

ARNBOROUGH SHOW: First on-the-spot report

# FLIGHT

## INTERNATIONAL



Australia	40 cents	Italy	L. 350
Austria	Sch. 16.50	Japan	Yen 150
Belgium	Fr. 25.00	Lebanon	£L 2.50
Canada	55 cents	Malaysia	MS 1.50
Cyprus	205 Mils	Malta	3/3d
Denmark	Kr. 4.60	N. Zealand	38 cents
E. Africa	S. 3/75	Norway	Kr. 4.80 inkl. Moms
Finland	Fmk. 2.40 sis. 1rv	Portugal	Esc. 18.00
France	Fr. 3.15	S. Africa	33 cents
Germany	DM. 2.50	Spain	Pta. 25.50
Greece	Dr. 11.00	Sweden	Kr. 3.90 inkl. oms
Holland	Dfl. 2.25	Switzerland	Fr. 2.99
Iran	Ris. 50.00	Turkey	£T 5.50
Israel	Is. £ 1.40	U.S.A.	35 cents



# Give generously- they did



*A scene from the Battle of Britain Film.*

## The 1970 Battle of Britain Week runs from Sept. 14th-20th.

The RAF Benevolent Fund,  
in its 50th Anniversary Year, will spend  
well over nine hundred thousand  
pounds on the relief of distress.

Please send your donations to  
Hon. Treasurer, RAF Benevolent Fund,  
67 Portland Place, London, WIN 4AR  
Telephone: 01-580-8343.

(Registered under the War Charities Act 1940 and the Charities Act 1960)

This advertisement presented by Rolls-Royce





## Commercial Farnborough

Most exhibitors at Farnborough are looking to civil aviation for their biggest future markets. Military research and development, particularly in avionics, still dominates technical advance, but not so much as in the past. Concorde, perhaps the most technically advanced aircraft flying in the world today, is a civil aircraft.

Concorde's message, and that of the civil VTOL projects on the stands and of the RB.211 in the VC10 overhead, is that the industry's future will be increasingly founded in design and production for the airlines.

The Three-Eleven is aimed at the air transport market; it is wanted by BEA and it will be made by one of the world's most successful suppliers of civil aircraft. At the other end of the scale is the similarly professional Islander, now being developed in tri-motor form.

Between these extremes come the One-Eleven 475, with the capacity of the series 400 and power of the 500, opening up literally new air transport fields for Europe's best-selling modern jet transport—ten years after the original version was launched and 20 years after the first of 445 Viscounts entered passenger service.

The Trident 3B, with its 1971 automatic flight and landing system and unique "micro-jet" booster, is the most advanced subsonic airliner in Europe, following through until at least 1975 production of the jet transport which was launched—again for BEA—just over a decade ago.

The Nimrod, appearing at its first Farnborough in operational form, is a reminder that the Comet continues today to earn money for its makers more than a quarter of a century after it was conceived, and

will probably be doing so—if the Shackleton's longevity is matched—for another 25 years. The first of all jet airliners, the Comet is now being supplied in military form as a maritime reconnaissance and strike aircraft—a reversal of the traditional military/civil sequence. Even its Spey engines, like the RB.211, were initiated by a civil requirement, though Nimrod's military avionics represent most of the advanced technology in the aircraft.

### ... and weapons

The aircraft industry will remain the nation's foremost armourer until defence is banished from every national budget—which may be some time yet awhile. The guided weapons at Farnborough like Blowpipe, Rapier and Martel, and the feats of micro-avionics which their deceptively simple external forms enfold, represent the summit of what most people mean when they talk about advanced technology. Being ordered in quantity, and comprising so many complex component parts, missiles advance also the production engineer's art. No other complex aerospace products are ordered in such long runs, or offer such an opportunity for really efficient production.

The Harrier stands out as perhaps the world's most remarkable manned weapon. It may well be the last all-British military aircraft; the obvious economic advantages of international co-operation are much easier to achieve when the sponsoring governments are themselves the customers.

The Harrier is also the first combat aircraft since the Canberra to have been ordered by an American military service. Selling weapons in that market in compe-

tition with the western world's biggest and most complete defence industry is even more difficult than selling commercial aircraft to American civil operators.

But military aviation does not offer, happily for the world, a certain enough future market for any aircraft industry. There will be ups and downs in the civil aviation market, no doubt. Indeed, the scheduled airlines are already bracing themselves for the full capacity impact of the 747, DC-10 and TriStar fleets. The financial stress of this widebody-fleet re-equipment will be accentuated by unprecedented competition from already aggressive charter companies who will be picking up attractive discarded 707s and DC-8s at knock-down prices. But taking one year with another, and given the financial stamina to ride the times of trouble, the firms at Farnborough see their richest long-term future rewards in the civil market.

### IN THIS ISSUE

World News	384
Air Transport	386
Light Commercial	390
Big-three challenger	393
Industry International	399
Letters	400
Perfection in display	402
Farnborough report	403
Oshkosh	417
Spaceflight	422
Defence	424
Straight and Level	426a

Front cover: flags of countries whose VIPs come as guests; caravans, aircraft, sunshine, green grass; the RAE "black sheds"—and people in their thousands; the familiar public days' scene at the SBAC Farnborough Display





# WORLD NEWS

## First A-300B customer

Air France has decided to place an order for six A-300B Airbuses, and to take an option on a further ten, said M Henri Ziegler, president of Aérospatiale, at Toulouse last week. The airline signed a letter of intent to this effect on September 3. The finance has yet to be arranged for the purchase, but there is little doubt, now that the decision has been approved by the full board of Air France, that a firm order will follow and that the airline will thus become the first customer for the type.

Air France is to pay a unit basic price of F60 million (£4.5 million). It plans to use the aircraft on such high-density routes as Paris-London, Paris-Geneva and Paris-Corsica. The airline's choice of the General Electric CF6-50 to power its A-300Bs could finally settle any

remaining doubts as to the standard powerplant for the type. Air France plans to take delivery of three Airbuses in 1974 and three in 1975.

M Ziegler, who was speaking at a roll-out ceremony for the stretched Caravelle 12, said that the Air France decision had greatly increased the manufacturers' confidence in the marketing prospects of the A-300B. He said that orders from Lufthansa and Air Inter were likely to follow soon, and that sales prospects in the USA were increasingly bright. The Lufthansa decision is, however, not likely to be taken until the airline has resolved its further order for long-haul equipment, which lies between the 747 and the DC-10 (a letter of intent for the latter having been placed to secure the lower price in force until

August). Such a decision could come at the end of September (see page 388).

The Caravelle 12 has been ordered by Sterling Airways—seven aircraft with an option on four more. Also on show at Toulouse last week were the Frégate—new name for the Series C Nord 262 (powered by Bastan VIIIs)—and the Corvette, Aérospatiale's new business jet/feederliner, which is undergoing flight testing but on which a decision to go into production has not yet been taken.

### X-rays for JT9D

An explosion and fire in an engine of an Air France Boeing 747 on August 17 has resulted in an FAA order for X-ray examination to be made of all JT9Ds to check for possible turbine misalignment. This was decided after a meeting with airline representatives on August 26. The blast in the engine of the Air France aircraft, which was over New Foundland en route from Montreal to Paris, damaged a second engine, but none of the 168 passengers was hurt. The 747 landed at New York. Pratt & Whitney has said that the misalignment in the Air France engine was "made on the assembly line" and "just happened in that one engine." But, in a letter, the National Transportation Safety Board urged the FAA to take action "to resolve this most serious matter," to check the records of the 250 JT9Ds in service and to eliminate some of the possible factors that may have caused the explosion.

### Senate Aid for Lockheed

With the recent United States Senate decision to approve a \$200 million (£83.4 million) contingency loan, Lockheed Aircraft Corp will be able to keep the C-5A Galaxy in production until June 1971. This loan forms the basis of a \$430 million (£179 million) financial package negotiated with the US Government and 24 banks to keep Lockheed solvent. The latter transaction might have collapsed if the Senate had not approved the contingency loan.

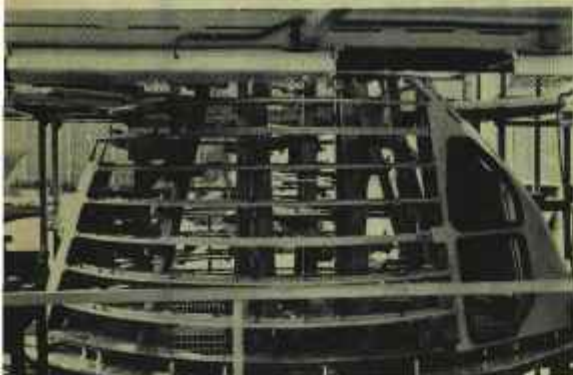
Some \$344 million (£143 million) of this year's US defence budget has now been approved by the Senate for production of 30 C-5As in 1970. The additional \$200 million will enable Lockheed to finance production of another 12 Galaxies.

### WG.13 Test-bed Flies

The Scout helicopter fitted with a full-scale WG.13 rotor head and blades made its first flight at Westland's Yeovil plant on August 31 (see photograph). The aircraft is one of a batch of 15 ordered

**Nosing into the market** The first cockpit section for the A-300B, ordered by Air France last week, on its jigs at Aérospatiale, Toulouse. See story on this page

**Scouting the idea** A Westland Scout, modified to take part in the WG.13 helicopter development programme, made its first flight on August 31 at Yeovil, as recorded on this page. The Scout carries a representative WG.13 semi-rigid rotor in place of its normal articulated system to gain experience before the WG.13's first flight next December. The semi-rigid rotor should result in simpler maintenance, lower costs and better performance. Behind the Scout is a Wessex 3





about a year ago by the Army, and was modified for trials of the composite metal/honeycomb/plastic semi-rigid rotor in support of the WG.13 helicopter development programme. The Scout was chosen because its rotor diameter of 32ft 3in, 10m, was the nearest to that of the WG.13 (42ft, 13m).

The engine development rig, a full scale WG.13 with representative engines (two R-R Small Engine Division BS.360s), rotors and transmissions, was due to begin operating last week. First flight of this Anglo-French helicopter is scheduled for December.

### "FLIGHT" NEXT WEEK...

... will be the third special SBAC Display number, the Farnborough Review issue, detailing equipment and systems exhibited and reporting on the three public days. This issue will also contain the annual Business Aviation special which includes air tests and a preview of the forthcoming NBAA Show in Denver, Colorado.

### Concorde Booms Over Land

A second series of overland supersonic flights prior to the expected appearance of Concorde 002 at the Farnborough show was due to be made at the end of last week as we went to press.

The earlier overland flight on September 1 was characterised by an upsurge in interest from news media and considerable divergence of opinion as to the effects of the boom. While elaborate measures have been taken by the Ministry of Public Buildings and Works and by Mintech to strain-gauge the 12th century St David's Cathedral in Pembrokeshire and to make objective measurements, it was the subjective opinions of those under "boom alley" (the colloquialism for the Concorde west-coast test corridor—see *Flight* for February 26) which have made the news. Headlines varied from such down-to-earth comments as "boom ignored by cows" to descriptions of it as "pops" and "thundercracks." After the first west-coast route test the aircraft returned to Fairford on three engines; an erroneous instrument indication had suggested overheating.

During the 2hr 5min flight, of which 50min was supersonic, a maximum speed of Mach 1.68 at 45,000ft, 13,700m (963kt, 1,780k.p.h.) was attained.

