109kt; cruise 96-104kt; max climb, 1,000ft/min; max payload range, 260 n.m.*

### The Kaman Aircraft Corporation

*Old Windsor Road, Bloomfield, Connecticut*

**Model 600-3 Huskie** Since 1945 Charles H. Kaman's intermeshing contra-rotating rotor and servo-flap control have been distinctive. The present version is in service with the USAF mainly for rescue duties (where the twin-rotor downwash is particularly effective in suppressing waves or clearing flames) as the HH-43B with 825 s.h.p. Lycoming T53-L-1B and as the HH-43F with the 1,100 s.h.p. T53-L-11. A "box-car" fuselage with clamshell rear doors can seat 12 equipped troops plus two pilots. The rotors are mounted on two pylons canted outward. A four-fin tail is carried on twin booms, between which lies the engine exhaust duct. The four-wheel undercarriage has small "bear-paw" skis for bush or snow landings. An important performance feature of the Huskie is a negligible "dead-man's curve," and it set up several class records for height, climb and distance in 1961 and 1962. Data are for the HH-43F.

*Rotor dia 47ft; fuselage length, 25ft 2in; height, 12ft 6in; max weight, 9,150lb; empty, 4,620lb; max speed, 112kt at 18,000ft; max vertical climb, 640ft/min; hover ceiling o.g.e., max weight, 4,000ft; range, max weight, 260 n.m.*

**K 1125 Huskie III** The status of this cleaned-up, civilianized version of the USAF type is not clear. It was company financed, the prototype flying in August 1962 powered by two 500 s.h.p. Boeing YT60 turbines mounted fore and aft of the rotor differential gearbox. The Huskie III is now flying with two 770 s.h.p. UAC PT6B-11 turbines. The rotors, their drive system, much of the fuselage and the undercarriage are Huskie II parts; but there is now a single slender tail boom with high-aspect-ratio tailplane, fin and rudder. The fuselage is equipped for a crew of two, with 12 troop or six VIP seats. The cabin is entered by an integral tail ramp which has passenger stairs incorporated. Data are for the PT6 version.

*Rotor dia (both), 47ft; fuselage length, 41ft 6in; max weight, 13,000lb; normal, 10,000lb; empty, 5,200lb; max speed, normal weight, 117kt; cruise, 112kt; max climb, 1,650ft/min; hover ceiling o.g.e., 6,600ft; normal range, 10 per cent reserve, 325 n.m.*

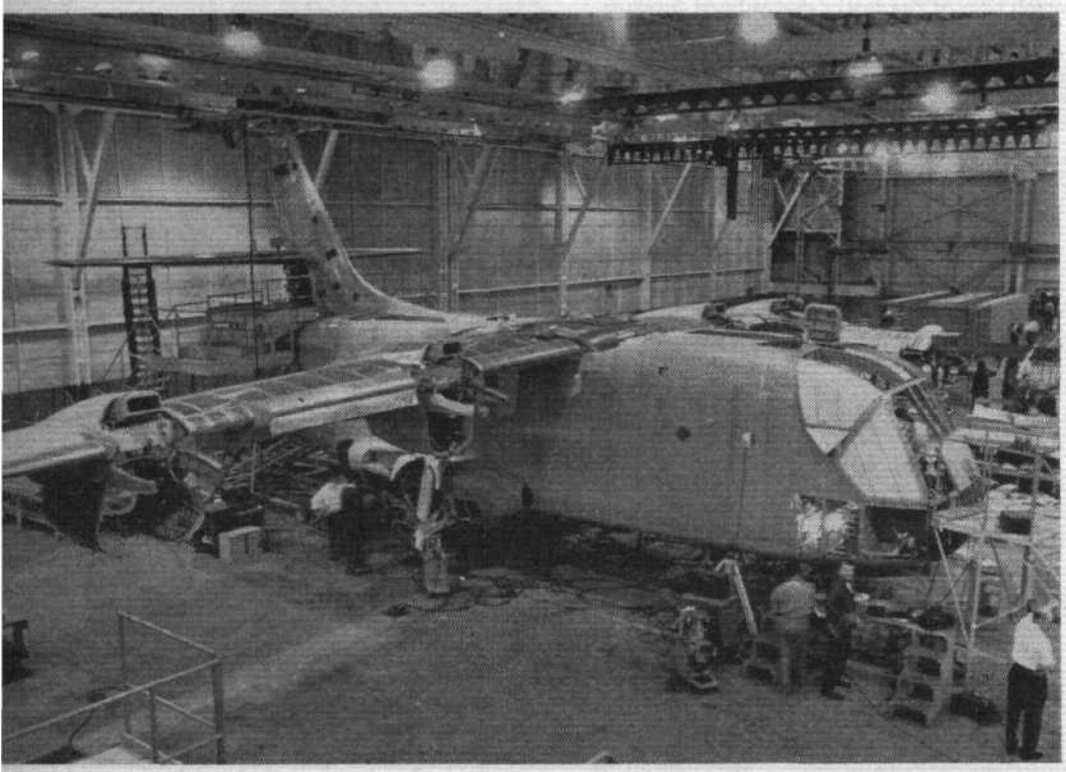
*Hiller Ten99 eight-seater*

*Hughes 300*

*Ling-Temco-Vought Adam II (artist's impression)*

as the Tomahawk) and has been evaluating them as a possible interim armed helicopter, but at the time of writing it seems that economics have ruled out an Army production order. For the offensive role stub winglets are attached to the bottom of the fuselage on which rocket pods, missiles or guns can be mounted. Under a US Army Transportation Research Command contract Kaman has modified a UH-2 with jet pods at the fuselage shoulder to investigate the high-speed rotor characteristics to their limit. The pods contain GE YJ-85 engines of about 2,500lb thrust each, and speeds in excess of 200 m.p.h. have already been recorded.

*Rotor dia, 44ft; length, 36ft 7in; height, 13ft 6in; max weight, 10,700lb; normal, 8,700lb; empty, 5,150lb; max speed, 145kt; cruise, 134kt; vertical climb, 1,170ft/min; hover ceiling o.g.e., 6,800ft; service ceiling, 17,400ft; range 10 per cent reserve, 285 n.m., ferry at max weight, 965 n.m.; endurance, normal, 3.6hr.*



*The first Ling-Temco-Vought XC-142 nearing completion*

### Ling-Temco-Vought Inc

*PO Box 5003, Dallas 22, Texas*

**XC-142A** Ling-Temco-Vought Inc (ex Chance Vought) is the prime contractor for this experimental V/STOL tilt-wing transport for the US Services, of which five are on order. It is a joint programme with Hiller, design and construction of flaps, ailerons and the power transmission; and Ryan, design and manufacture of wing, tail, rear fuselage, engine nacelles and mountings. Roll-out is expected in June, with flight in August.

The tri-Service specification, under the ægis of the USAF, called for a capacity of 32 equipped troops or 8,000lb of freight, with a combat radius of about 200 n.m. and a ferry range of 2,250 n.m. carrying 4,000lb payload. The aircraft consists of a typical transport box fuselage, with a rear loading ramp, on a stubby undercarriage. A large, typical slow-flying, cruciform tail surface is supplemented by a horizontal tail balance airscrew. The 8.6 aspect ratio, slightly tapered wing tilts 100° to give backward movement or hovering in a tailwind. Four 2,850 s.h.p. GE T64-6 turboprops drive through a cross-shaft four large propellers which cover the whole wing with slipstream. Roll control during VTOL is provided by differential pitch, yaw by the ailerons in the slipstream, and pitch by the tail airscrew. A mixing linkage will vary these controls during transition until conventional aeroplane control is used in level flight. Leading-edge slats outboard of each engine will

## VTOL AIRCRAFT 1964...

**Model K-20** This helicopter breaks with the Kaman intermeshing-rotor tradition, although the servo flaps are retained on the single four-bladed rotor. The type was designed to a US Navy specification for a high-performance all-weather helicopter with a 0.1g vibration level throughout the speed range. The fuselage, which has an integral tail boom with a tall streamlined upward extension for the three-blade tail rotor, is of good aerodynamic form, with the single 1,250 s.h.p. GE T58 free-turbine neatly cowled on top of the cabin. A retractable tailwheel undercarriage is fitted. A crew of two plus 11 passengers, or four stretchers, or freight or equipment up to 4,000lb, are carried.

As the UH-2A Seasprite, this aircraft has been in service with the US Navy since December 1962 on general utility duties. The US Army has also bought some (known

*Kaman (K-20) UH-2 Tomahawk modified to carry rocket pods*

Lockheed CL-595 Aerogyro being flown hands-off


Lockheed 330 Hummingbird hovering

be used to correct the asymmetry of the slipstream to prevent stall at the critical transition point.

*Span, 67ft 6in; length, 58ft 2in; height, 26ft 1in; max weight, VTOL 42,500lb, STOL 44,500lb, empty 22,600lb; max speed, 355kt; cruise, 250kt; hover ceiling, 6,000ft.*

**Adam II** This is an original advanced PV project which has not yet received government finance. The scheme is to combine high-efficiency turbofans buried within the wing itself, so that the efflux can be deflected downward for VTOL, when there would be useful entrainment over the wing as in the jet flap. The turbofans would also contribute to economical fast cruising. Fore-and-aft balance and control would be provided by a fan in the fuselage nose.

### Lockheed Aircraft Corporation

*Burbank, California*

**Model 330 Hummingbird** This VTOL aircraft was made by Lockheed-Georgia under a US Army contract as the XV-4A. It looks like a conventional jet aeroplane with two close-coupled nacelles and very small wings. First tethered hover was on November 30, 1962, and first transition on February 11, 1963. Vertical thrust is obtained by diverting the engine efflux into a "mixing chamber" in the fuselage, where it acts as a jet-pump, thereby inducing some 40 per cent extra air mass flow. This thrust-augmentation helps the usual jet-lift arithmetic (thrust 105-115 per cent weight), but occupies considerable fuselage space. Stability and control are maintained by nose, tail and wing-tip jets. For take-off the pilot opens the fuselage doors, opens up the two 3,300lb s.t. P & W JT-12A jets and gets some 8,300lb lift-thrust. Tilting the nose down, he accelerates to 80kt, then turns the thrust of one engine aft, raising the nose to get positive incidence until at 120kt transition is completed after about 90sec. Due to the low thrust loading the Hummingbird can reach 10,000ft in 58sec, despite the small wings. The close setting of the engines allows one to be shut down for economical cruising.

*Span, 26ft; length, 33ft 9in; height, 11ft 10in; gross engine s.t., 6,600lb; max VTO weight, 7,200lb, empty, 5,000lb; max speed, s.l., 450kt; rate of climb, s.l. 18,000 ft/min, on one engine, 5,500ft/min; conventional take-off to 50ft, 2,070ft; range, VTO 250 n.m., ferry 520 n.m.*

**CL-595 Aerogyro** Two prototypes of this inherently stable rigid-rotor helicopter (designation XH-51A) have been built for US Army/Navy research by Lockheed-California. The rotor system consists of three blades attached to the rotorhead with freedom about the feathering axis only, together with balance weights, a gyro and a spring dashpot interposed between the pilot's controls and the rotor. A reduction of 50 per cent in rotor parts and 27 per cent in maintenance (under Service trials) is claimed. The aircraft itself has been made aerodynamically clean, even the skid undercarriage being retractable, to see how fast it can fly with a 450 s.h.p. UAC T74 (PT6) turbine.