### Skyvan de Luxe

A new development of the Short Skyvan was announced this week which, it is claimed, brings one step nearer the establishment of ultra-short-haul air services in Britain. The new aircraft, seating up to 22 passengers, has emerged as the result of ARB certification of the Skyvan at the new maximum take-off weight of 13,500lb, 6,125kg. According to Shorts, the effects of the ARB's re-certification of the Skyvan to Group A performance standards include substantial improvements in payload/range performance.

British Air Services, a BEA subsidiary



**New commuter** Up to 22 airline seats, overhead baggage lockers, in-flight stereophonic music and concealed lighting are some of the internal features of Shorts' new luxury passenger version of the Skyvan (top picture). See story on this page

**New helicopter**, the Cierva C.R.L.H.-1, which is being demonstrated at this week's SBAC Display at Farnborough. A five-seater, it is powered by two Rolls-Royce Continental IO.360 205 h.p. de-rated engines (or two Lycoming H10-360s of 210 h.p.) driving two co-axial, contra-rotating, two-bladed rotors

and parent company of the regional airlines Cambrian and BKS, is to use the new Skyvan for an intensive evaluation throughout Britain immediately after the Farnborough Show closes. This evaluation, biggest of its type yet run in Britain, will embrace 23 cities and towns and will probe the operational and economic feasibility of scheduled short-range air services linking provincial towns off the main air routes and with only limited airfield facilities.

In the longer term, BAS foresees possibilities for services from special Stolports close to city centres. In running the evaluation this month, BAS will call the Skyvan the "Skyliner."

Internal features of the Skyvan de luxe include well upholstered airline seats in dual and solo units, triple-glazed windows in recessed surrounds, enclosed overhead baggage lockers, in-flight stereophonic music, individual passenger service panels, concealed lighting, a cabin PA system, a washroom, reduced cabin noise levels, generous baggage space and new low-entry side passenger door, with an additional emergency side door opposite.

The flight deck is separated from the

## SENSOR: page 405

passenger cabin by a full bulkhead, with sliding doors, and has itself been restyled. A Decca map-display area-navigation system and a Bendix radar are fitted. A variation to the 22 passenger and one cabin attendant layout is another option for 19 passengers.

### BAC's Fairford Test Centre

British Aircraft Corporation's recent decision to set up a Commercial Aircraft Group Flight Test Centre at Fairford, Glos, where Concorde flight testing is concentrated, has been followed by a number of senior management and executive appointments there.

Mr E. B. Trubshaw, as director of flight test (commercial aircraft) and chief test pilot, is in overall charge of the centre; Mr R. White-Smith, as general manager, will be responsible for management of the centre and be in overall charge in Mr Trubshaw's absence.

Mr J. Cochrane has been appointed manager, flight operations, and deputy chief test pilot, with responsibility for the operational management of experimental and production test flying, flight training and communication flying.

### Jean Batten Reception

The British Women Pilots Association reception for Miss Jean Batten next Saturday, September 12, will now be held at the Kronfeld Club, 74 Eccleston Square, London SW1, and not at the BOAC Terminal, Victoria, SW1, as originally announced.





# AIR TRANSPORT



## TriStar rolls-out to new order

**F**IRST SALES PROSPECTS FOR the Lockheed TriStar in more than a year has come from Pacific Southwest Airlines which issued a letter of intent for two aircraft the day before roll-out on September 1. The Californian airline, which is the largest intra-State carrier in the USA and the only such airline of any size in the world, has also reserved firm delivery positions for another three TriStars. The agreement brings the total number of orders and options for the aircraft to 178. The first two PSA aircraft will be delivered in 1972, the remainder in successive years beginning in 1973.

They will be used initially on the high-density 284n.m., 525km Los Angeles-San Francisco route for which 250- to 300-seat layouts are being considered. This year PSA expects to carry more than 5 million passengers and Lockheed market research indicates that its traffic will have doubled in the next six years.

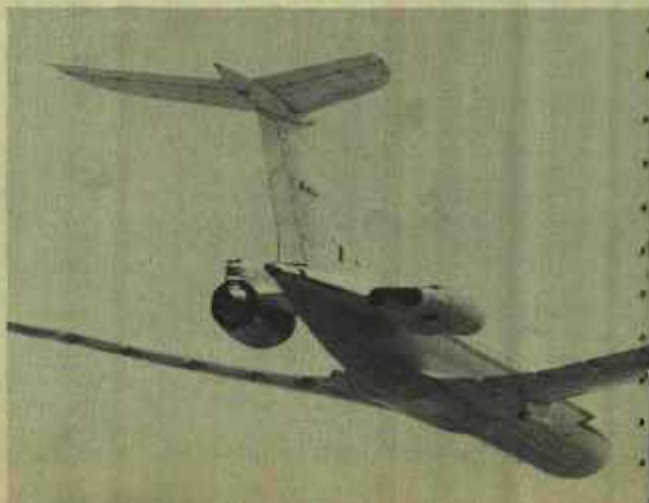
Financial arrangements for buying the aircraft are "being negotiated" says Lockheed. However, the airline is at present going through a tight economic period with marginal profits and is finding diversification into hotels, maintenance work for other airlines, flight training and leasing to be among its more profitable activities. Indeed the TriStar order comes at a time when the airline has an excess of capacity with 14 Boeing 727-200s and nine 737s in service, while two more of each type are due to be delivered during October and November.

Long-term debt repayments are becoming due: \$11 million (£4.6 million) this year; \$8 million (£3.3 million) in each of the next three years; and \$10 million (£4.15 million) in 1974. As reported in *Flight* for July 16, page 76, cash flows are unlikely to enable these to be met without disposal of some existing aircraft.

But, whatever the financial situations of the airline and

Above, the TriStar was rolled out on schedule at Palmdale on September 1, ready for a first flight in November, while below, a flight-standard RB.211 of the type to be fitted to the aircraft is now flying in the VC10 test-bed. An alternator loading pod fitted below the starboard wing boosts the total electrical load to simulate that of the TriStar

manufacturer this latest TriStar order must come as welcome respite for Lockheed and Rolls-Royce, who have seen the competitive DC-10 steadily building up its sales total.







## **the Wessex beats the weather with Ferranti stability**

Off-shore oil rigs have to be serviced—fair weather or foul. To help pilots to reach them and return under the worst conditions, Bristow Helicopters have installed Ferranti Stability Augmentation Systems in their Wessex machines. These take the hard work out of bad weather flying, increase safety and extend instrument flying capability.

The Ferranti Stability Augmentation System is a simple lightweight unit, reliable and low in cost and can be installed in helicopters of most types.

Write for details to -

**Ferranti Limited,**  
Aircraft Equipment Department,  
South Hill Park, Easthampstead, Bracknell,  
Berkshire, England, RG12 1RA.  
Telephone: 7344 4202.

# **FERRANTI**

Stability Augmentation Systems



# The Boeing 747, like is several

Parts of the Boeing 747 jumbo jet are being made at Shorts' Aircraft Engineering Division in Belfast.

The contract is for 23ft. machined fuselage components.

It's by no means our largest contract. But it's very valuable to us. Because aircraft firms like Boeing and Northrop don't sub-contract to just anybody.

Only to firms who know what they're doing. And do it at a reasonable price. Shorts know all about making planes. We've been making them for 61 years.

Sub-contract work has become a third and a very important part of our business.

As a result we've worked with and for many large aircraft companies in Europe and America.

We're making wings for the

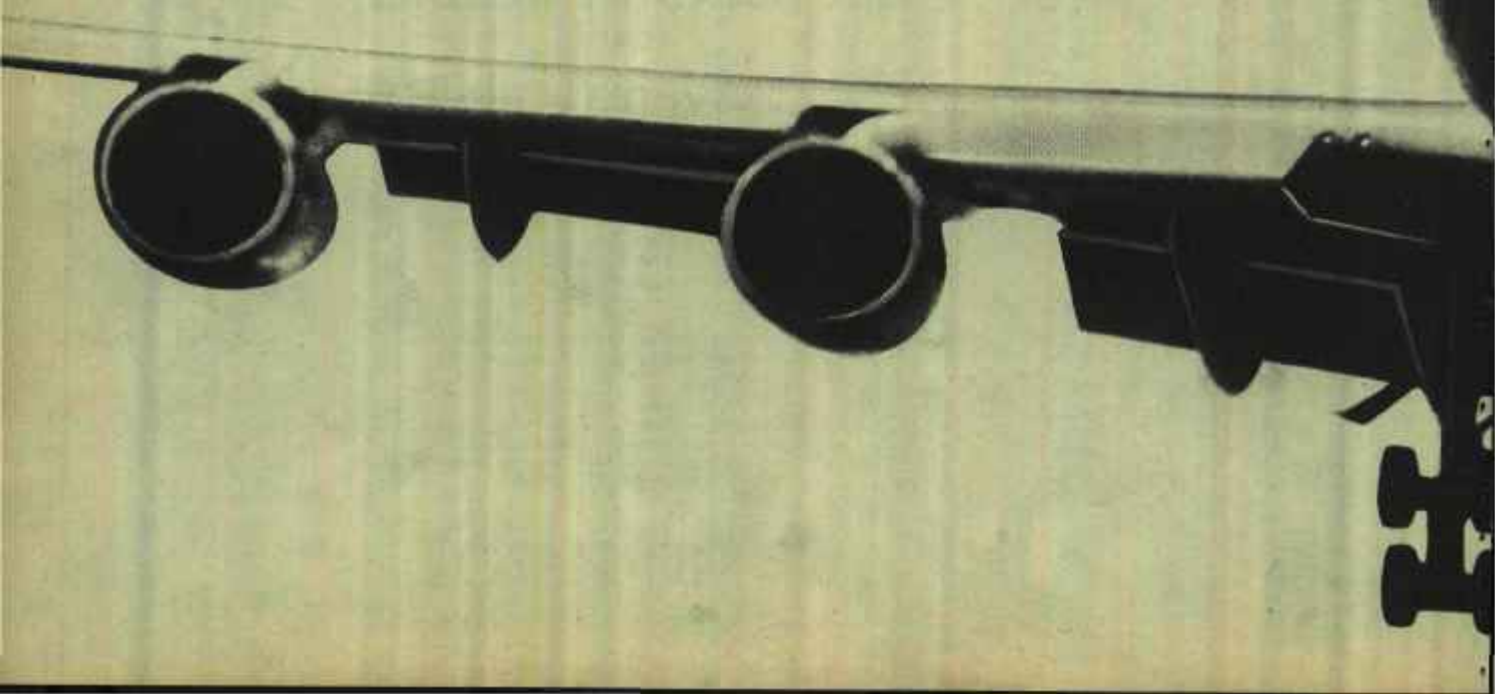
new Fokker Fellowship and we've made outer wings for Phantoms, main stub spars for the Comet and its derivative the Nimrod. We've made VC10 fuselages, whole Britannias and Canberras.

Our biggest contract to date is for the Lockheed TriStar. It's worth over £24 million.

With Rolls-Royce we're making the engine pods for their vast RB.211 turbofans.

The contract also includes ailerons, spoilers, wing tips, ground lift dumpers and main undercarriage doors.

For this we've installed some of Europe's most advanced facilities for the hot forming of titanium, and the manipulation of creep resistant alloys.