*Rotor dia, 35ft; length, 31ft 10in; height, 8ft 3in; max weight, 3,500lb, empty, 2,130lb; max speed, estimated, 175kt (to date, 140kt); range, 300 n.m.*

### Omega Aircraft Corporation

*Old Liverpool Road, Syracuse, New York*

This company, now a subsidiary of Aero Industries Inc, is preparing for production the unusual twin-engined helicopter designs by B. W. Sznycer. These are of crane form, with a five-seater cabin at the front of a rectangular section tubular lattice girder, the rotor is driven by two piston engines mounted athwartships, and there is a lanky tricycle undercarriage. Owing to the engine position the four-bladed rotor is mounted high. There is a two-bladed tail rotor and a tiny horizontal trim plane. The BS12-D1 has a type C of A with Lycoming engines; but it is the D3-S, with 260 h.p. Franklin

Omega crane-style light helicopter

6AS-335, which should be certificated in June, that is going into production. In June the BS12-DF-S should fly and is expected to be the next to be made in quantity. It has a two-seater cabin and can carry either an eight-seat cabin pod or a crane freight load. Data are for the BS12-D3-S.

*Rotor dia, 39ft; overall length, 48ft 5in; height, 13ft; max weight, 4,925lb, empty, 3,425lb; max speed, 83kt; rate of climb, 1,000ft/min; hover ceiling, 4,500ft; service ceiling, 9,500ft; range, 150 n.m.*

### Piasecki Aircaft Corporation

*Island Road, International Airport, Philadelphia 42, Pennsylvania*

**Model 16H Pathfinder** This is a helicopter in which the rotor is off-loaded by a small fixed wing in high-speed flight; but,

Piasecki 16H Pathfinder


*Sikorsky CH-3B (S-61A) retrieving a Q-2C drone*

**VTOL AIRCRAFT 1964 . . .**

although propulsion is by a propeller, the drive to the rotor is not cut off and the latter does not go into autorotation for cruising. The private-venture prototype flew in February 1962 as a partially stripped helicopter and was flying in its definitive form by the autumn. Production status is not revealed. The Pathfinder has a well-streamlined aeroplane-style fuselage with a five-seater cabin. The three-bladed rotor is mounted on a streamlined pylon, aft of which is a 500 s.h.p. UAC PT6B-2 turbine. A small tapered low wing, with flaps, is fitted. To the rear of the fuselage are attached cruciform fins which support an annulus in which revolves a propeller. Aft of the propeller are four rudder surfaces. A tailwheel undercarriage is fitted, the lever-action main wheels of which retract into the fuselage. The rotor blades and the mainplanes fold, the latter upward. In operation, the Pathfinder takes off as a helicopter, the propeller and rudders providing anti-torque control. Acceleration is achieved by directing power from the rotor into the propeller and as speed increases the wings take a larger share of the lift. Greater weight can be lifted with a ground run.

*Rotor dia, 41ft; span n.a.; length, 25ft; height, 10ft 8in; max weight, 5,700lb (this figure is for ground-run take-off of 650ft to 50ft; VTO max weight n.a.), empty, 2,600lb; max speed, 147kt; max rate of climb, 1,000ft/min; hover ceiling o.g.e., 6,200ft; range with 1,950lb payload, 10 per cent reserve, 530 n.m.; with max fuel, 10 per cent reserve, 1,360 n.m.*

**Model 59** This was the pioneer shrouded-propeller VTOL vehicle which the US Army bought for experiments in rough duty over difficult terrain before the advent of the ACV. The first version was the VZ-8P Airgeep I, which was later fitted with pontoons, when it became the Seageep I. An improved version, the Airgeep II (Model PA-59H, or VZ-8P-B) has been flying since the summer of 1962. Both aircraft have two propellers in short-chord annular ducts driven by two 400 h.p. Turbomeca Artouste single-shaft turbines coupled so that either can drive both fans. Controls are similar to a helicopter, but they act upon vanes in the annuli. The Mk II has the fans set at a dihedral and is fitted with a tricycle undercarriage. Data are for the Mk II.

*Length, 24ft 5in; width, 9ft 3in; height, 5ft 10in; max weight, 4,800lb.*

### Ryan Aeronautical Company

*Lindbergh Field, San Diego 12, California*

**XV-5A** The two prototypes of this US-Army-sponsored experimental V/STOL jet aircraft were delivered to Edwards AFB and the NASA Ames Research Center in February and March. Before the first free flights the aerodynamic behaviour will be checked in the 40ft by 80ft wind tunnel, as this will be the first full-scale wing-fan aircraft to fly. A two-seater, it has a conventional wing and tail with control surfaces and flaps, plus multi-blade fans let into the wing and the fuselage nose. In the fuselage top deck are two 2,660lb-thrust GE J85 turbojets which normally exhaust under the tail. For vertical flight the efflux is deflected into two bifurcated ducts which feed into volutes that impel the tip-bucket drives of the wing fans. The delivery is cross-coupled so that the port engine delivers to the forward volute of both fans, while the starboard one feeds the rear volutes. Similarly, each engine supplies the nose fan through separate ducting. In this way an engine failure cannot have an asymmetric effect and the duct capacities are always matched to the deliveries. The fans are estimated to augment the jet thrust by nearly 300 per cent and therefore to offer relatively economical lift. In addition to doors over the fan openings there are deflector vanes to assist control and transition.

The chief question-mark is whether wing lift can build up satisfactorily in the presence of the fan airflow through the wing. The nose fan has a maximum lift of 1,750lb and its thrust gives pitch control, while the wing fans and their louvres are adjusted to give roll and yaw—all through the stick and rudder pedals. An additional control is a "lift stick," like a collective-pitch lever and having a twist grip throttle, to raise and lower the aircraft during VTOL.

*Span, 29ft 9in; main fan dia, 5ft 3in; length, 44ft 6in; height, 14ft 9in; gross engine s.t., 5,320lb; max weight, 9,200lb, empty, 4,350lb; max speed at s.l., Mach 0.72 (475kt), at 25,000ft Mach 0.77; transition speed, 105kt; stall, clean 100kt, flaps down, 82kt; max rate of climb, 9,500ft/min; absolute ceiling, 40,000ft; ferry range with 4,650lb internal fuel, Mach 0.7 at 35,000ft and 10 per cent reserve, 1,065 n.m.*

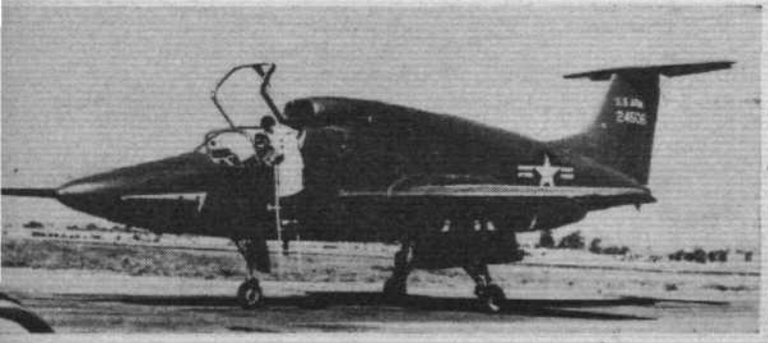
### Sikorsky Aircraft, Division of United Aircraft Corporation

*Stratford, Connecticut*

**S-58** Few pioneer companies have maintained so pronounced a leadership as has Sikorsky—ever since Igor Sikorsky made his historic controlled helicopter flights a quarter of a century ago. In this period 4,216 helicopters have been built, mainly in the larger sizes, and the best seller has been the S-58, with 1,733 examples by March

*Right, Sikorsky S-62*

*Below, Ryan XV-5A*



this year (American production continues for West Germany). Data are for the standard US version, i.e., the Navy SH-34J Seabat, the Army CH-34A/C Choctaw and the Marine UH-34D, with 1,525 h.p. Wright R-1820 piston engine.

*Rotor dia, 56ft; fuselage length, 46ft 9in; height, 15ft 11in; max weight, 13,000lb, empty 7,900lb; max speed, 106kt; cruise, 84kt; max rate of climb, 1,100ft/min; hover ceiling o.g.e., 2,400ft; service ceiling, 9,500ft; max range, 215 n.m.*

**S-61A/B** The US Navy ordered this helicopter for anti-submarine hunter/killer duties in September 1957 and it was in service by the end of 1961 as the HSS-2 (now SH-3A Sea King). An amphibious hull, with side floats, and twin turbine power—two GE T58 engines—were new features now almost universal in larger helicopters. It was also the first in production with a five-bladed main rotor. The anti-submarine version is in service with the RCN as the CHSS-2, with the USAF as the utility transport CH-3B, and with the US Army as the VH-3A "top brass" transport. Data are for the CH-3B with 1,250 s.h.p. GE T58-8 free turbines.

*Rotor dia, 62ft; fuselage length, 54ft 9in; height, 15ft 4in; max weight, 19,100lb, empty, 11,190lb; max speed, 138kt; cruise, 126kt; max climb, 1,500ft/min; hover ceiling o.g.e., 1,700ft; max range, 470 n.m.*

**S-61L/N** The obvious commercial transport possibilities of the S-61 formula were realized in the S-61L, which flew in December 1960 and received its civil C of A in November 1961. It was quickly ordered by Los Angeles Airways and by Japan. The S-61N has a sealed hull and floats for amphibious operation. It has been bought by Pakistan International Airlines, BEA, New York Airways and Ansett-ANA. Both versions carry a two-pilot crew, plus either 28 seats (or 25 with toilet and galley) and 100 cu ft of baggage space. Data are for the S-61N.

*Rotor dia, 62ft; fuselage length, 59ft 4in; height, 17ft; max weight, 19,000lb, empty, 11,730lb; max speed, 130kt; cruise, 122kt; max rate of climb, 1,300ft/min; hover ceiling i.g.e., 6,700ft; service ceiling, 11,500ft; range, 240 n.m.*

**S-61R** This is the USAF CH-3C, which flew in June 1963 and was delivered to an operational squadron and received its FAA Type C of A in December. The hull and tail boom have been considerably altered to accommodate a rear loading ramp and the substitution of large sponsons for the side floats. To meet greater load variation a larger trim plane is fitted. The retractable undercarriage has nosewheels instead of a tailwheel. There is a 2,000lb-capacity internal cargo winch.

By the time this issue appears a modified S-61R should have completed its initial series of flight trials in order to demonstrate that it can fully meet the original US Air Force specifications and those issued for a heavy logistics helicopter for the Federal German Air Force. Increases in equipped empty weight are reported to lie at the root of the shortfall in payload/range performance, and the alterations include a slight increase in diameter of the main rotor (by adding elliptical tips) and tail rotor (by extending each hub and root fixing by 4in), and replacing the present landing gear by a simple non-amphibious land undercarriage similar to that of the S-61L/N. It is also likely that the 1,400 s.h.p. T58-10 engine will become standard in helicopters of this type next year. Special versions of the 61R may be bought by the US Army Special Warfare Group and other US Services, and civil sales are anticipated.

*Rotor dia, 62ft; fuselage length, 56ft 11in; height, 18ft; max weight, 22,000lb, normal, 19,500lb, empty, 11,325lb; max speed, 143kt; cruise, 126kt; max climb, 1,100ft/min, vertical, 820ft/min; hover ceiling o.g.e., 3,800ft, service ceiling, 12,000ft, at max weight, 7,800ft; range, 10 per cent reserve, normal 205 n.m., ferry 700 n.m.*


*Artist's impression of Sikorsky S-65A*

**S-62A/B** This, the first production Sikorsky turbine-powered helicopter, flew in May 1958 with S-55 rotor and transmission components; later, in the B model, a cropped S-58 main rotor was substituted. The S-62A was first sold to Petroleum Helicopters Inc, then to the Indian Air Force, Thailand Police, Okanagan Air Services, Nitto, Fuji, Nakenihon and Nishinchon airlines in Japan, San Francisco and Oakland Helicopter Airlines, World Wide Helicopters, the Humble Oil and Refining Co and the Canadian DOT. Commercially the S-62 is amphibious and carries two pilots and 11 passengers. A developed version, the HH-52A, was ordered by the US Coast Guard, delivery starting in January 1963. Data are for this model with the 1,250 s.h.p. GE T58-8 free turbine.