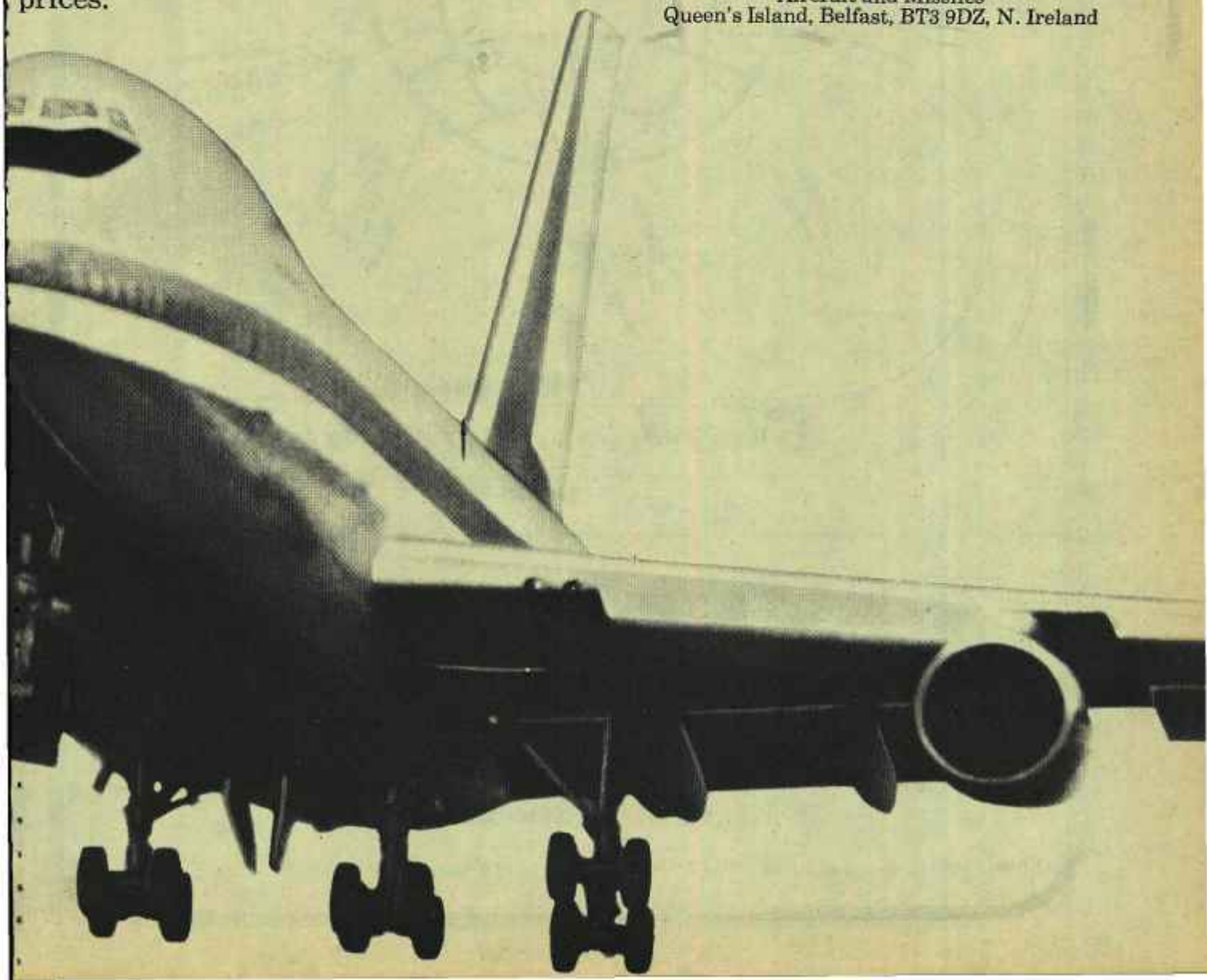
# many other aircraft, parts Short.

The skills learned by our men over years of building complete aircraft as well as contract work has made them quick off the mark and sure of their planning and production.

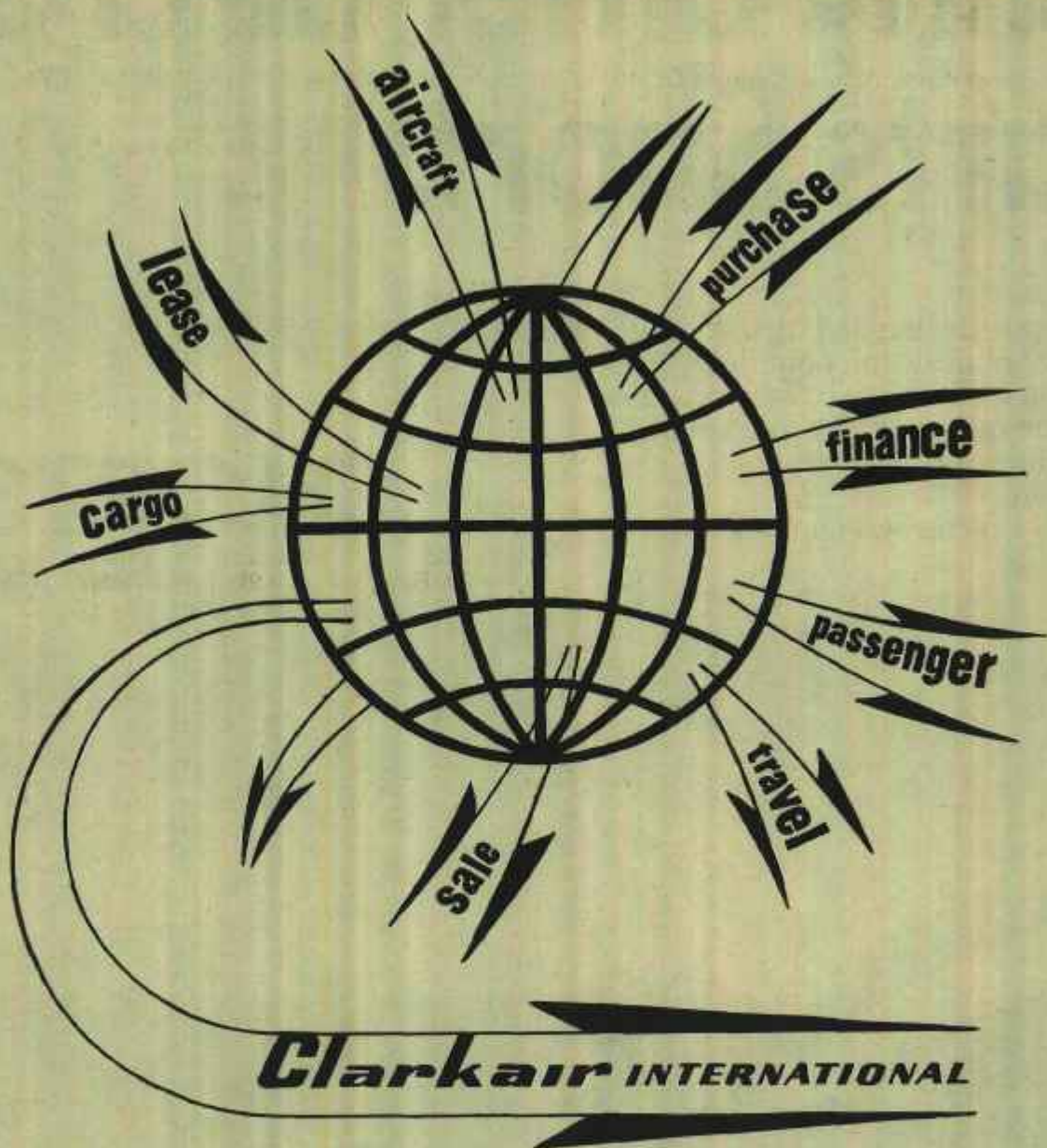
And this means competitive prices.

## SHORTS

Aircraft and Missiles  
Queen's Island, Belfast, BT3 9DZ, N. Ireland







**Let our truly international  
organisation help you to sell, charter,  
lease or purchase an aircraft.**

Head Office: Clarkair House, 85 Tooley Street, London SE1  
telephone 01 407 8417/8 Telex 88455

Other offices: Amsterdam, New York, Montreal, Miami, Sydney, Rio de Janeiro, Hong Kong, Bangkok, Beirut



## DC-10 FLIES

The first flight of the McDonnell Douglas DC-10 took place on August 29 when chief project pilot Mr Clifford L. Stout flew the aircraft from Long Beach to Edwards Air Force Base. The trip took 3hr 26min and the planned speed of 345 m.p.h., 555 k.p.h. and an altitude of more than 30,000ft, 9,000m were attained. The DC-10, which took off at a weight of 340,000lb, 154,200kg (some 70,000lb, 31,750kg below the maximum take-off weight of early production DC-10s) used 4,980ft, 1,520m of runway. The aircraft had a four-man crew and carried about 25,000lb, 11,300kg of test instrumentation and 100,000lb, 45,400kg of fuel. Handling characteristics were explored and instrumentation and telemetry calibration was carried out. Several flights have now been made from Edwards, including a 1½hr flight on September 7, according to Californian sources. The aircraft will later move back to Long Beach.

**T**HE FIRST FLIGHT OF THE McDONNELL DOUGLAS DC-10 has come some five weeks after roll-out on July 23. When the aircraft first took off from Long Beach on August 29 it was heading by all indications for a most successful future. Orders and options to date for all DC-10 variants now total 119 and 122 respectively from 15 airlines. Of these, 75 orders and 49 options are for the medium-range DC-10-10, while the Pratt & Whitney JT9D-powered long-range DC-10-20, ordered only by Northwest, accounts for 14 orders and 14 options. Where perhaps the largest market exists is for the long-range DC-10-30, which at the moment is the only long-range trijet being taken seriously by the airlines because it is more than a paper aeroplane. First delivery of this type to the airlines, the first of which are those of the KSSU consortium, should take place in 1972, while the first of the medium-range DC-10s should be delivered to American Airlines and United Air Lines for crew training in August 1971.

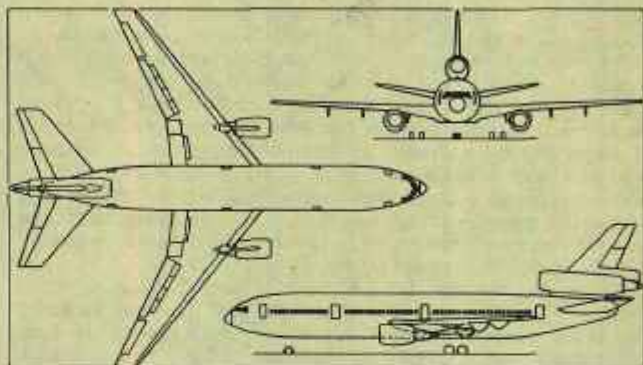
The DC-10 originated in American Airlines' April 1966 requirement for a large-capacity aircraft capable of flying the Chicago-Los Angeles route with a full payload and of departing from the short runway at LaGuardia, New York, in ISA +17°C conditions with a full-capacity payload for Chicago. To fulfil this specification American Airlines envisaged a twin-engined aircraft, but by the middle of 1967 both Lockheed and McDonnell Douglas were thinking in terms of larger markets, longer range, better drift-down performance and potential for further range stretch. The transcontinental TriStar and DC-10-10 were to result—these aircraft being able to carry 30,000lb, 14,000kg payloads about 4,000 n.m., 7,400km with full tanks and about 80,000lb, 36,000kg over 2,500 n.m., 4,600km stages.

The first of the trijet orders (for 25) came from American on February 19, 1968, when it chose the McDonnell Douglas aircraft. The airline took options on another 25 but did not at that time specify an engine. A go-ahead was not warranted by this total and things thus looked a little bleak for the DC-10 by the end of the next month, because on the last day of March 1968 Lockheed went ahead with the TriStar—its first commercial transport since the Electra. When the decision to go ahead was taken there were 144 orders and options from Eastern, TWA and Air Holdings. Since then the total has increased to 178, says Lockheed.

But on April 25 United Air Lines ordered 30 DC-10-10s with an option on a similar number, and McDonnell Douglas gave the go-ahead. Soon afterwards both American and United chose the General Electric CF6-6 of around 40,000lb, 178kN thrust to power the aircraft.

Paradoxically the first order for a long-range variant (from Northwest) specified Pratt & Whitney JT9D-15 engines. It is so far the only, and probably the last, order for DC-10s with this type of powerplant, which is basically the same engine as that fitted to the 747. All other airlines have chosen the CF6-50 for their long-range DC-10s—known as the -30—and Pratt & Whitney has been left out on a limb having spent £20 million on the DC-10 installation.

The second big breakthrough in the DC-10 order situation, following the American and United decisions to buy the medium-range aircraft, was the KSSU order for the long-range -30 aircraft in June 1969, which came after Lockheed and McDonnell Douglas had had a pitched battle for the European foothold which KLM, SAS, Swissair and UTA



The latest general arrangement drawing of the long-range -20 and -30 variants of the DC-10

represented. Fourteen DC-10s were ordered and 21 taken on option at a cost of £8.3 million each with deliveries due to begin in 1972. Ten days later Overseas National ordered three -30F convertible passenger/freighters and took options on a further three, while TIA had earlier announced its decision to settle for two with two options on the same type.

Meanwhile, on January 6, 1969, McDonnell Douglas had started cutting metal on the first medium-range aircraft by milling a cockpit window-frame forging. Ceremonial fastening of the same component represented the start of DC-10 assembly. Manufacture of the aircraft is spread around North America and Europe, as has happened with the DC-9. Aerfer, for example, builds the fin and rudder in Naples, while Dowty Rotol makes half of the nose undercarriage legs. The rest are made by Abex Industries in Canada, but all are to a McDonnell Douglas design.

The -30 aircraft bought by KSSU was a true intercontinental design but offered a slightly lower payload-range performance than its proposed Lockheed competitor which was, in fact, more of a redesigned than a developed aircraft. The DC-10-30 fitted into the latter category despite a gross weight increase of some 145,000lb, 65,700kg over that of the -10 (which is in the order of 410,000lb, 186,000kg). This necessitated the addition of a third main undercarriage leg. Other major revisions, apart from a slightly lengthened fuselage, were made to the internal layout. Galleys were moved from under the floor to the main cabin giving a larger cargo volume.

Recently the Atlas consortium has also shown signs that it is moving *en bloc* to the McDonnell Douglas camp. The consortium originally wanted greater range than the DC-10 was able to offer and KSSU wanted. Since then the DC-10-30 has been stretched again, and of course is now the only aircraft in the long-range trijet market with a definite go-ahead. Alitalia could have been expected to buy the DC-10, having operated a large number of the manufacturer's other aircraft. But eventual firm orders for DC-10s by Lufthansa and Air France will be particularly significant (if they come) because both airlines were earlier thought to be firmly pro-Lockheed. Lufthansa has placed a letter of intent for five, and Sabena two, while Air France is still deliberating.

Work on the DC-10 at Long Beach is concentrated in a 1.3 million sq ft complex where the final assembly sequence begins



## AIR TRANSPORT...

with manufacture of the centre wing box and the tail section. This includes the fuselage aft body, and the 8ft-diameter straight-through duct for the aft engine. The bare nose section is delivered to the Long Beach sub-assembly area for fitting out from McDonnell Douglas Astronautics in Santa Monica, Calif, while the main fuselage arrives from the Convair division of General Dynamics in San Diego. The manufacturing philosophy has been to build "in house" in Southern California those fuselage sections (notably the more complex ones) taking 50 per cent of the available man-hours. A further quarter is being built in other McDonnell Douglas factories with the remainder sub-contracted.

Each fuselage segment is positioned in the sub-assembly building where interior fittings are installed along a double-decked assembly line which provides simultaneous access to the upper and lower cabin sections. Here, the nose section is joined to the forward fuselage, and the tail section is connected to the aft section. A major departure from traditional McDonnell Douglas practice has been the assembly of fuselage sections with most wiring and internal fittings already in place and electrical couplings at each fuselage break. Most fluid-services pipes have brazed joints. Essentially all electrical wiring and cabin interior fittings are made at Long Beach, although galleys, lavatories, seats and avionics systems are supplied by outside manufacturing companies.

Wings for the DC-10 are built at the Douglas Aircraft Company of Canada, near Toronto. On delivery to Long Beach the wings are joined to the centre wing box, fuel-tank installations are completed, control linkages and engine pylons are installed and the main landing gear is attached. The aircraft then proceeds along the assembly line on its own wheels. Final production assembly of the DC-10 begins in an adjoining building with the mating of the centre fuselage section to the wings. Forward and aft fuselage segments are then connected to the centre section to complete the airframe.

The new aircraft then moves through additional assembly-line positions for completion of interior fittings, installation of the horizontal stabiliser and wing control surfaces, for pressure testing and fuselage painting. After this operation, the

## DC-10 ORDERS

Operator	Model	Orders	Options
American	-10	25	25
United	-10	30	30
Northwest	-20	14	14
TIA*	-30F	2	2
KLM (KSSU)	-30	6	6
SAS (KSSU)	-30	—	6
Swissair (KSSU)	-30	6	5
UTA (KSSU)	-30	2+2	3+1
ONA	-30F	3	3
National	-10	9	8
Air Afrique	-30	2+1	1+1
Alitalia	-30	4	5
Air New Zealand	-30	3	1
Continental	-10	8	8
Sabena**	-30	2	—
Lufthansa†	-30	119	122
		5	—

\* Previously three orders and no options. \*\* Letter of intent only.  
† Letter of intent but subject to board approval.

DC-10 is towed to the new final assembly and functional check-out facility. Here, the upper fin is attached, control cables are rigged and engines are fitted. Passenger seats are installed, and all aircraft components and systems are tested as the aircraft passes through the six final-assembly positions.

The completed DC-10 rolls off the assembly line to a pneumatic test area before it is weighed and delivered to the Douglas flight ramp, where crews conduct hydraulic, electrical and fuelling tests and engine run-ups in preparation for flight. It is then turned over to flight crews for taxi tests and at least three long-duration flight tests (approximately four hours each). Delivery is made after a final test flight by a crew from the customer airline.

But before flight testing can become a routine task to be completed after the aircraft come off the production line, the certification programme must be completed (see *Flight* for July 23, page 124). It is on this that the DC-10 has begun under the management of Mr Clifford L. Stout, chief project pilot. Five aircraft will be used in the flight-test programme: the company hopes to have it completed by October and 12 aircraft delivered by the end of 1971. Deliveries should be into three figures by the end of 1972 and production rate two a week. Ten aircraft are now on the line at Long Beach and the production rate is building up.

## Profitable year for BEA—2

The following is the continuation of a review of BEA's report and accounts for 1969-70 (the first part appeared in "Flight" last week, on page 373). The corporation returned a record group profit of £6.53 million for the year, and its biggest-ever operating profit of £11 million. The results took account of a credit of £4 million from the special account set up by the Government when BEA was refused permission to buy the US aircraft that it wanted.

**A** PRESS CONFERENCE following publication of the report was notable for the impassioned plea, by the airline's chairman, Sir Anthony Milward, on behalf of the BAC Three-Eleven. He left his audience in no doubt that BEA wants to buy it, and that if it is not built the consequences for the British aircraft industry will be serious. Mr Henry Marking, the airline's chief executive, spoke of the difficulties of running domestic services.

None of BEA's domestic routes are profitable at the moment. Mr Marking pointed out that fares are in general lower per mile than those of international routes, and landing fees in Britain are regarded as extremely high (they accounted for 16 per cent of variable costs on international services, but

29 per cent on domestic services). The operating loss on domestic services was £1.1 million, compared with a £16.2 million surplus on international services. Domestic traffic in 1969-70 was only slightly up on the previous year—passengers carried increased by 2 per cent, against 14 per cent for international traffic. The losses on domestic services are incurred despite the high passenger load factor of 66.5 per cent (against just over 61 per cent for international services).

The possibility that British Air Services, through its two subsidiaries Cambrian and BKS (the latter soon to be renamed Northeast), may take over some of the BEA domestic routes is under consideration. There is no intention to relinquish the trunk routes to BAS, but some groups of routes such as those to the Channel Islands could be transferred.

Losses of BAS during the period under review amounted to £2.7 million (£3.7 million for the 18 months to March 31, less provision made in last year's accounts for six-month losses of £1 million). Results this year are expected to be much improved. "At last," said Sir Anthony, "we believe we have got BAS on to a profitable basis. This is no mean feat." The BEA financial director, Mr Cyril Herring, is at present serving as BAS managing director, with the primary task of putting the group on its feet.

BEA Airtours, the corporation's charter subsidiary, is in its first year of operations, but is expected to make a small profit. The corporation has given the company a strict brief that it must operate profitably and generate a worthwhile return. Mr Marking said that the start of operations had made a big impact and had been very successful. Mr P. C. F. Lawton,



# The military requirement of the '70s



## 1. Primary training and air experience

The SF 260M combines classic handling qualities, docility, side-by-side seating, excellent cockpit visibility for instructor and pupil, and ease of maintenance.

## 2. Basic and refresher training

The SF 260M provides performance and precision. Ample accommodation for avionics. Full aerobatic capability. Exceptional reserves of strength and high fatigue life.

## 3. Counter-insurgency operations

The SF 260M can carry up to 350 lb of underwing bombs, guns or rockets. It has the performance and manoeuvrability needed to ensure swift and effective ground strikes.

## 4. F.A.C. and target reconnaissance

The SF 260M has an endurance, with standard tanks, of up to six hours. Complete all-round visibility. The ability to fit reconnaissance cameras and a full radio installation.

## 5. Fast, economic communications

The SF 260M provides three/four seats in a comfortable cabin. A maximum range of 1,270 miles and cruise speeds of up to 180 knots—with 20 m.p.g. economy.



**SIAI Marchetti SF 260M** powered by 260hp Lycoming 0540

... already in service with or on order for 8 air forces and airlines



# We're handing out a strong line at Farnborough.

Aviation engineering is a tough job. To build in tons you think in milligrams. As with everything, the fastening devices are vital factors in the struggle between weight and strength. On stand No. 159 Avdel are introducing four new Cherry fastening systems. Every one with a critical job to do; every one developed over years of close association with aircraft constructors.

From the first all metal aircraft to the first supersonic transport, Avdel are the leaders in both aviation and industrial fastening technology.