*Rotor dia, 53ft; fuselage length, 44ft 7in; height, 14ft 2in; max weight, 8,300lb, normal, 8,100lb, empty, 5,085lb; max speed, 95kt; cruise, 85kt; max rate of climb, 1,080ft/min, vertical, 100ft/min; hover ceiling o.g.e., 1,700ft, service ceiling, 10,200ft; range, 390 n.m.*

**S-64A Skycrane** This flying crane is being developed in association with the West Germans, two prototypes being on intensive development in that country. Six have been ordered by the US Army (designation CH-54A) to investigate the need and operation of heavy crane helicopters on the battlefield. The appearance of this aircraft, with its six-bladed rotor, driver's cab, spinal fuselage and straddle main legs is becoming familiar at American and European air shows. The engines are two 4,050 s.h.p. Pratt & Whitney free-turbines, mounted ahead of the rotor pylon. Any payload up to 20,000lb is slung beneath the fuselage. Delivery of the development aircraft is due in the summer and a FAA civil certification programme has been started.

*Rotor dia, 72ft; fuselage length, 70ft 3in; height, 18ft 7in; max weight, 38,000lb, empty, 17,240lb; max speed, 108kt; cruise, 96kt; max rate of climb, 1,400ft/min, vertical 800ft/min; service ceiling, 10,500ft; max range, 150 n.m.*

**S-65A** This heavy assault transport was ordered by the USN for the Marine Corps in August 1962 under the designation CH-53A. The hull is similar to the S-61R, being fully seaworthy and with a rear loading ramp. Long, narrow sponsons are fitted along the sides of the hull. The two 2,850 s.h.p. GE T64 engines are mounted in nacelles alongside the large rotor pylon. Six-bladed main and four-bladed tail rotors are fitted. The tricycle undercarriage is low-set and fitted with twin wheels on each leg. A crew of three with 38 troops or some 10,000lb of guns and trucks can be uplifted.

*Rotor dia, 72ft; fuselage length, 67ft 3in; height, 16ft 7in; max weight, 33,485lb, empty, 20,950lb; max speed, 170kt; cruise, 150kt; max rate of climb, 1,800ft/min; hover ceiling o.g.e., 7,200ft, service ceiling, 16,700ft; range 250 n.m.*

### Skyway Engineering Co Inc

*251 Second Street, S W, Carmel, Indiana*

**AC-35** This company was formed in 1959 to take over the rights of the original roadable autogyro from the Autogiro Company of America. The design has been revised and a 210 h.p. Continental engine fitted in place of the 90 h.p. Pobjoy. A prototype is scheduled to fly this year. The aircraft is a simple cabin two-seater with a tractor propeller, three-blade rotor, conventional tail surfaces and without wings.

*Rotor dia, 38ft; fuselage length, 18ft 11in; height, 8ft 10in; max weight, 1,750lb, empty, 1,175lb; max speed, 116kt; cruise, 99-106kt; rate of climb, 950ft/min; take-off to 50ft, 50ft; range, 350 n.m.*

### Vertigyro Company

*Rhode Island, New York*

**VG-1** The Austrian rotary wing experimenter Bruno Nagler has obtained backing in America and is flight testing his theories for an auxiliary-powered autogyro with an aircraft comprising a Piper Colt fuselage with a Sud-Aviation Djinn rotor driven by compressed air from an AiResearch gas generator. It is claimed that this testbed, in addition to making vertical take-offs to nearly 150ft before transition, can fly at 65kt as a jet-driven helicopter, at 80kt as an autogyro and at 95kt using both power units. A definitive model, the VG-2 is expected to fly at the end of this year. This is a two-seater with an egg-shaped nacelle, tail booms and high-set tail. A 230 h.p. Franklin pusher engine is used for propulsion, with a BMW turbine to supply the rotor; alternatively the main engine can drive the air compressor. A cruising speed of 130kt is estimated, with a hover ceiling out of ground effect of 5,000ft and a range of 215 n.m. An empty weight of 1,040lb, with a loaded weight of 1,630lb have been quoted.

*Kamov Ka-22 Vintokryl*

## VTOL AIRCRAFT 1964 . . .

## U S S R

### Nikolai I. Kamov

**Ka-18 ("Hog")** A four-seat utility helicopter developed from the same designer's Ka-15 two-seater. A well-formed fuselage carries a twin-fin tail and four-wheel undercarriage. Three-blade co-axial rotors are driven by a 275 h.p. Ivchenko AI-14V radial piston engine. De-icing is standard, and all-weather and night-flying equipment can be fitted.

*Rotor dia, 33ft; length, 23ft; height, 11ft; max weight, 2,890lb; empty, 2,255lb; max speed, 80kt; cruise, 60-65kt; service ceiling, 11,500ft; range, 215-400 n.m.*

**Ka-20 ("Harp")** Similar in layout to the Ka-18, this larger helicopter is powered by two small turbines mounted on the roof, ahead of the rotor mast, and has a triple-fin tail. It was seen at the 1961 Soviet Aviation Day flypast carrying two air-to-surface missiles on outriggers, a chin radome and, apparently, two bow guns. It is presumably for anti-shipping patrols.

**Ka-22 Vintokryl ("Hoop")** This large twin-turboprop convertiplane established a formidable set of class records in 1961: 356.3km/hr (193kt) over 15/25km; 15,000kg (33,070lb) payload to 2,558m (8,500ft), also beating the figures for 1,000/2,000/5,000/10,000kg; and reached 2,000m (6,560ft) with a payload of 16,485kg (36,345lb).

The Ka-22 has a long square-section fuselage with a raised cockpit, a slightly tapered wing of about 90ft span, and a single-fin tail unit. Control surfaces and flaps are conventional. The undercarriage is a fixed nosewheel type. At the tips of the wings are mounted two 5,600 s.h.p. TB-2 turboprops and four-bladed rotors. From the size of the wing it is evident that after take-off and acceleration the Vintokryl (screw-wing) will cruise in autorotation.

### Mikhail L. Mil

**Moskvich ("Hare")** The latest in the series of helicopters originating from the Mi-1 of 1950. It incorporates numerous refinements, including metal rotor blades and power controls. A four-seater, it is powered by a 575 h.p. AI-26V seven-cylinder radial. In May 1963 a distance record of 1,200km (684 n.m.) in closed-circuit was flown in 8.5hr.

*Rotor dia, 46ft; fuselage length, 40ft; height, 11ft; max weight, 4,960lb; empty, 3,925lb; max speed, 110kt; cruise, 75kt; hover ceiling o.g.e. ,6,560ft; range, 190-320 n.m.*

**Mi-4 ("Hound")** This is the "S-58" of the Mil family and it has been exported to at least ten countries. In April 1956 an Mi-4 established a class record by lifting 2,000kg (4,400lb) to 6,018m (19,750ft). The four-blade rotor is driven by a 1,700 h.p. ASh-82V fourteen-cylinder radial.

*Rotor dia, 69ft; fuselage length, 55ft; height, 17ft; max weight, 16,750lb; normal, 15,870lb; empty, 13,220lb; max speed, 5,000ft, 113kt; cruise, 86kt; service ceiling, 16,000ft; range with 11 passengers plus 220lb baggage, 135 n.m.; with eight passengers plus 220lb, 215 n.m.*

**Mi-6 ("Hook")** Dating from 1957, this is still the largest helicopter, with the two 4,635 s.h.p. Soloviev TB-2BM turbines on top of the fuselage, its small shoulder wing and its six-bladed rotor. It is understood that 35 are being, or have been, built. Several international records are held: notably 44,350lb to 6,560ft, 11,000lb at 153kt on a 1,000km circuit, and 11000lb. to 18,320ft. There are rear loading doors and the cabin can hold 75 to 120 passengers.

*Rotor dia, 115ft; max weight, 86,000lb; empty, 41,000lb.*

**V-2** An enlarged version of the Mi-1 announced in 1961 and in service with Aeroflot. Two 400 s.h.p. GTD-350 shaft turbines are mounted on top of the roof of the unobstructed eight-seat cabin. In May 1963 this helicopter established a speed record of 137kt over a 100km closed circuit.

**V-8 ("Hip")** This is said to have the same overall dimensions as the Mi-4, but there the resemblance ends. The fuselage is larger and of better aerodynamic shape, with two 1,300 s.h.p. turbines on the roof ahead of the four-blade rotor. There is a fixed nosewheel-type undercarriage and external cylindrical fuel tanks. The cabin seats 24, the payload being 5,500/6,600lb.

**V-10 ("Harke")** A crane version of the Mi-6 was one of the many revelations at the 1961 Aviation Day at Tushino. This palpably has the original engine and rotor installation, but the fuselage is comparatively shallow and is mounted on a tall straddle undercarriage with four pairs of wheels. Unlike most cranes, the V-10 has a long passenger cabin with a dozen windows on each side. As in the Mi-6 and V-8, cylindrical droppable tanks are slung on each side of the fuselage. There are no winglets. In October 1961 the V-10 lifted a 15,103kg (33,300lb) payload to 2,326m (7,630ft).

**Yak-24** A tandem-rotor heavy transport helicopter with two 1,700 h.p. ASh-82V radials in which the four-bladed rotor of the Mi-4 was originally used in 1953. It has a square-section fuselage and a tailplane with end-plate fins. The 24A carries 30 passengers; the 24K has an abbreviated fuselage with nine luxury seats and airstairs; while the 24P has two Ivchenko shaft turbines and carries 39 passengers.

*Rotor dia, 79ft; length, 80ft; height, 23ft; max weight, 35,300lb; max speed, 95kt (24P, 114kt); cruise, 85kt (98kt); range, 110 n.m. (140 n.m.).*

*Mil V-2*

SPORT AND BUSINESS

*Some of the 140 aircraft which went to Jersey. Almost three times that number would have been entered had acceptances not been limited*

# FULL HOUSE AT JERSEY

THERE have now been ten Channel Islands International Air Rallies, their success increasing year by year. For this year's event, in fact, the Channel Islands Aero Club had to limit the numbers to 385 visitors in 140 aircraft, although almost a thousand people would like to have taken part and 394 aircraft would have been entered. The rally took place over the weekend May 8-10.

As with most rallies of this kind (writes a participant), the idea is to fly to and from, take part in simple competitions and a *concours d'elegance*, and for the rest of the time to enjoy oneself and get to know the resort upon which the rally is based. There was very little formality—a *vin d'honneur* in the Town Hall at St Helier and a banquet with prizegiving on the final night.

A splendid selection of private aircraft, varying in size from a Queen Air from Lubeck to the smallest single-seaters from France, Belgium, Switzerland, Denmark and the British Isles, were shepherded into Jersey's airport, and in due course many of their pilots received prizes.

The president of the club, Deputy M. L. Thomas, took the chair at the banquet in the Hotel de France with Mr Julian Amery as guest of honour, and under the patronage of the Lieutenant Governor, Vice-Admiral Sir Michael Villiers.