## Fasteners by Avdel



**AVDEL** *Fasteners for the Aerospace Industry*

Avdel Limited, Black Fan Road, Welwyn Garden City, Herts.  
Telephone: Welwyn Garden 28161



## AIR TRANSPORT...

BEA traffic and sales director, said in answer to a question that it was unlikely that Airtours would operate an aircraft such as the Three-Eleven until it had been in service some time with the parent company.

An area of BEA's 1969-70 operations which the airline describes as disappointing is that of cargo. Freight tonnage carried was 1.3 per cent down, to 130,758 tons. Freight ton-miles increased marginally. This result was occasioned, says the report, by industrial problems at Heathrow, which resulted among other things in a delay to the introduction of the Vanguard freighters, and to problems connected with the transfer of Heathrow operations to the new Cargo Centre terminal.

Sir Anthony said that he was not persuaded of the value of an Airways Board such as had been suggested by the Edwards Committee to form an overall board of management for BEA and BOAC. "I'm totally opposed to any change in the structure," he said; "we are happily divided up, and we have each got our job to do." Co-operation between the two airlines, he said was improving. The report mentions that during the year 1969-70 the scope of the Air Corporations' Committee was increased; it now has four separate subcommittees reporting on personnel and industrial relations, planning, finance and services, and technical matters. There are facilities for a greater exchange of mutual problems and for joint co-operation in the fields of medicine and training. Asked if he had been informed of the policy of the new Government towards the Airways Board, Sir Anthony said: "I haven't heard a word."

BEA's report says that the airline's depreciation policy is unchanged from 1968-69; "the estimated operational lives and realisable values of the various assets [are] reviewed and adjusted from time to time in the light of experience and changing circumstances." Owing to the sharp decline in the market value of turboprop aircraft, says the report, an additional provision for amortisation of the Viscount fleets of the BAS group—Cambrian and BKS—has been made. This amounts to £1,462,000.

Provision for amortisation of the BEA fleet in 1969-70 was £11.8 million (compared with £12.5 million in 1968-69, a figure which included an additional provision of £2.8 million to write aircraft withdrawn from service down to estimated market value). The amortisation provision for the group fleet was £14.2 million, compared with £13.3 million in 1968-69.

## BEA: STATISTICAL SUMMARY, 1968-70

	1969-70	1968-69	Variation (%)
<b>Financial (£ x 1,000)</b>			
Revenue	126,038	108,385	+ 16.3
Expenditure	115,018	109,133	+ 9.4
Operating profit	11,020	3,252	+238.9
Group profit attributable to BEA	6,532	3,536	+ 84.7
<b>Traffic</b>			
Capacity short ton-miles (millions)	661.3	590.5	+12.0
Load short ton-miles (millions)	385.0	348.9	+10.3
Overall load factor(%)	58.2	59.1	- 0.9pt
Load factor to cover total expenditure (%)	55.9	59.7	- 3.8pt
Cost per CTM (d)	43.9	44.5	- 1.3
Revenue per CTM (d)	45.7	44.0	+ 3.9
Passengers carried (thousands)	8,475.9	7,728.7	+ 9.7
Passenger-miles (millions)	3,259.8	2,920.3	+11.6
Available seat-miles (millions)	5,229.1	4,717.0	+10.9
Passenger load factor (%)	62.3	61.9	+ 0.4pt
Mail (short tons)	16,436	15,581	+ 5.5
Freight (short tons)	130,758	132,422	- 1.3
<b>Operations</b>			
Regularity (passenger services) (%)	96.9	96.2	+ 0.7pt
Punctuality on arrival (passenger services) (%)	72.8	75.8	- 3.0pt
Aircraft utilisation (revenue hr/year)	2,065	2,137	- 3.41
<b>Staff and productivity</b>			
Average no of employees	23,228	22,185	+ 4.7
CTM per employee	28,471	26,818	+ 7.9
Revenue per employee (£)	5,426	4,886	+11.1

## Reporting Points



**BOAC** Financially speaking, BOAC (whose annual report was reviewed in *Flight* for August 27, page 300) ought not to be too smug about its performance, bright though it may seem amid the current airline gloom. Just one point: BOAC revenue per employee is £9,073 for each of 22,400 employees; TWA achieves £11,600 for each of 39,700, better by some 19 per cent, and this with a large domestic rate in the USA which is low in comparison with *lata* fares. This is reflected in cost and revenue rates. BOAC's traffic cost per available ton-mile is 20.8d, compared with 18.3c for TWA (one cent is equal to one penny); break-even load factors are 52.5 per cent and 41.8 per cent for BOAC and TWA respectively, whereas the achieved load factors were 55.7 per cent and 42.4 per cent.

BOAC's aircraft utilisation has now increased to 3,960hr per aircraft per annum, which shows a 46 per cent improvement over nine years ago, when it was 2,770hr. This new level compares favourably with Pan American at 4,270hr.

On a ten-year basis the profit-and-loss accounts for major airlines have all followed similar patterns, with losses during the early 1960s, when the first jets arrived on the long-range routes. BOAC was no exception, and was further burdened with political decisions on the VC10, which still appears to cost 11 per cent more per capacity ton-mile to operate than the 707; moreover the passenger appeal of the VC10 may be slowing against the 747. But other carriers did not get so deep in the red and by 1963 were showing healthy profits again; BOAC took longer to get straightened out. A sympathetic Government cleared the decks of £80 million of accumulated losses, but now it is claimed that the airline would be back to par again without such help.

BOAC has other facilities, as shown by the balance sheet. Not only has the airline a large capital of £65 million but there is also a loan facility from the Board of Trade of £31 million at 4 per cent per annum interest available until the end of 1975 out of total borrowings of £57.6 million. TWA has only \$53.5 million (£22.3 million) of subscribed capital and \$100 million (£41.5 million) borrowed at 4 per cent per annum out of a total of \$780 million (£325 million), the remainder costing appreciably more. It might also be noted that BOAC is receiving interest, presumably at more than 4 per cent, on short-term deposit on £52 million.

It is interesting to note the ratios as shown by the balance sheets. Based upon the finance required for the total assets employed, BOAC percentages are split into public dividend capital, 27.4 per cent, retained earnings, 31.7 per cent, borrowings, 22.8 per cent, deferred liabilities taking up the rest. TWA's equivalent figures are 4.5 per cent, 25.6 per cent, 61.5 per cent. For that matter those of most American airlines are similar. This shows how the borrowing gearing differs because little permanent capital has been injected into TWA and thus does not have to be serviced by dividend performance. Nevertheless, the loan interest is a fixed charge on annual profits and reflects accordingly, particularly as BOAC has not paid too many dividends in the past, even if this year's 20 per cent is a good effort. Incidentally, had there been no BOAC reconstruction, the figures might be: capital, 27.4 per cent, retained earnings, nil, borrowing, 54.5 per cent.

On general financial policy, BOAC is struggling to get into line for the next few difficult years. Depreciation has been revised giving the Conway-powered 707 fleet a 14-year write-off to zero and extending the VC10 write-down from 8½ years to 12. Balances have been transferred to reserve in case premature retirement throws up uncovered residuals. Insurance reserves of £30 million indicate that not all the fleet cover finds its way to Lloyds or the new *lata* insurance company. Perhaps it can be summed up as "not so much an airline, more a way of life."



## AIR TRANSPORT

# LIGHT COMMERCIAL & BUSINESS



The simple construction of the Evangel 4500 is evident in the square fuselage section and straightforward Jodel-style cranked wing. The use of 2024-T3 Al. aluminum skinning is claimed to make field repair easier. See story on this page



**Survey by Learjet** Aeroleasing of Geneva now has a Learjet 24 specially equipped for aerial survey, hydrographic analysis and photogrammetric work.

Aircraft modifications consist of various items among which is the installation of a special door permitting operation of the WILD RC-8 camera. This equipment allows the camera to be used within the pressurised section of the aeroplane. Also, a direct view-finder system (drift sight) and Doppler have been fitted to give the navigational accuracy which is necessary to perform high quality work. It is claimed to be the first time that Doppler equipment has been used for navigation on photogrammetric work. Aeroleasing claim that the navigational precision attainable permits a considerable reduction in the overlapping margin of picture strips. Should the Doppler go wrong the drift sight system acts as standby equipment. The Learjet operates with a three-man crew: pilot, co-pilot (operating the Doppler equipment) and cameraman.

An initial contract has been signed with KLM-Aerocarto, covering a two-period photogrammetric mission in Indonesia totalling six months. For these missions, the Learjet always leaves with a complete crew as well as a mechanic who stands by for maintenance of the aeroplane at any location, with a complete set of tools and spare parts at his disposal.

Aeroleasing also uses a Commodore jet for ambulance flights. Two stretchers can be carried as well as seats for medical assistants and nurses.

**Evangel 4500** Shown for the first time at the recent Abbotsford air show in Canada was the Evangel 4500 Stoll utility twin, designed specifically for bush-flying. The aircraft can seat nine people or take up to a ton of freight. Large doors

on each side give good access to the 10ft. 3m long cargo bay. Two 300 h.p. Lycoming IO-450-K1B5 engines are used which are claimed to give a cruising speed of 175 m.p.h., 280 k.p.h. at 65 per cent power and a range of up to 700 miles, 1,130km. The aircraft is built by the Evangel Aircraft Corporation, Orange City, Iowa 51041.

**S-58T Twin-Pac Order.** Helicopter Utilities of Sydney recently placed an order for five Sikorsky S-58T Twin-Pac 16-seat helicopters. At the same time the company took an option to purchase five more. Delivery will commence in the middle of 1971.

A successful first flight of the twin-engine helicopter took place on August 20 at Stratford, Connecticut. The S-58T Twin-Pac is a conversion of the original Sikorsky S-58 in which the existing piston engine has been replaced by a twin turbine PT-6 developing 1,800 h.p.

The Airfast/Helicopter Utilities Group at present operates some 68 aircraft including more than 20 turbine helicopters. The aircraft are based throughout Australia and Papua/New Guinea and also in Fiji, Indonesia and Korea. The helicopters are supported in the field by a mixed fleet of fixed-wing aircraft ranging from DC-3 downwards.

**Helicopter Survey Amendments** The following amendments have been received to the World Helicopter Market published in *Flight* for July 30: Asahi Helicopter Co Ltd—16 Bell 47G-2, 20 Bell 47G3B-KH4, 2 Alouette II, 2 Bell 204B. Schreiner Air Transport NV—address is now Keizerstraat 2, The Hague, Netherlands. The Schreiner Group of Companies also has associated companies in Iran, Nigeria and Indonesia using helicopters.

Below, left, Commodore jet ambulance of Aeroleasing and, below, the survey Learjet 24 showing the camera housing below the door. The Learjet's time to Jakarta, where it is at present based for survey work, was just under 20hr from Geneva. See story on this page





# Decca Doppler navigates the Viggen and the Vulcan



Two major military contracts for Doppler Type 72 equipment, worth approximately £2m, have recently been signed.

Over 200 aircraft systems are involved in contracts awarded jointly by the Ministry of Technology and the Ministry of Defence for re-equipping Vulcan aircraft for Strike Command, and also by the Swedish Air Material Department for the supply of similar equipment for the Royal Swedish Air Force supersonic combat aircraft, the SAAB Viggen.

Since the initial development of Decca Doppler 70 series equipment four years ago, over 400 sets of equipment have been ordered for aircraft ranging from the French Air Force and Navy Jaguar to the development models of the WG13 helicopter.

Farnborough Air Show Stand No. 161-162

TOP  
DOPPLER

The Decca Navigator Company Limited London



F.A.A. Repair  
Station 4778



## World's Largest Independent Supplier of Aircraft Accessories and component Parts

### Donalco

Abex, Adel, Aro Equipment, Candler-Hill (Titan), Chandler-Evans (Ceco), Delco Electric, Eclipse, General Controls, Hydro-Aire, N.Y. Air Brake, Pesco, Romeo, Thompson, Vickers, Weldon, Whittaker.

### Steben

Airesearch, American Bosch, Bendix-Pacific, Bendix Red Bank, Bendix Scintilla, Bendix Stromberg, Bendix Utica, Breeze, Delco Generators, G.E. Generators, Hamilton Standard, Jack & Heintz, Eicor, Leece Neville, Leland, Westinghouse.

# Donalco Steben

Aircraft Accessories and Component Parts  
Donalco International Sales Offices

### UNITED STATES

7240 Coldwater Canyon Ave., North Hollywood  
California 91605. Phone: (213) 875-0550.  
Telex: 677140. TWX 910-499-2175

### ENGLAND

Room 172, Airport House, Purley Way, Croydon,  
Surrey, England. Phone: London Area Code  
01-688-0285. Telex: 27642

### AUSTRIA

1101 Wien, P.O. Box 1, Wien, Austria.  
Phone: 64 82 51. Telex: Vienna 11815

WE ARE PROUD  
TO ANNOUNCE THAT  
WE ARE PRODUCING  
THE FINEST  
EXECUTIVE AIRCRAFT  
FLYING TODAY  
THE

## JETSTREAM

100 SERIES MK. II



DELIVERY 8 WEEKS.  
ALL BACK UP AND  
SERVICE FACILITIES  
AVAILABLE.

See us on display at the  
1970 Farnborough Air Show.

## TERRAVIA LTD

PRINCE CONSORT DRIVE • ASCOT • BERKSHIRE  
Telephone: ASCOT 21678 (24 hours)  
Cable: WORLDWIDE ASCOT

BLACKBUSHE AIRPORT • CAMBERLEY • SURREY  
Telephone: YATELEY 3121



# ATC criticism: the controllers reply

Is the British air-traffic control system creaking at the joints? A recent article by "Flight" columnist Mainliner (August 20, page 265) suggested that it was, and alleged that recent power failures and current equipment deficiencies in the Scottish area were evidence of the fact. Two organisations taking issue with Mainliner's comments are the Guild of Air Traffic Control Officers and the Board of Trade, statements from both of which are reproduced below.

THE GUILD OF AIR TRAFFIC CONTROL OFFICERS has little quarrel with some of the basic points which Mainliner makes. However, there are several contributory factors to the many stresses which have obviously become apparent to pilots this summer, particularly in the airways ATC environment. Some of these have been and are related to the sudden imposition of flow control restrictions on the Continent; these always make life difficult to the ATCCs. The main trouble is, however, that more and more high-performance aircraft are requiring a narrow vertical band of upper flight levels to the exclusion of the once popular middle flight levels, now under-utilised. This demand places an undue strain upon some elements of the airways system and ATC procedures. Certainly we agree with Mainliner that modern ATC re-equipment is a painfully and traditionally slow process. These are just some problems which face controllers today.

We think the sense of urgency Mainliner has felt is certainly shared by most controllers in ATCCs and at many busy airports nowadays. Everything happens so much faster than was the case even a few years ago. Experience in terms of years may not always be visibly apparent among controllers; much of the work, however, is best performed by the younger ones at ages where high intelligence and extreme alertness are perhaps at their peak. Expertise is not lacking, nevertheless, and these controllers do try to make the best possible use of radar equipment and navigational aids alike.

Mainliner's comments regarding frequent ATC requests for rapid descent—we would prefer to call it relatively rapid—are not accepted by the Guild in the context in which he presents them. It is absolutely critical in all cases when aircraft are asked to achieve specified cleared levels by a given navigation aid that they do so in order to achieve separation from other traffic converging or crossing in other sectors of the system. Such descent requests are normally well considered in relation to aircraft performance. Whereas many controllers will not be entirely *au fait* with the attendant flight-deck problems, we do suggest that Mainliner is on a wrong steer if he thinks that they are not conversant with the technical performance of aircraft in the system. Indeed, it would not be unreasonable to suggest that an experienced radar controller at a busy ATCC has an even better all-round appreciation of relative aircraft performance capability than have most pilots—many of our people have a background of considerable aircrew experience themselves with no little understanding of the subject.

We do agree that it would be most useful for controllers to spend more time in the air on the flight deck on longer and more purposeful flights than present arrangements permit, but some valuable liaison is achieved nevertheless. Our great regret is that it is a one-sided arrangement. There are few major ATC units of the types discussed here which enjoy to any measurable extent the benefits of visits by aircrews. Judging by experience there must be many pilots who fly within the UK airways system who have never visited such ATCCs and control towers, nor discussed at first hand problems

of controllers and how they are being tackled. We trust that Mainliner is not one.

The greater degree of familiarisation-flight liaison for controllers might also give them a better understanding of a phenomenon carefully not mentioned by Mainliner. This concerns the enormous variation of practice and performance between identical aircraft types flown by different companies and, particularly, those flown by different pilots of the same company in basically identical operating conditions. In short, our observation is that the aircraft performance Mainliner might achieve with his aeroplane gives absolutely no guarantee that Captain X of the same company in the same aeroplane would achieve the same result under identical conditions. The Guild would welcome international standardisation by operators of certain performance factors, such as rates of descent, descent speeds and fixed-IAS departure, within various type categories.

It is not the first time the Guild has noted comment—usually adverse—concerning radar vectoring. It would appear to us that Mainliner is forgetting that the prime aim of the use of radar is to achieve separation from other traffic and not to perform his navigation for him. Pilot organisations constantly echo the need for navigation to be retained in the cockpit, and the Guild would agree entirely. There is no doubt that controllers do return pilots to their own navigation to short-range aids after separation vectoring, but we suggest that most aircrews worth their salt will not, in the United Kingdom, be too uncertain of their position—particularly when it is common practice to give a QDM to the facility, supplemented with a range either voluntarily or on request.

In *Flight* for August 20, page 265, Mainliner states that excessive reliance is placed on the radar systems in the UK. We agree with him that the true rôle of primary radar should be a monitoring one, but this presupposes an area-navigation environment which we do not yet have. At present the availability of nav aids, both airborne and ground-deployed, although comparing favourably with that existing throughout Europe, places constraint upon the route structure.

The Guild has already stated its requirements for a system which will permit the monitoring of standard instrument departure (SID) and standard arrival (STAR) procedures, supported by full SSR capability in the air and on the ground. But does Mainliner seriously think that more extensive use can be made now of procedural methods, at existing or forecast traffic loadings and within the present environment, before the availability of area-navigation techniques becomes general? There is every indication that in the immediate future the ATC systems of the world will largely be radar-oriented, although in the longer term radar will become a monitor providing an essential fail-safe backup within future systems.

Until these better things are with us, controllers, being human, may well convey their feelings of urgency unwittingly and will certainly have their difficult moments. The Guild is concerned and surprised, however, that Mainliner should think that pilots flying in the UK might consider their own "do-it-yourself" form of ATC in the event of certain breakdowns envisaged by him. Does he really think any one of them would get the picture of an existing or pending TMA situation on, say, a Saturday morning in high summer with a converging flow in full cry for descent?

Regrettably, the Guild finds that Mainliner's articles imply that pilots are being forced to carry out unsafe or unpleasant manoeuvres. This simply is not so. Air traffic controllers in the United Kingdom issue clearances and instructions which they consider safe and acceptable in a given traffic situation. If the captain of an aircraft does not like such clearances for any operational reasons, all he has to do is to say so. He will then receive an alternative clearance once this situation





## AIR TRANSPORT...

has been assessed by ATC. The tempo and pressures of air traffic control work have increased enormously but, if he cares to visit us, Mainliner may be assured that he will find in ATCCs and airports an atmosphere of confident professionalism. The concern is entirely for the safety of the aircraft under the control of such units, and for the best possible service to aircrews and passengers, on whom no little consideration is bestowed by ATC. These things can only be provided with the co-operation of aircrews and their willingness to operate their high-performance aircraft to optimum advantage.

There has traditionally existed in the United Kingdom an indefinable bond of respect between aircrews and controllers. Certainly a few ATC errors have contributed to incidents in recent years; however, it should not be assumed from Mainliner's many articles that aircrews themselves are faultless with regard to similar occurrences. Whereas the Guild would not necessarily support all aspects of the present or even the coming UK Mediator ATC system as the ideal, we do say that both pilots and controllers have a job to do in a uniquely difficult environment with what equipment is, or is planned to be, at their disposal. In order that both the existing and the Mediator systems are to work harmoniously, a considerable degree of mutual co-operation and trust is and will continue to be necessary to maintain this bond of professional respect to which we refer. Far too many outbursts in the Press today by the uninformed and those who should know better contribute neither to the maintenance nor improvement of this bond.

**The Board of Trade writes:** Mainliner's account of the radar problems in the Glasgow and Prestwick areas really is rather exaggerated. Certainly it draws conclusions which need to be corrected.

At 1427 GMT on July 24 there was a grid power failure into Kilmarnock affecting the Prestwick area. This caused a limited failure (reduced coverage) for one or two minutes on certain RT communication channels at the Scottish Air Traffic Control Centre while the standby power took over. The centre's three radars at Gailles were also affected by the failure and, although the standby power took over quickly, by the nature of radar equipment, it took about ten minutes for an operational service to be resumed. Later there was another short break in service of certain communication channels and the Gailles radar when mains power was restored. This power break also caused a component failure in the Prestwick VOR and it was off the air for about an hour. The radar at Prestwick Airport was on scheduled maintenance as it normally is on Friday afternoons and as is notified in the *Air Pilot*. As a result of all this, some Prestwick aircraft suffered delays.

There was no "failure of the high-level Ulster/Scottish radar services," which were operating normally. Nor, except for the Glasgow DME, were the other facilities at Prestwick or Glasgow airports affected. Investigations so far have revealed

*Ariana's new Boeing 727, which replaces one leased from World Airways, on final approach to Gatwick. The airline operates once weekly from Kabul to London via Istanbul and Frankfurt*

no evidence whatever of "dangerous unpreparedness" or "lack of liaison." The radar at Prestwick centre is normally in use for only 14hr a day, so controllers have ample opportunity of working without it.

The old DME at Prestwick is being replaced by an up-to-date one, and it was the subject of a Notam on June 30 as being withdrawn from service. The Skipness Tacan was withdrawn from service by the Ministry of Defence on June 15 for installation of a dual equipment; this too was in the Notam. Both the Skipness and the Prestwick DME will be back in service shortly. This is neither "continued unserviceability," nor is it an example of "ignorance of the need for capital investment to provide an improved standard of reliability." The UK records of serviceability of facilities will stand comparison with any. The standards are high, and as new and more reliable equipment is introduced they will become even higher.

The new radars in the Scottish area will start coming into use shortly, and they will, as will all the Mediator radars and facilities, be fully duplicated; in some cases a third or even a fourth facility will be available. The UK standard of back-up and standby equipment is believed to exceed those of any other country. Despite it, controllers will still have to be prepared to operate with reduced facilities. They are trained to do so and are quite capable of doing so.