The Minister, who flew to Jersey in a Beagle 206, proposed the toast of the club, congratulating Senator W. H. Krichefski on the Island's developments in aviation and the encouragement it was giving to private flying. Mr Amery remarked that Europe was far behind the Americans in private flying. "We must catch up, modernize, and adapt," he said. Referring to the Junior Wings scheme, he paid a generous tribute to *Flight International* for its "imaginative" gesture in offering a follow-up scholarship.

Speaking of the nineteenth anniversary of the island's liberation from the Germans, being celebrated that day, the Minister suggested that in two years' time there should be a "monster rally in memory of 1066 and all that."

Senator Krichefski, who is president of the States of Jersey Harbours and Airport Committee, thanked the Minister for his toast and for the help and co-operation of his Ministry since the liberation of the island. It was a happy thought, he said, that on this nineteenth anniversary of the liberation the first prize for the rally could be given to a young German pilot from Lubeck.

"The Guests" were proposed by Deputy M. L. Thomas, and Sir Alan Cobham amused everyone with stories of some of his early flying experiences. Before the prizes were presented by Lady Villiers, one visitor from each of the countries represented in the rally thanked the organizers.

The principal prize-winners (Grand Prix: navigation and airmanship; *concours d'elegance*; and best British and foreign entries) were H. Bauer (Queen Air, Lubeck), E. Wein (Picchio, UK), and G. W. Scheel (Tripacer, Lubeck). Special awards went to P. Holst (Turbulent), who flew from Denmark, and to T. A. Davis from Elstree, who gave a first-class display in his Spitfire. Other prizes were awarded to D. M. Parsons (Comanche 250, Fairoaks), L. P. Zobel (Jodel, Lubeck), A. McLennan (Cessna 210, Perth), — Westerbarkey (Cessna 175, Gutersloh), G. Lassen (Aztec, Hamburg), Mrs Sudborough (Cessna 172C, Bedfordshire), — Huebinger (Bölkow, Düsseldorf), S. Attwood (Autocar, Blackbushe), P. Genest (Jodel, Cosne) and M. W. Warner (Cessna 182). The club prize went to the Halfpenny Green Flying Club.

*Appropriately on this 19th anniversary of the island's liberation in 1945, a Spitfire 9, G-ASJV, was flown in and demonstrated by its owner, T. A. Davies*

*Winner of a special award was P. Holst, in a Turbulent from Denmark*

# Letters

*Letters for these columns are welcomed, though "Flight International" does not necessarily endorse the views expressed. Name and address should be given, not necessarily for publication in full. Brief letters will have a better chance of early publication.*

## Dichotomy in the Sixth

SIR,—Your recent leader "Strengthening the Junior Wings" (April 30) prompts me to write this letter.

I am most emphatically against the suggestion that the competition for the award should take the form of an essay. The sixth form in most schools is quite markedly split into "historians" and "scientists," the latter set being able to give much more to aviation. Would not the historians have the edge on us in the use of our language (English, not mathematics)?

Surely it would be justifiable to award the sum to the pupil for outstanding flying aptitude, his parents' financial circumstances, and most important of all, his likelihood of making his career in the realms of aeronautics.

Perhaps we shall be seeing company advertisements on the lines "fly on us now, work under us later"!

*Senior Sixth,* STEPHEN G. HARRIS
*Queen Mary's Grammar School,*
*Basingstoke, Hants*

## Buffet Speeds

SIR,—With reference to "$V_1$ $V_2$ and All That," Part 2, January 30, the definitions 3.1 and 3.2 for buffet speeds appear to be in error.

Your contributor "CCJ" states correctly in the preceding discussion that "Low Buffet Speed would be encountered at successively higher altitudes and Mach numbers," i.e., that Vslb varies *directly* with altitude. In definition 3.1 he states that Vslb (CAS or Mach) "varies inversely with altitude." In fact it is Mach which varies, CAS remaining constant for an aircraft of a particular weight. Similarly, having correctly stated that High Buffet Speed is encountered at "*decreasing* ceiling with speed," i.e., lower Mach number with increase in altitude, his definition 3.2 states the opposite.

*West Ewell, Surrey* M. H. SUTCLIFF
*Navigation Instructor, BEA*

## Untrustworthy Spot Heights

SIR,—Mr G. C. Scott's interesting article "Full of Sound—Signifying Nothing" in *Flight International* for April 30 prompts me to add to his views on flight safety having high priority, by drawing further attention to "Straight and Level" for March 19 in which UK Notam 65-75/1964 is quoted thus: "Map SE 47/138, Edition 2: Change spot elevation 2,690ft at 44° 05'N 06° 45'E to 8,264ft."

Roger Bacon remarked that he was glad this mistake had not killed anyone and of course I endorse that, but it does show that, as mountains do not grow in the night, a very serious state of affairs exists if spot heights on up-to-date maps can so easily be 5,574ft in error.

When I first saw that Notam I felt that no other spot height could be trusted 100 per cent and it will be seen from the co-ordinates that this is not in the wilds of Siberia but in the vicinity of Nice.

*Brighton 7* PHILIP M. CRITCHLEY

## The Bigger Concord and the Sonic Boom

SIR,—Although the recent changes in specification make the Concord project seem much more likely to be a commercial success, the sonic boom problem may be considerably more difficult to solve. Perhaps it is natural that BAC's statement (*Flight International*, May 7, p. 744) should be designed to allay any fears that the new gross weight might bring unacceptable intensities. But it is interesting to recall one recent public statement on this subject.

Your December 19, 1963 issue reported Dr A. E. Russell, deputy technical director of the BAC-Sud Concord programme, when at the RAeS London Airport branch panel discussion, as speaking thus: "A supersonic airliner weighing 400,000lb, the sort of weight the Americans are talking about, will certainly produce unacceptable sonic booms . . . 'I am certain of this,' said Dr Russell, 'because *we are only just sure that our own weight [262,350lb] is not too great*.' " (my italics). But now, the weight has been increased by almost 25 per cent, to 326,000lb.

BAC's statement notes that although the "volume effect" will be worse, this will be offset by the "lift effect," which will be less bad due to the lower wing loading. This raises the question—that I as an interested layman would naturally like answered—of whether in fact "lift effect" does not refer to the weight, but rather, refers to the wing loading? A situation which if taken to extremes seems somewhat surprising. Additionally, I find it difficult to reconcile the statement with certain basic facts given by Mr J. C. Floyd in the sixth Chadwick Memorial Lecture to the Manchester branch of the RAeS (see September 1961 issue of the Society's *Journal*). These are that (1) the lift effect is the dominant factor at high altitudes [i.e., the altitudes where the Concord will be going supersonic, presumably]; and (2) aircraft gross weight and altitude are the most powerful variables.

*Ipswich, Suffolk* K. C. REAVELL

## Letting the Passengers Hear the Patter

SIR,—Presumably Messrs Allen and Critchley (April 23 and May 7) would not expect to hear the air-to-ground communication in an emergency, so that should one develop, the broadcast would have to be abruptly switched off. This raises two points: first, that the passengers would realize something was amiss and become alarmed; secondly, that some member of the crew would have to spend some time (albeit a split second) in switching off—which might, in a sudden emergency, make all the difference between survival and non-survival.

*Leeds 2* R. M. SMITH

## Gasholder Landing System

SIR,—When aircraft mistake Northolt for Heathrow and appear to a large extent to rely on visual reference to two correspondingly placed gasholders, surely the only remedy is colour? I suggest one gasholder white and the other red. By differential labelling, as you suggest in the May 7 issue, and when flying into the sun, difficulty could be experienced in ascertaining which is which, whereas by colouring they would be instantly recognizable and at a far greater distance.

*Loughton, Essex* NOEL DUNMOW

## Engine Control in the Avro 504

SIR,—I was very interested to read Air Cdre Wheeler's reply (May 7) to my letter concerning the engine controls of the Avro 504K.

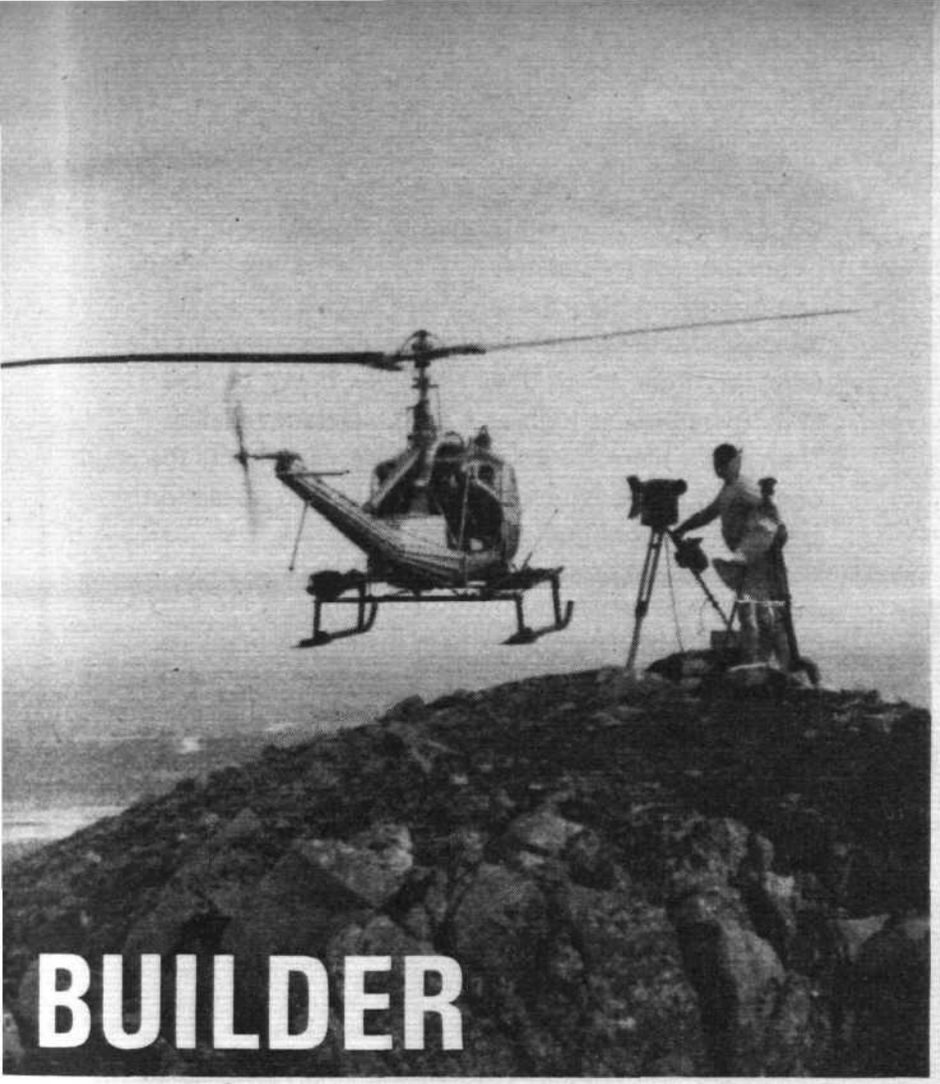
The incompletely reported sentence in his lecture to the Kronfeld Club, now explained in his reply, is perfectly correct. and I agree it was possible to run a rotary engine slowly without using the "blip" switch, but one had to be an expert.

Since quite a lot of juggling with the throttle and "fine adjustment" was required to hold the engine at a slow speed, the "blip" switch method of controlling engine speed was normally used by most pilots.

Another correspondent, Sqn Ldr Horrox, in the same issue mentions the Monosoupape rotary engine. This engine, I believe, became obsolete in the Avro 504K because of its unreliability and the fact that it had only single ignition, whilst the Clerget and Le Rhône both had dual ignition and were more reliable engines.

As regards the 504 with a Bristol Lucifer engine fitted, this was definitely a 504K, not a 504N, and was last seen by me at Southend aerodrome in 1936, when it called to refuel.

Although the Clerget and Le Rhône-powered 504K air-




Industry and the armed forces of the Free World continue to order and reorder Hiller 12E series helicopters. Repeatedly, critical evaluations of this aircraft against its latest rivals result in purchase of more 12E's. Steadily, the reputation of the 12E as a dependable workhorse increases world-wide.

There are sound reasons why analytical users continue to buy Hiller 12E's. Among them: the performance-where-it-counts of Hiller's unequalled 305 usable horsepower; Hiller's "growth potential factor" insuring the owner's investment against sudden obsolescence; speed—a Hiller OH-23G (U. S. Army 12E) recently flew 123.77 mph, set 6 world speed records; the reliability of a manufacturer which has delivered light helicopters to armies and industries for nearly two decades.

**HILLER**
AIRCRAFT COMPANY
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The Hiller 12E—world's most widely accepted light helicopter

## LETTERS...

craft were generally used in the joy-riding business up to about 1935, there were several fitted with the 80 h.p. air cooled vee-8 Renault engine to be seen each summer in North Wales in the early 1930s.

This Renault engine became the source of a large number of parts for the original Cirrus Mk I engine, and I believe it is correct to say that, except for a new crankcase and new design of cylinder head, almost everything else was Renault.

Further, the Cirrus I with only four cylinders gave almost as much power as the eight-cylinder Renault, presumably due to the efficient design of the cylinder heads.

*Swansea, Glam* C. S. WILLIAMS

SIR,—Concerning Squadron Leader Horrox's letter (May 7), the following particulars of Avro 504Ks with a variety of engines may interest him. I have personally flown or been flown in 504Ks as follows: *Monosoupape* (the original rotary for the type); *110 h.p. Le Rhône* (rotary); *130 h.p. Clerget* (rotary); *100 h.p. Anzani* (radial, ten cylinder in two banks of five, with automatic inlet valves and two five-cylinder-firing magnetos); *80 h.p. Renault* (vee-eight, air cooled—when fitted with this engine the type was re-named the 548).

I have also seen a 504 with a B.R.2 rotary, which overheated very badly in such a slow airframe: also (in 1917) a 504 with a front spider bearing to its Gnome rotary engine.

I also remember photographs of a 504K, in Australia, fitted with a 200 h.p. Sunbeam Arab vee-eight engine, water-cooled (in my opinion, probably the worst aero engine ever made!). Finally a 220 h.p. Wolseley Viper vee-eight (from an S.E.5A), water-cooled, was fitted in a 504K airframe, but again overheating could not be overcome. The Viper was a Hispano Suiza made under licence.

The Avro 504N was not a true 504 type at all, only a development from it. The "toothpick" undercarriage was scrapped in favour of an oleo and the weight of that, combined with the Lynx radial engine, necessitated the fitting of a variable-incidence tailplane. Many other detail alterations were also necessary.

*RAF Staff College, Andover, Hants* RIVERS OLDMEADOW

### The Paper You Can Trust?

SIR,—No doubt other air-minded readers of *The Daily Telegraph* were as surprised as myself recently, when they read details of the types of aircraft currently engaged by the RAF in the South Arabian operations.

As I waded through the gloomy news on the back page of the May 4 issue, despondency set in when I noted that ground operations were being supported by "rocket-firing Hurricanes"!

Faith was restored two days later, however, for on the front page on May 6, mention was made of "a Beverley helicopter." This would seem to be a major breakthrough for Britain, and I dare say we can look forward to reading about helicopter versions of the Hastings and Shackleton in the near future. I suggest that a *Flight International* photographer be dispatched to RAF Khormaksar with all speed.

*East Bolden, Co Durham* R. LEVY

### Preserving the Veterans

SIR,—I was most interested in the letter from Mr R. C. Brown (April 23), concerning our policy regarding historic aircraft.

Whilst I cannot agree with his contention that non-flying veteran aircraft are not worth saving (the thirteen thousand people who visited the Short Sunderland at Pembroke last summer would not agree either!) there is something to be said for this point of view. The annual Veteran Car Run to Brighton gives rise to a much greater interest in old cars that would be the case were these static for evermore.

The great difficulty is, of course, the huge increase in cost which is inseparable from any scheme to keep veteran aircraft in flying condition, particularly Second World War types like the high-powered twin-engined Mosquito.

In order that those enthusiasts who believe that the aircraft must fly to justify their existence may have the chance to assist in the good work of implementing such a scheme, a Skyfame Supporters' Society is to be formed very shortly. In this way, for a modest amount subscribed annually, a member will not only have free access to the Museum and flying demonstrations by its aircraft throughout the year, but will also have the immense satisfaction of knowing that he (or she) is contributing to the furtherance of a popular idea.

We will be interested to know readers' reactions to this plan. Perhaps Mr Brown would be the first subscriber?

*Staverton Airport, Cheltenham, Glos* PETER M. THOMAS, *Managing Director, Skyfame, Ltd*

### History of CFS Standards Squadrons

SIR,—For some considerable time one of the aims of the Central Flying School has been to ensure that the desired quality of flying and flying instruction is maintained throughout the RAF. At present the standardization elements of the CFS are known as Standards Squadrons, but in the past their task was carried out by the Examining Wing and for a while the Examining Flight.

Although much is known about the history of CFS generally, there seems to be a lack of photographic evidence available concerning the varied activities undertaken in the past by the predecessors of the Standards Squadrons.

I would, therefore, be grateful if any of your readers could supply us with photographs, either for retention or for copying, dealing with past activities and aircraft flown by either Examining Wing, Examining Flight or Standards Squadrons during their association with either CFS or ECFS. Any item sent on loan would, of course, be carefully treated.

It is hoped that in this way the present Standards organization will be able to build up a photographic record of its history for display in Standards Headquarters at the CFS.

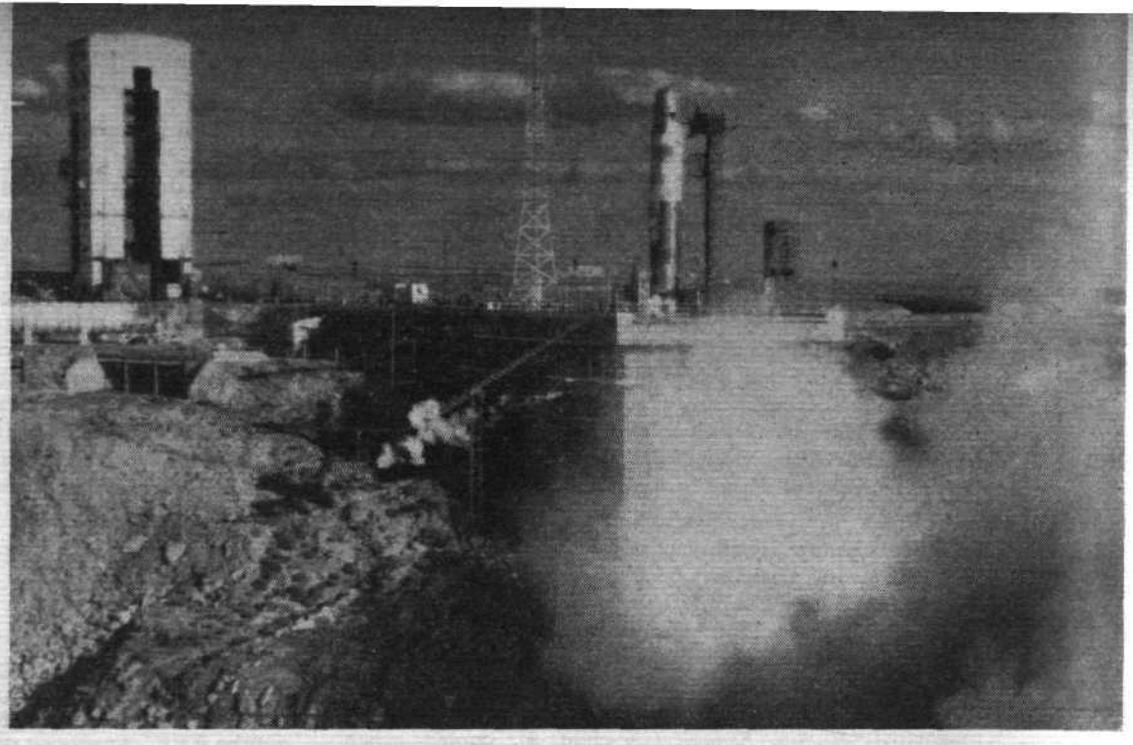
*Central Flying School, RAF Little Rissington, Cheltenham, Glos* J. HODGSON, *Sqn Ldr, RAF*

### In Brief

Photographs of Hurricanes and Spitfires at RAF Kenley in 1939 and 1940 are proving extremely difficult to locate, says Mr W. Gordon Newall, who hopes *Flight International* readers can help him. Mr Newall's address is 80 Beverley Road, Whyteleafe, Surrey.

### FORTHCOMING EVENTS

| | |
|---|---|
| **May 21** | *RAeS Rotorcraft Section: "The US Army's Light Observation Helicopter Project," by C. C. Crawford.* |
| **May 21** | *RAeS: Second Handley Page Memorial lecture: "Life and Work of Sir Frederick Handley Page," by Dr G. V. Lachmann.* |
| **May 22** | *RAeS Agricultural Aviation Group: a.g.m.* |
| **May 23** | *US Armed Forces day, Alconbury, near Huntingdon, and Bentwaters, near Woodbridge, Suffolk.* |
| **May 23-24** | *International "Wings Pilgrimage," Tarbes/Laloubère.* |
| **May 26** | *RAeS: Joint discussion with the IEE, "Designing and Engineering Aircraft Electrical Systems for Reliability," to be opened by G. G. Wakefield.* |
| **May 26-28** | *Society of Automotive Engineers: Air Cargo Forum, Montreal.* |
| **May 28** | *Fleet Air Arm Review, Yeovilton (entry by invitation ticket only).* |
| **May 28-June 7** | *Light Aviation Salon, Cannes; Paris - Cannes Race.* |
| **May 30** | *de Havilland Aerobatic Trophy, Ipswich.* |
| **May 30-31** | *Côte d'Amour Aero Club: 4th European Rally, la Baule.* |
| **May 30-31** | *Maconnais Aero Club: International Maçon rally, Maçon.* |
| **May 31** | *Waveney Flying Group: Light-aircraft rally, Seething.* |



*Static firing of Blue Streak F.1 on the launch pad at Lake Hart, Woomera. First flight test of the rocket is now scheduled for next week (May 25)*

# Missiles and Spaceflight

## APOLLO ESCAPE TEST

First flight test of the emergency-escape system designed for NASA's Apollo spacecraft was made successfully at White Sands missile range on May 13. A Little Joe II booster—six Recruit motors clustered around one Algol, with a total thrust exceeding 300,000lb—fired an engineering model of the Apollo craft to an altitude of about 21,000ft, where the launch escape system was triggered, carrying the command module away from the service module and the exploded Little Joe. At about 28,000ft the escape tower was jettisoned and parachutes were deployed to lower the command module to the ground.