On DME there is as yet no requirement for aircraft to carry this equipment when flying in the UK, and until most aircraft are suitably equipped there is little advantage in trying to base separation on its use. Nevertheless, such procedures are being prepared ready for introduction when practicable. Mainliner is hardly right in suggesting that the UK is underprovided in navigation aids. Perhaps he does not realise that there are 39 VOR installations here, and that 18 of these have an associated DME. Next year 30 will have DME.

It is accepted that the procedures for airborne radio failure are complicated, but as pilots will probably know, they are being simplified following an agreement at an Icao/EUMED meeting held in November last year. These new procedures will be published shortly.

**Brazilian Carrier Defunct** Paraense Transportes Aereos has been declared bankrupt and "extinct" by the Brazilian authorities, reports *Interavia Air Letter*. The airline suffered an accident to one of its Fairchild Hiller FH-227Bs in March.

**Caledonian Airways** has opened a Far East sales and operations co-ordination centre at Kuala Lumpur. The office is under the control of Mr Graham Broadbridge, the airline's regional manager, Far East and Australasia.





Every once in a while we succumb to the perfectly natural temptation to blow our own trumpet. It is not so much a conceit as pride in a job well done. This is such an occasion. A prolonged look at the British Register of Light Aircraft has revealed that there are significantly more Pipers registered than any other aircraft. Since the import restrictions were lifted in June 1959, 743 Pipers, 466 Cessnas and 86 Beechcraft have been registered. And the trend continues. As CSE are Piper distributors for the UK we feel entitled to blow a small but harmonious tantantara.



# PILLAR AERO SERVICES

## AIR ENGINE SERVICES LIMITED

BLINDLEY HEATH, LINGFIELD

Telephone: LINGFIELD 2646, Telex: 95260

Cables: PRATWIT LINGFLD

**R.R. DART TURBO-  
PROP AND P&W  
PISTON ENGINE  
OVERHAUL AND  
EXCHANGE SERVICE**

A.R.B., M.O.T., F.A.A.,  
C.A.A., APPROVED

## HANTS & SUSSEX AVIATION LTD

CITY AIRPORT, PORTSMOUTH.

Telephone: PORTSMOUTH 62304/5/6

Cables: HANSUSSEX PORTS, Telex: 86343

LIGHT AERO ENGINE (LYCOMING,  
CONTINENTAL, GIPSY) OVERHAUL  
AND EXCHANGE SERVICE.

PROPELLERS • ENGINE DRIVEN  
ACCESSORIES • MISCELLANEOUS  
AIRFRAME EQUIPMENT • AUSTER  
AIRCRAFT SPARES, REPAIRS AND  
SERVICE.



## TECHNICAL PLATINGS LTD.

**SPECIALISTS IN**

**ANTI-CORROSION TREATMENT**

**FOR THE AIRCRAFT INDUSTRY**

**ANODISING (INC. HARD)**

**PRECIOUS METALS**

**HARD CHROME**

**STOVE ENAMELLING EPOXY, ETC.**

SEE US ON

STAND No.

**196**

AT THE

S.B.A.C. SHOW

FARNBOROUGH

1970

**CRAIGS WORKS, LUTHER ROAD, TEDDINGTON, MIDDLESEX**

**01-977 4381/4**



## IN THE AIR

By Tony Smith: Number 246 of the series



## BIG-THREE CHALLENGER

Competitor for Cessna, Piper and Beech trainers

IT HAS LONG BEEN THE FASHION in Europe to condemn the unresponsive handling of American mass-production light aircraft. The introduction of the American Aviation AA-1 Yankee, now available for the first time this side of the Atlantic, has shown that there is at least one exception to this generalisation. The Yankee has light, positive and responsive controls which make it very pleasant to fly. Judging from handling reports in American journals, the Yankee is in fact, quite a revolution in the USA where it is viewed as much as a sport aeroplane as a tourer or trainer. For European pilots more privileged than Americans as far as the availability of pleasant-handling aircraft is concerned, it is as well to put this in perspective. The Yankee does not have that same purity which French and Italian designers seem able to achieve, but at the same time, it contrasts so much with the uninspiring feel of many American types that it is virtually in another class. This, coupled with the low price of £5,800 fully equipped (including full panel and Narco Mk 12B) makes it very competitive in the club tourer/trainer role.

The aircraft I flew recently was one of the second batch of four to be assembled by Eagle Aviation Services at Leavesden. The distributors for the UK and Eire are General Aviation sales based at Jersey and I flew with Dave Blackburn, one of the directors, who has been touring UK clubs in the company's demonstrator.

Continued overleaf



**Heading picture:** a castoring nosewheel is an unusual feature on the Yankee. The wheel spats are claimed to add 2 m.p.h., 3.2 k.p.h. to the cruising speed. Above, a landing light comes as part of the basic package



## BIG-THREE CHALLENGER...

(Left) the left tailplane and elevator (the right carries the trimmer) and the fin and rudder are interchangeable—the fibreglass tips are easily detachable. Below, the smooth rivetless finish of the Yankee is a noteworthy feature.



First impressions were of the roominess of the cockpit. It was easy to adjust the seat position by means of a handle alongside the cushion—much better than fumbling for a catch near the floor. Trim and flap controls fell conveniently to hand on the central console and conventional engine plunger-type controls were placed in the panel centre. Accessibility is average—the *Cherokees* and *Musketeers* remain just about the only low wing aircraft in the same class which you can step into through a door like a car. Of note were the fuel gauges—simply glass tubes on the cockpit sides; larger variations of the principle used in the *Super Cub* and *Tiger Moth*.

The non-steerable nosewheel is fully castoring and can go right round to 90° from straight ahead so the turning circle can be very small if necessary. Taxying by applying brake is so simple I wondered why the extra expense of a steerable nosewheel is ever justified on small aircraft. The only time, I suppose (apart from brake failure while taxiing, which could be awkward) would be for crosswind take-offs, when the Yankee needs a little brake initially to keep straight; but once again the action is instinctive and the rudder very soon becomes fully effective.

A criticism of the Yankee by some American pilots has been on the length of take-off run but, with half tanks and two up, the run seemed perfectly reasonable to me. The book claims that 1,615ft, 492m, are required to reach 50ft, 15m, which compares well with equivalent types. We registered a rate of climb of just under 800ft/min, 4m/sec at 85 m.p.h., 137 k.p.h. which is also reasonable on 108 h.p. The aircraft I flew was fitted with a cruise propeller—a climb version is available as an alternative. The book recommends a cruise climb of 95 m.p.h., 150 k.p.h., which helps over-the-nose visibility.

Flying a few circuits around our photographer at the end of the runway, I found the ailerons gave a surprisingly high rate of roll for this sort of aircraft. It was noticeable that the rudder had to be used all the time to keep the Yankee in balance; there was no question of ailerons-only turns as in some comparable types—a fact which no doubt adds to the Yankee's usefulness as a trainer.

A few steep turns confirmed my impression about well-harmonised controls and also noteworthy during such manoeuvres was the excellent visibility from the bubble canopy. This is cleared for opening during flight but, unless you're wearing a silk scarf, this is really for very hot days as there is a fair amount of buffeting.

The Yankee approached the stall progressively with no sudden build-up of drag. A buffet preceded a positive but gentle nose drop at an indicated speed just above 65 m.p.h., 105 k.p.h. There was no wing drop and the ailerons remained effective to a point—they would bank the aircraft all right but were reluctant to pick the wing up again. It seemed fairly easy to pull a little too hard during recovery but this impression may have been due to the over-enthusiastic stall warning reed which whined away at 15 m.p.h., 25 k.p.h. or so above the stall speed. After this, I put the Yankee into a fairly steep

turn and just kept hauling back on the stick waiting for something to happen. The result was all very docile; the nose dropped but there was no suggestion of a spin. Insufficient rudder in this configuration caused a fairly rapid rotation rather than a flick out of the turn and into a nose down one the other way; but once again no suggestion of a spin. The aircraft is not yet cleared for spinning but would clearly not be easy to get into one anyway.

Next I came to the flaps which are electrically operated by a switch on the centre console. When this switch is released the flaps stop extending, but for retraction it does not have to be held—a useful feature when doing touch and goes. The flaps are very small and even before we took off I wondered just how much they could contribute. The answer is very little indeed. I tried a glide with flaps up and then without touching the controls I put full (30°) flap down. After the initial nose up movement the Yankee resumed its glide at much the same figures as before. The manual gives the stalling speed, flaps down, of just 1 m.p.h., 1.6 k.p.h. less than with them up. The flaps do make the approach slightly steeper although, with the Yankee's fairly high wing loading, it already is quite steep with the aircraft clean. It could almost be said that the main value of the flaps is to teach trainees what they are and (just) what they do. Not surprisingly, the Yankee climbs happily with flaps down and an overshoot from a full flap glide needs only moderate forward pressure on the stick.

On the way back to Leavesden a check on cruising speed showed 130 m.p.h., 209 k.p.h., at 2,450 r.p.m., at 2,000ft, 600m—a commendable performance on 108 h.p. The noise level was surprisingly low, conversation being possible without excessive vocal effort.

The flap limiting speed is 100 m.p.h., 160 k.p.h. and this makes a comfortable speed for the downwind leg. Recommended approach speed is 85 m.p.h., 137 k.p.h., coming off to 80 m.p.h., 130 k.p.h., over the threshold. This is 1.3V<sub>L</sub> and is sufficient to give a comfortable round out. The Yankee then settles on its laminated glass fibre "Face Saver" main legs after a little float. With the high rate of descent power off, the speed needs to be held no lower than 80 m.p.h., 130 k.p.h., otherwise the flare and touch down tends to become compressed into rather a short space of time. Even so, the elevator remains effective for a surprising amount of time after touch down and, using a light touch, the nosewheel can be lowered gently on to the runway. Until you get used to it, this elevator sensitivity tends to make the aircraft feel a trifle twitchy in the pitching plane during landing.

With Leavesden closed and no traffic about, I tried some short circuits. The high rate of descent meant that we could get in from very close to the runway, especially using a steep descending turn from downwind on to finals. The manual points out that side slips are very effective in the Yankee. Unfortunately I did not have the opportunity to try these but I can well believe that a slipping turn, instead of just a steep one, on to finals would be very effective—and great fun.

Continued on page 395





ITALY's civil and military jet transport, the **PD-808** is in full production.

This is the straight-wing jet with the aerodynamically-balanced flying controls which handles like a pilot's dream aeroplane. The generously-proportioned, exceptionally well-glazed flight deck is of great appeal to all pilots who have flown the **PD-808**.

The structure is fully tested and fatigue-free, the wing resembling the DC-8 in its design.

The **PD-808** has a good field performance and is economical to operate, with its two Rolls-Royce Viper Mk 526 turbojets.

Accommodation ranges from 5 to 8 VIP seats up to a navigational training version. The **PD-808** has been ordered as a communications type for the *Aeronautica Militare*, as a high-altitude radio aids check ship and as a *de luxe* executive jet.

On the left, one of the Pininfarina styled interiors available to the businessman—luxury transport and flying office in one.

Equipped weight 4785 kg; max take-off weight 8165 kg; max landing weight 7257 kg.