The test was the first in a series of five unmanned flights scheduled to develop and demonstrate the Apollo launch escape system. The Apollo escape tower is similar to that used in the Mercury flights, and measures 10ft long by 46in × 50in at the base. Thrust of the 15ft 3in long, 26in diameter solid-fuel launch-escape motor is 155,000lb, while the tower-jettison motor produces 33,000lb thrust.

A NASA spokesman said that the only apparent trouble experienced was that one of the three parachutes attached to the command module broke away during descent. NASA had stated earlier that two parachutes are adequate to effect a safe descent.

## SYNCOM 2 DRIFT CHANGED

NASA's Syncom 2 communication satellite has again been manœuvred in its orbit to effect a change in its rate of westward drift. The change was made to slow the satellite's drift rate so that the spacecraft would be in position to serve as a back-up for Syncom C. Syncom 2 had been drifting westward at a rate based on a May 5 launch for Syncom C; this launch has now been rescheduled to "sometime after June 1."

Syncom 2 had been moving west at a rate of 1.3° per day since March 17. At that time hydrogen peroxide jets on board the craft speeded it up by 8.5 m.p.h. to place it in a higher orbit and begin its move from over Brazil to the Pacific.

On April 24 the jets were again activated to slow the westward drift to 0.8° per day. It was placed in a slightly lower orbit by decreasing the velocity of the satellite by about 4 m.p.h. Synchronous orbit speed is approximately 6,800 m.p.h. Since its launch on July 26, 1963, Syncom 2 has been used to carry out communication transmissions between the USA and Africa, Europe, Central America and Hawaii.

## COSMONAUTS TO HAVE RADIATION DOSIMETERS

On April 30 Moscow Radio reported: "Soviet scientists have analysed the tissue dose of cosmic radiation received by Valery Bykovsky and Valentina Nikolayeva-Tereshkova during their joint orbital flight. The dose received by Valery Bykovsky is about 80 millirad. Valentina Nikolayeva-Tereshkova received about 44 millirad. Such doses, even considering the possible greater biological effectivity of cosmic radiation, cannot have a considerable influence on the cosmonauts.

"But research has shown that the level of radiation near the shell of the space ship is two to three times greater than in the middle of the cabin. Soviet specialists believe that apparently the so-called secondary 'soft' corpuscular radiation takes place near the sides of the ship.

"This peculiarity, given higher doses, the scientists believe, may be of great importance for assessing the radiation conditions of a flight. Individual dosimeters will be arranged in the space suits of future Soviet cosmonauts, and several in the biological block in the walls of the space ship."

**Lunar Orbiter Contract** An incentive contract with a basic value of about $80m for five lunar orbiter spacecraft has been placed by NASA with the Boeing Company. If all lunar orbiter missions are successful Boeing could receive up to $5.3m in addition, while the company is required to make penalty payments for late delivery of spacecraft. Furthermore, Boeing will retain ten per cent of any savings below target costs and lose from their fee ten per cent of costs above the target. The lunar orbiter spacecraft (artist's impression, last week) will take close-range photographs of the lunar surface for scientific study and to help in selecting landing sites for the manned lunar landing programme.

# AMERICA'S SPACE PHILOSOPHY

**By Don Adams**

SOME time ago the late President of the United States, John F. Kennedy, stated that "Space is the new ocean and we must sail on it." These words, which have become symbolic in America's drive to conquer outer space, were quoted repeatedly at an important space meeting in the latter part of April. The occasion was the fourth national conference on the peaceful uses of space, held this year in Boston, Massachusetts. The meeting was memorable not because of any pronouncements about new accomplishments or changed objectives, but because it gave to NASA's experts the opportunity of explaining their programmes to an audience of scientific and industry observers.

Dr Hugh L. Dryden, the Deputy Administrator, opened the four-day meeting with a keynote speech which made a lasting impression on many members of the assembly. He said, "The most advanced technological development of our time came to the notice of the world on October 4, 1957, when man sent into space the first artificial satellite of the Earth, the Soviet Sputnik. That first venture into space could have been *ours*—we had the ability to do it, but not the foresight or determination . . .

"This event and the events of the intervening six years have had a profound impact on human affairs throughout the world, and especially within our own country. Repercussions have been felt in science, industry, education, government, law, ethics, and religion. No area of human activity or thought has escaped. The toys of our children, the ambitions of our young men and women, the fortunes of industrialists, the daily tasks of diplomats, the careers of military officers, the pronouncements of high church officials—all have reflected the all-pervading influence of the beginning steps in space exploration."

The exploration of space was, in Dr Dryden's opinion, a logical continuation of the geographical exploration by man of the unknown areas of the Earth. Early Phoenician mariners had roamed the seas and stimulated three thousand years of almost continuous exploration. Today, space was the new frontier, and Dr Dryden presented some relevant comments made earlier by Ralph Cordiner, General Electric's former chief executive officer. "At this stage," he quoted Mr Cordiner, "the new frontier does not look very promising to the profit-minded business man, or to the tax-minded citizen. Every new frontier presents the same problems of vision and risk. Lief Ericson discovered America 500 years before Columbus, but apparently the Vikings did not have the vision to see anything worthwhile on that vast, empty continent, and so history waited for another half-millenium.

"When a new frontier is opened," Dr Dryden continued his quotation, "the new territory always looks vast, empty, hostile and unrewarding. It is always dangerous to go there, and almost impossible to live there in loneliness and peril. The technological capacities of the time are always taxed to the utmost in dealing with the new frontier. It takes an immense imagination for the citizens to see beyond these initial difficulties of opening a new frontier. No one would pretend to foresee all the economic, political, social and cultural changes that will follow in the wake of the first exploratory shots in space, any more than the people in the days of Columbus could foresee the Twentieth Century world. But such an effort at prophetic imagination is what is required of us as citizens, so that we will not, like Lief Ericson, leave the making of the future to others."

Dr Dryden then returned to his main theme, noting that the USA as a nation had accepted the challenge of this new frontier, and this year was spending a little more than $5,000,000,000 on the exploration of space for peaceful purposes. This sum represented an expenditure of approximately 50 cents per week by each of America's 200 million inhabitants. "We have mustered a great array of manpower, money, and scientific and engineering talent for a peaceful undertaking—on a scale formerly reserved only for making war." Dr Dryden went on to trace the progress of space work in the USA from that time six years ago when the country "with great effort, managed to put a very small spacecraft of 31lb weight and limite capability into orbit," to today's work on the Apollo programme. Dr Dryden tempered his praise of present efforts, however, with some words of caution.

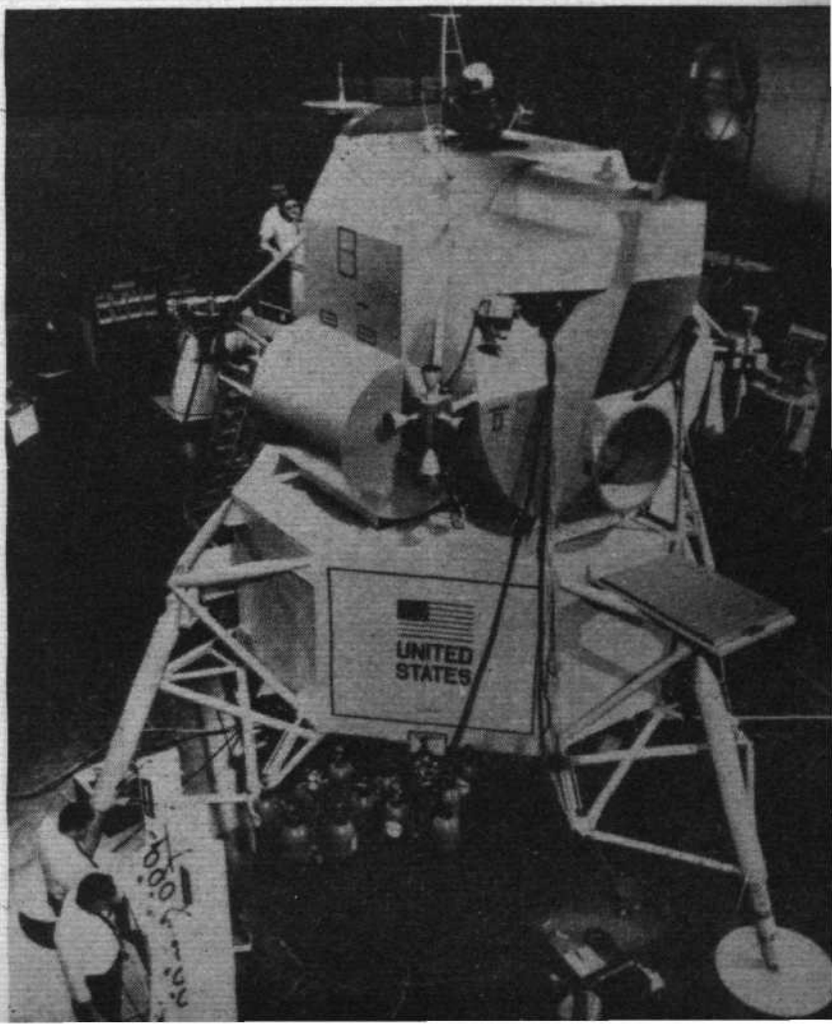
"We have developed the necessary tools and now have the capability of doing many more missions than available resources will permit," he said. "We are not only moving into a period of fruition but one in which we must look to refinement of the technology already developed and the scientific knowledge already gained. Most important, it is imperative that we look ahead to the things we must do now, or soon, to prepare for the space missions which the future will demand of us if we are to maintain leadership in space.

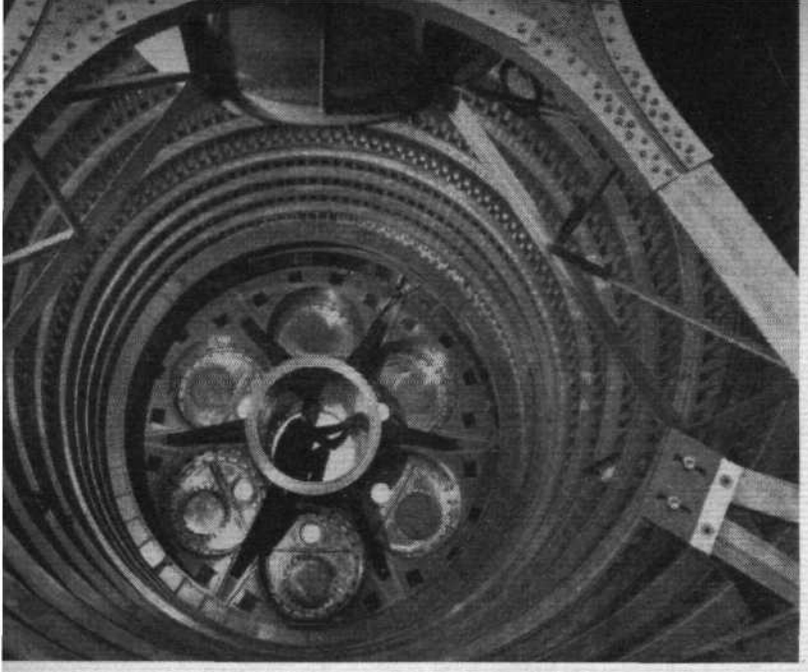
"The history of research and development in areas in this country is one of repeated preoccupation with the current requirements of the nation at the expense of or to the neglect of the basic, long-range efforts needed to maintain leadership in the vital areas of science and technology."

"Today the nation faces this question: have we learned enough from the often bitter and always costly experience of the last half-century not only to carry out with determination this effort to meet the requirements of the present in space research and exploration, but to exercise the vision which is demanded if we are not, once again, to find ourselves lagging in the next phase of this most challenging effort?

"It must be hoped that we have learned enough from the sequence of events which I have described to put aside for all time any feelings of comfortable assurance that science and technology are areas in which the United States will remained firmly and forever supreme. It is not surprising that we should have felt such assurance in the past, for we did as a nation establish an early technological ascen-

*Mock-up of the lunar excursion module of the Apollo spacecraft, displayed recently by Grumman at Bethpage*





*Interior structure of Convair's Little Joe II launch vehicle. One Algol motor is mounted centrally, and six Recruit motors are ring-mounted around the Algol. Last week's Little Joe II launch is reported on page 870*

## Missiles and Spaceflight

dancy over the other countries of the world. But it is equally clear that many other nations have overcome our early lead and that future leadership in this competition, which has such great economic, military and political significance, will not easily be held or won."

Dr Dryden closed his remarks with some comments about America's determination to place a man on the Moon in this decade. "We have chosen to go to the Moon because manned exploration of the Moon involves every facet of overall space capability this nation must develop if we are to become a leading spacefaring nation. . . . But some will say: 'What do we want of the vast worthless area? To what use could we ever hope to put these deserts or these endless mountain ranges?' " Interestingly enough, observed Dr Dryden, these identical words were used by Daniel Webster in 1844 when, as a Senator from Massachusetts, he opposed an appropriation of $50,000 to extend mail service to California.

On succeeding days, speeches on the subject *Men in Space* were given by Dr Robert R. Gilruth, Director of NASA's Manned Spacecraft Center; Dr Joseph F. Shea, Apollo Project Manager at MSC; Dr Ebahard Rees, Deputy Director of the Marshall Space Flight Center; Dr Kurt H. Debus, Director of the John F. Kennedy Space Flight Center; and by Dr George E. Mueller, Associate Administrator for Manned Space Flight. They spoke of the programme to land a man on the Moon and highlighted their presentations with slides and films which showed their group's progress on the Apollo project. The naïve among the audience were staggered by the immensity of the programme, and even the hardened professionals in attendance were seen to profess occasional amazement at some gigantic effort associated with a detail which had previously escaped their notice. For example, the US investment in the Merritt Island Complex for Saturn V launches is now approaching $1,000m and there will soon be 300,000 people (including 50,000 scientists and engineers) working full-time on Project Apollo.

Dr Shea noted that much had been accomplished since the beginning of the programme in 1961, and much more work obviously had to be done before the command module splashes down, "still warm from its triumphant re-entry." He then made the interesting observation that, important as the splash would be, it would be in a sense an anti-climax. It was not so much the attainment of goals that was significant, but the things encountered on the way. "On the way to the Moon we will meet and solve all the problems which stand between us and mastery of space. The heritage of the lunar programme will not merely be the lunar rock we bring back, but rather the Apollo spaceships and launch vehicles, coupled with the broad-based national team capable of coping with any and all requirements for operations in space which may be thrust upon the country." Dr Shea closed with the comment that the programme was on schedule and within the budget discussed at a similar conference one year earlier.

The highlight of the banquet, held on the evening of the opening day's session, was an address by Dr Wernher von Braun, Director of the George C. Marshall Space Flight Center, Huntsville. His speech covered a variety of points centred on NASA's broad programme for space exploration. Towards the end of the presentation he said; "I could not possibly take leave of you tonight without briefly discussing the question which is probably put to me personally more often than any other. It runs something like this. We agree that the nation should have a space programme. We further agree that it should move forward on a broad mission front. But to do these things, why is it necessary to go to the Moon? Why can we not develop a space capability second to none through manned applications in near-Earth space, and forget this business about going to the Moon?

"I think I can best make my point here by using an example. When Charles Lindbergh made his famous first flight to Paris, I do not believe anyone believed that his sole purpose in going was simply to get to Paris. If going to Paris had been his sole objective, he could have travelled by boat in much greater security and comfort. His purpose was more than personal transportation. His purpose was to demonstrate the feasibility of trans-oceanic air travel, not to get to Paris, but to fly across the ocean.

"Now he could have selected a wheat field in Alsace-Lorraine, or perhaps he could have landed in one of the moors in Scotland. But Colonel Lindbergh had the farsightedness to realize that the best way to demonstrate his point to his world audience was to select a target familiar to everyone. Everyone knew where New York was, and everyone knew where Paris was. The history books have recorded the immediate impact of his voyage. Lindbergh achieved his objective, and today we are using trans-oceanic air transportation not only to go to Paris, but to deliver cargo to Copenhagen, mail to Manila, tourists to Tokyo and, on selected occasions, maintain the Berlin airlift.

### The Lunar Goal

"In the Apollo programme, the Moon is our Paris. We have selected a target familiar to everyone. Rather than asking the man on the street to accept the esoteric language of the trade, such as "rendezvous," "docking," and "orbital transfer," in defining the immediate objectives of man in space, the late President Kennedy selected a goal which is entirely familiar to the man on the street: sending men to the Moon before the end of this decade. The fellow next door knows what a man is, where the Moon is, and he knows when this decade is out."

Dr von Braun went on to note that, in preparing for the lunar trip, NASA would have developed space vehicles with an ability to perform all of the orbital operations presently envisaged by the USA or any other nation. After the Moon were conquered, he believed that this versatile capability would remain for other manned spaceflight applications, in both near and outer space. The speaker then observed; "The purpose of the manned spaceflight programme is to build an important national resource, a broad space capability, that will enable the United States to investigate and utilize the environment of space for a long time to come. It is providing the muscle which will undergird the nation's posture in this newest dimension of national power—outer space.

"And I can illustrate this same point by treating it in terms of dollars. In this decade we expect to spend about $20,000,000,000 on the manned spaceflight programme. We consider that about 92 per cent of this money, or well over $18,000,000,000, is being and will be used to create permanent capital for the United States. Some of this permanent capital will be measured in terms of new technology, industrial manufacturing complexes, and governmental test and launch sites. But the vast majority of this newly created capital will be the large numbers of highly trained technical people who will provide the nucleus of talent for the space missions following the lunar landing."

In closing, Dr von Braun answered the oft-repeated question "Why invest in space at all?" He likened this question to the query "Why have an age of science?" Man had an insatiable curiosity about his natural environment, he said, and, if there were one lesson that man had learned in the past 2,000 years, it was that man's attempts at satisfying his curiosity about the world about him had consistently, and handsomely, and in often unsuspected ways, paid rich dividends.

*Naval re-equipment—the aircraft on the right is the one that's new. A Sea Vixen FAW.2, a type about to become operational in the Fleet Air Arm, shares the RNAS Yeovilton apron with a Sopwith Triplane loaned by the RAF (who aren't using it either) for the FAA Museum, which opens with the 50th Anniversary Review at Yeovilton on May 28. The Sopwith "Tripe" served with the RNAS in the First World War*

# SERVICE AVIATION

*Air Force, Naval and Army Flying News*

### SEATO Simulations

AIRCRAFT AND OVER 1,000 MEN of the RAF, RAAF and RNZAF took part in the SEATO tactical air exercise, "Air Boon Choo," in Thailand earlier this month. To Bangkok International Airport went a small air movements section from RAF Changi, to support FEAF logistic flights between Singapore and various Thailand centres. No 48 Sqn Hastings and 34 Sqn Beverleys, from Changi and Seletar, flew in the team's trucks, refuellers, water tankers and other stores. No 224 Gp Air Portable Communications Element operated at Bangkok and Udorn to provide communications for the Commonwealth air forces. Apart from logistic transports, active RAF participants in Air Boon Choo included 20 Sqn's ground-attack Hunters, 45 Sqn's Canberra bombers, 81 Sqn's Canberra PR.7s, 209 Sqn's Pioneers and Twin Pioneers and 215 Sqn's Argosies. RAAF aircraft involved were Avon Sabres, from their regular base at Ubon, Canberras and C-130 Hercules. RNZAF Canberras and Bristol Freighters also took part.

During the 10-day exercise, which additionally engaged tactical units of the Royal Thai and US air forces on simulated counter-insurgency warfare, King Phumiphol of Thailand visited RAAF Ubon.

### US Considers Aid to IAF

INDIA'S MINISTER OF DEFENCE, Mr Y. B. Chavan, arrived in Washington on Monday, May 18, for consultations on India's defence requirements. During his visit a decision is expected to be announced on whether the USA should aid financially the manufacture of supersonic fighters in India. A US Government spokesman said on May 5 that the Administration was giving favourable attention to the Indian proposal.

Three fighters are being or are about to be built in India—the transonic licence-built Hawker Siddeley Gnat; the Hindustan HF-24 Marut, the first two Orpheus-powered transonic prototypes of which were handed over for IAF testing earlier this month, and the Russian Mig-21, for the production of which factories are being built.

It is unlikely that the US would materially aid the licence-production of a Russian type and the Gnat is, of course, now obsolescent. If the US decides to aid fighter construction in India, rather than simply supplying the IAF with US fighters, it seems most likely that aid will be in the form of development assistance for the proposed supersonic version of the Marut, including the provision of a US engine in place of the Russian turbojet around which project work has been done.

### Big Campaign for RAF Recruits

AFTER EIGHTEEN MONTHS of restriction in the enlistment of airmen in ground trades the RAF is to start recruiting on a large scale with the aim of attracting 100 a week. Four thousand recruits by the end of next March is the target. For the first time the minimum age for enlistment will be reduced from 17½ to 17 years. The rate of pay will be 9s 6d a day until the age of 17½.

The reason for the big increase in recruiting quotas, announced in the Commons on May 13, is that many men who signed on when conscription was about to end are now reaching the end of their five-year engagements.

### Airlift for the Navy

RAF TRANSPORT COMMAND and charter operators will combine to mount the RN's biggest air trooping operation this summer when the aircraft carrier HMS *Victorious* completes her present commission in the Far East. The paying-off complement of 2,400 will fly home from Singapore and the new crew will fly out for the ship to re-commission on station. RN warships have previously been re-commissioned by air but never before a ship of this size.

THE MINISTER OF DEFENCE FOR THE RAF, Mr Hugh Fraser, is at present touring RAF and other Service units in the Far East. He left London Airport in a 99 Sqn Britannia on May 14 and will return on May 26. His tour will include units in Borneo.

HMS "EAGLE," newly modernised at a cost of over £20m, re-commissioned at Devonport on Thursday last week, May 14, under the command of Capt L. D. Empson, RN. She will now be engaged in working-up trials to become fully operational later in the year.

*Effluorescence The CFS Red Pelicans formation aerobatic team has blossomed into the premier RAF display unit for 1964, as recorded in print last week. Recorded here in terms of light and shade by MoD (Air) photographer Mike Chase are the Pelicans' six fluorescent red Jet Provost T.4s performing some manœuvre or another*

# INDUSTRY International

*Products*

*Company News*

## Great Britain

**Symposium on Dynamic Balancing** The dynamic balancing of rotating machinery is becoming increasingly important as the rotational speeds increase. If the modern requirements of quiet and vibration-free running, coupled with the desire for longer trouble-free life, are to be met, then facilities for accurate balancing must be available. W. & T. Avery Ltd, long-established manufacturers of weighing and testing machines, recently sponsored a symposium at the Department of Mechanical Engineering, Birmingham University, on dynamic balancing, which forms an important part of their business.

Among the papers presented was one by Mr K. S. Hodgkinson of Rolls-Royce on *Gas Turbine Aero-Engine Rotor Balance and Vibration*. Speaking of the Spey engine, he said that the importance paid by his company to the achievement and maintenance of good balance throughout the design, development and tooling stages has paid dividends. The Spey was the first new engine to which Rolls-Royce had applied this close attention, and as a result it has proved to be the smoothest-running axial-compressor engine they have ever made.

Copies of this and the other papers presented will shortly be available on request to W. & T. Avery Ltd, Soho Foundry, Birmingham 40.

**US Alclad for One-Eleven** Imperial Aluminium Company, sole British agent for the Aluminium Company of America, has received an order from BAC, Weybridge, for 52 tons of skin quality Alcoa Alclad 2024 sheets.

These sheets will be used for skinning One-Eleven short-haul airliners. Alcoa Alclad 2024 sheets are produced with a high lustre, high quality surface suitable for use on the aircraft without painting or further surface treatment. This particular quality of aluminium is not at present available in the UK from other sources.

**Solartron Founder Joins Fenlow** Mr Leslie B. Copestick has joined Mr D. McDonnell and Mr R. L. B. Wall on the board of Fenlow Electronics Ltd, of Weybridge, Surrey, and has been appointed chairman.

Mr Copestick was co-founder in 1948 of the Solartron group. After 15 years, during much of which he supervised research and development, Mr Copestick relinquished his interest in Solartron in 1963.

**Selling Bonded Structures** A Dutchman has been appointed sales manager of Bonded Structures Ltd, Duxford, Cambs, an associate company of CIBA (A.R.L.) Ltd.

He is Mr D. Ris, who graduated at Haarlem in aircraft technology and joined the company last year from Fokker, where he was engaged in the development and testing of bonding processes and equipment and the design and non-destructive testing of bonded aircraft components.

**TSR.2 Integral Tank Sealing** It is felt that the article on TSR.2 published in our April 9 issue may have given rise to confusion with regard to the materials used for sealing the integral fuel tanks of that aircraft. The sealants used both in the original stages of development and at the present time are, in fact, produced by British Paints Ltd at their Newcastle-upon-Tyne factory. The materials are being manufactured under licence from Products Research Co International of Los Angeles.

Two series of sealants are used, the PR 1400 type for temperatures up to 130°C and the PR 1700 type for higher temperatures. The PR 1400 series of sealants have been in general use throughout the aircraft industry for several years, and their application to TSR.2 presented no particular problems. The PR 1700 series were new developments and did present formulation and application difficulties.

Co-operation between BAC and British Paints Ltd resulted in materials and application techniques which are currently standard on the aircraft, and at present there is no move to change these standards. It should be clear from the above that British Paints are the sole suppliers for the main sealing compounds used on TSR.2 tanks at the present time.

**Trident's Sperry Instruments** In the caption to the Trident's blind flying "T" which appeared on page 538 of the April 2 issue the Sperry Gyroscope Company's attitude director was erroneously attributed to another manufacturer. For the record, the ASI is also by Sperry.

## USA

**New Head For Bendix International** Mr L. Edwin Smart, Jr, has been appointed vice-president of international operations of the Bendix Corporation.

Mr Smart is also made a member of the corporation's administration committee. He succeeds the late Mr Dugald Black in both positions, and will be based at the international operations' main office in New York.

Mr Smart has been closely involved in Bendix legal affairs as a partner in Bendix corporate counsel, Hughes, Hubbard, Blair and Reed, of New York. Mr Smart served in the Second World War with the USN and saw action in the Pacific as captain of a submarine chaser.

Born in Columbus, Ohio, he has been with Hughes, Hubbard, Blair and Reed since graduation from Harvard Law School in 1949 and partner in charge of Bendix legal work since 1957. He is a member of the bar of New York State, the US Court of Appeals for the Third Circuit, and the US District Court for the Southern District of New York.

**Westinghouse International Forms Defence and Space Subsidiary** Formation of the Westinghouse International Defense and Space Corp has been announced by the Westinghouse Electric International Co. President of the new corporation is Mr Peter G. Schmitt, who also will continue to serve in his present position of vice-president advanced technology products, for Westinghouse International.

The new subsidiary has been formed to serve "as the nucleus for all Westinghouse defence and space activities in Europe and the Far East, and as such it will be in a better position to offer maximum services to customers in those areas."

The space corporation will work closely with the Westinghouse defence and space centre at Baltimore, Md, and the aerospace electrical division at Lima, Ohio.

Mr Schmitt will continue to keep his headquarters in New York, and the corporation will have three main offices overseas, in London, Bonn and Sydney.

## Canada

**727 Test Set** Garrett Manufacturing Ltd, the Garrett Corporation's Canadian subsidiary at Rexdale, Ont, has developed a portable test set for the Garrett cabin and cockpit temperature control systems in the Boeing 727.

Now being delivered to 727 operators, the test set is of less than 1 cu ft volume and weighs just 25lb. Simplicity in design enables servicing personnel to learn its operation quickly and the operator is able to select individual units within the temperature control system and isolate malfunctions.

The set is to be adapted to test similar Garrett systems in the Caravelle and the DC-9, following the pattern set with the same company's pneumatic signal generator, developed to test central air data computers in the F-104 and now used in testing the pitot-static systems of numerous aircraft.

# FLIGHT International

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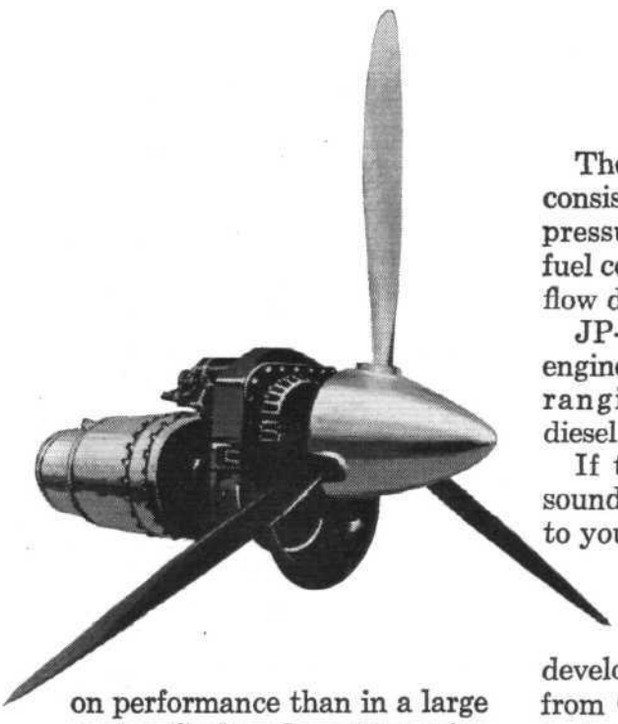

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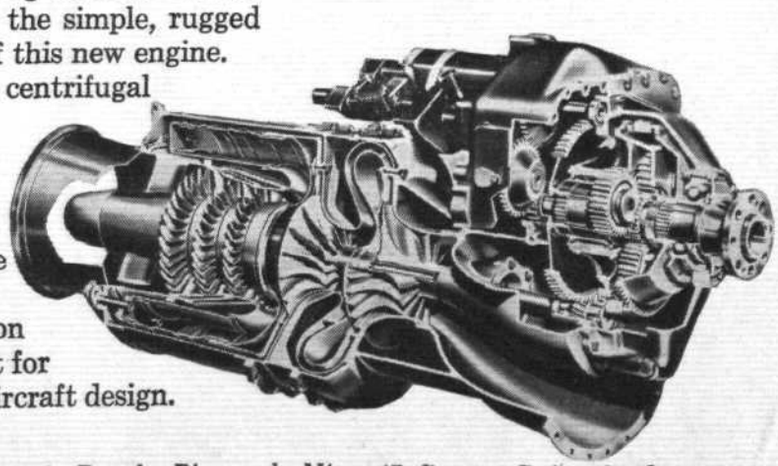

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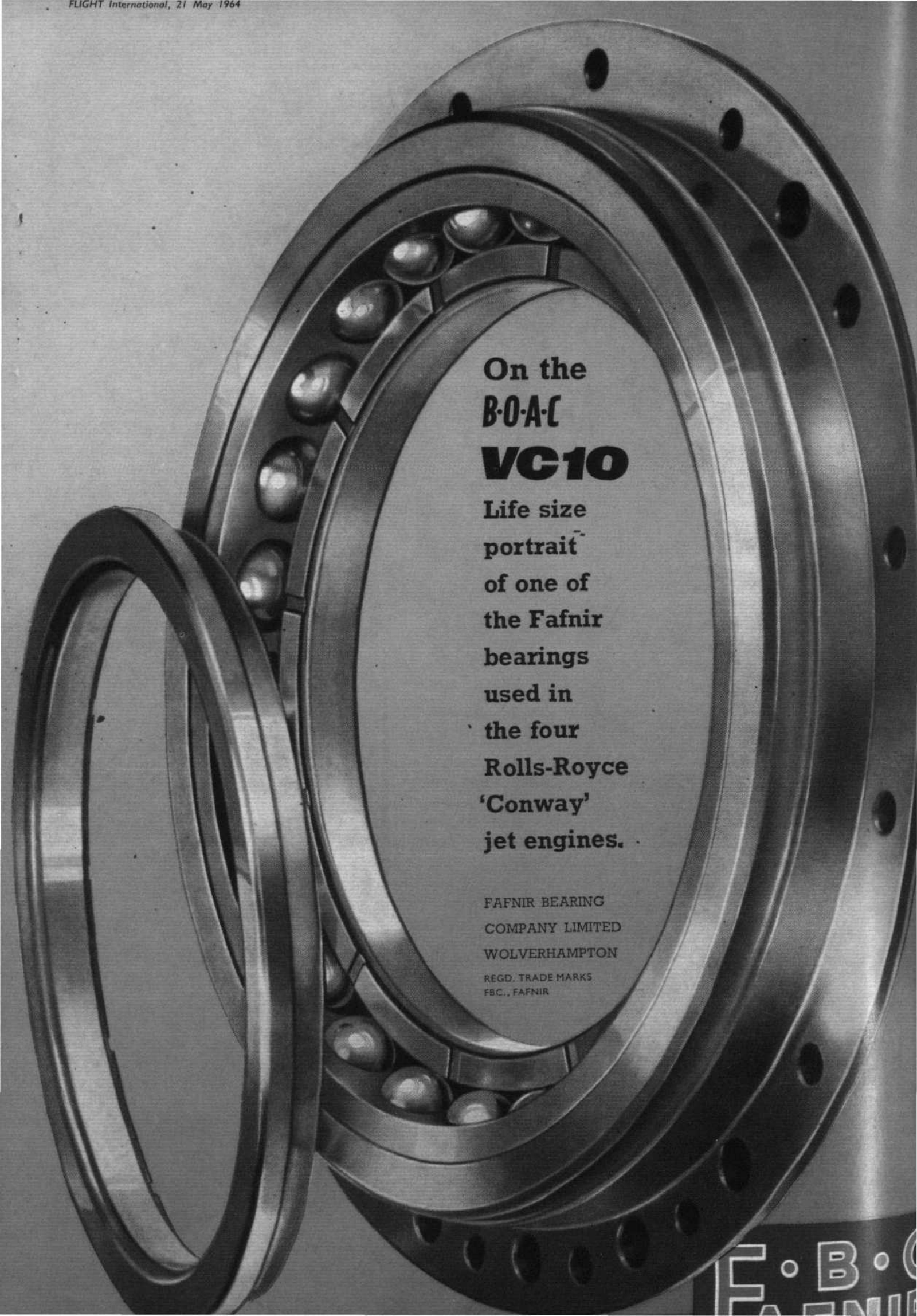
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