Balanced field (FAA) 1800 m

Max speed, 6700 m, 852 km/hr (460 knots)

Service ceiling (0.5 m/sec) 13715 m, one engine 7925m

Max range with 432 kg payload 2253 km (1215 nm) 3 hrs 5 mins

Max range with 725 kg payload 1868 km (1008 nm) 2 hrs 34 mins

INDUSTRIE AERONAUTICHE e MECCANICHE

**RINALDO PIAGGIO**

Viale Brigata Bisagno 14, Genoa, Italy

SpA







Let the experts\*

smooth out your

**SHOCK  
VIBRATION  
SHOCK**

problems

A whole range of shock and vibration isolators and isolating systems, backed by years of experience, is available to meet most specifications for mounting equipment in aircraft, ships and vehicles. Muffelite isolation systems are proven and in service under all conditions. New ideas are always on the way ask us about them.

*\*Muffelite are the only people exclusively concerned with shock and vibration isolation and acoustic control.*

**CEMENTATION**  
**muffelite**

CM 74

**Cementation (Muffelite) Limited**

Hertford      Walton-on-Thames      Surrey  
Telephone: Walton-on-Thames 24122      Telex: 282700

# AIRCRAFT MATERIALS LIMITED

## AERONAUTICAL ENGINEERS

## STOCKHOLDERS

FORTY-FIVE YEARS OF SERVICE

Designers and manufacturers of assemblies, release mechanisms, research equipment and fittings for aircraft and helicopters; metalware for crew and paratrooper safety harnesses; and for supply dropping including "Trianco" platforms and pallets, and brake parachutes. Pop riveting tools.

Consultants & Stockholders  
of "Pop" and "Imex" Rivets.

Steel & Non-Ferrous Metals  
AGS, AS, and BS parts & components.

MINTECH/M.O.D./A.R.B./DISC  
APPROVED

Head Office & Works	Midland Road, London, N.W.1.
Works & Stores	Camley Street, London, N.W.1.
Works	Brunel Road, Newton Abbot, Devon.
Warehouse & Sidings	Somers Town, London, N.W.1.

STAND 98 AT FARNBOROUGH

MIDLAND ROAD LONDON N.W.1.

TEL.: 01-387 6151 (10 lines)



## BIG-THREE CHALLENGER...

## The Yankee's background

THE YANKEE APPEARED in Europe for the first time at the last Hanover Show so it is worth investigating where it fits into the market. In America, it is being pushed as a sports aeroplane as well as a trainer. Sports in this sense is rather a loose term implying fishing trips into the backwoods, but in Europe it is likely to become established as a major contender in the club trainer role (and tourer role in those clubs where the temporary loss of an aircraft from the training department does not hurt balance sheets too much). It has the disadvantage against aircraft like Airtourer and Monsun of being non-aerobatic (and non-spinnable) but it makes up on low price. There is no present intention to introduce an aerobatic version. American Aviation president, Russell Meyer, says that the necessary extra power, strengthened structure and revised loads analysis and testing programme would cost too much to be justified at the present rate of demand for such a version.

In club use, one of the major advantages claimed is the cheapness and ease of maintenance and repairs. Non-structural parts of the unique bonded honeycomb structure can be repaired without special heat treatment. Although more major repairs need extensive facilities, complete replacement parts are not expensive—an entire wing costs £250 for example—and the fin and left tail plane are interchangeable, which simplifies spares ordering and holding. The time required for a 100hr check is claimed to be only 6 to 8hr.

General Aviation Sales is currently arranging to appoint three dealers within the UK—one each in southern England, northern England and Scotland. Yankees are sent from America four at a time packed in a single 40ft, 12m, container, which is shipped direct from Cleveland. Assembly time at Eagle Aviation started off at about 40 to 45 man hours per aircraft but this is coming down with experience.

Distributors have also been appointed in Denmark, Norway, Belgium, Germany, France, Switzerland, Austria and Portugal. Eagle assembles the aircraft for all European destinations but American is considering the possibility of establishing a major assembly point in Europe early next year. A large proportion of the cost of the Yankee in Europe consists of shipping costs. Currently the aircraft are completed and test flown at Cleveland before being dismantled for shipment. There would be a large saving in both labour and container space per unit if the aircraft could be left in kit form. Meyer is planning to visit Europe again shortly for discussions on this proposal. Regardless of this, he hopes to have 50 Yankees in Europe by the end of this year and another 100 by December 1971. In the

USA, American Aviation has the fourth largest production rate so far this year for the two seat trainer/tourer type. It is led by Cessna, Piper and Champion but beats Beech, Butler (ex Mooney) and North American.

A vital part of Meyer's marketing philosophy is the importance of establishing a range of types. He is very conscious of the fact that fairly newly-qualified pilots have a marked affection for the aircraft on which they trained. Buyers of say, Cessna 172s, have often trained on 150s. To make the most of this trait, American has a four seater called the AA-2 Patriot (see *Flight* for May 14, page 806) which is now undergoing development flying for intended introduction on to the market next year. It has been designed to have a slight family resemblance to the Yankee but not to look like a stretched version of its smaller stable-mate. Powered by a 180 h.p. engine, it is intended as a direct competitor to such aircraft as the Cherokee 180 and Cessna Skyhawk.

On the drawing board is the retractable-gear version, the AA-3 and after that, maybe for first flight in 1972, will be the twin, powered by two 180 h.p. Lycomings or conceivably by Continental Tiara 4-180s. This is perhaps Meyer's greatest ambition for American—to introduce the inexpensive twin, competitive with the top bracket singles. Apart from the low-priced bonded honeycomb structure, considerable use will be made of parts common to AA-2, AA-3 and twin.

This is all a far cry from Bede Aircraft, as the company was in 1966 when Meyer took over as president. For two years from late 1963, Jim Bede had struggled to bring to reality his dream of producing the BD-1 (which became the Yankee) to sell for a mere £900. Bede apparently has that gift for making people see things his way and he found backers for his project. But he found it impossible to adapt the bonding process he used to mass production and there were also handling troubles. In turn, two more men took the president's seat as, by the end of 1965, there was still little to show for the two years' work. Then, in June 1966, Russ Meyer was elected president. He was a lawyer with the firm representing Bede and then was seconded full time as company secretary. Also, and just as important, he was an ex Marine Corps Reserve and USAF Strategic Air Command pilot with 3,500 hours to his credit. With new staff he led his team through the necessary re-design and development to certify the AA-1 in August 1967. By then, the company had been changed to American Aviation Corporation. Many of Meyer's staff came from Cessna bringing a wealth of light aviation knowledge and most of his executives are under 40 years old—Meyer himself is 36. Bede's original dream had included aerobatic capability and folding wings for road towing. The second was dropped owing to the difficulty of designing a low cost, foolproof wing lock mechanism and, equally important, the cost of insuring the





## BIG-THREE CHALLENGER...

aircraft during towing. As far as aerobatic capability was concerned, it was found in extensive tests that aerobatic spin recovery requirements could not be met with simple or readily available modifications. At this point, the aerobatic spin programme was dropped with the Yankee showing excellent recovery characteristics in the normal and utility category.

### Constructional details

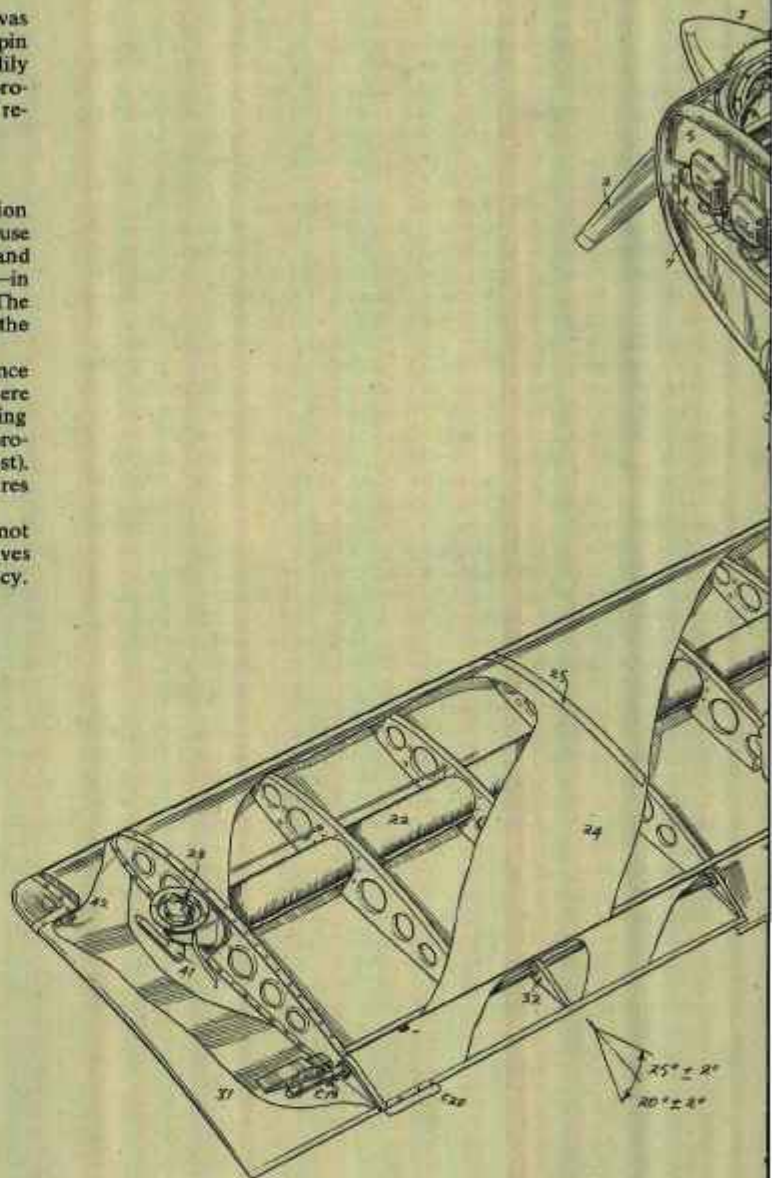
TECHNICALLY, the American Aviation Yankee marks an aviation milestone in being the first production light aircraft to use modern bonding techniques—95 per cent of its seams and joints are glued. This concept itself is far from new—in Britain, bonding techniques have been used for 20 years. The decision to use these methods in the Yankee arose from the requirement to produce a competitor to the Cessna 150.

Such an aircraft had to provide simplicity, high performance and low cost. To do this the design parameters specified were low wetted area (lower cost, less drag, lower weight); high wing loading (lower drag, higher performance); new assembly procedures and reduction in number of parts (lower labour cost). The first two points were a matter of design. Several features were used to achieve the second two.

A honeycomb fuselage provided simplicity as it does not require stiffening or a separate floorboard. Metal bonding gives lower assembly time and aerodynamic and structural efficiency.



Above, the full panel and the radio are standard fittings in the Yankee as delivered in Britain. The unusual fuel gauge can be seen on the right-hand cockpit side



### American Aviation AA-1 Yankee

**Powerplant** One Lycoming O-235-C2C horizontally-opposed four cylinder engine giving 108 h.p. at 2,600 r.p.m., driving 71in, 190cm dia. McCauley fixed-pitch metal propeller.

**Dimensions** Span, 24.46ft, 7.48m; length, 19.24ft, 5.86m; height, 6.8ft, 2.07m.

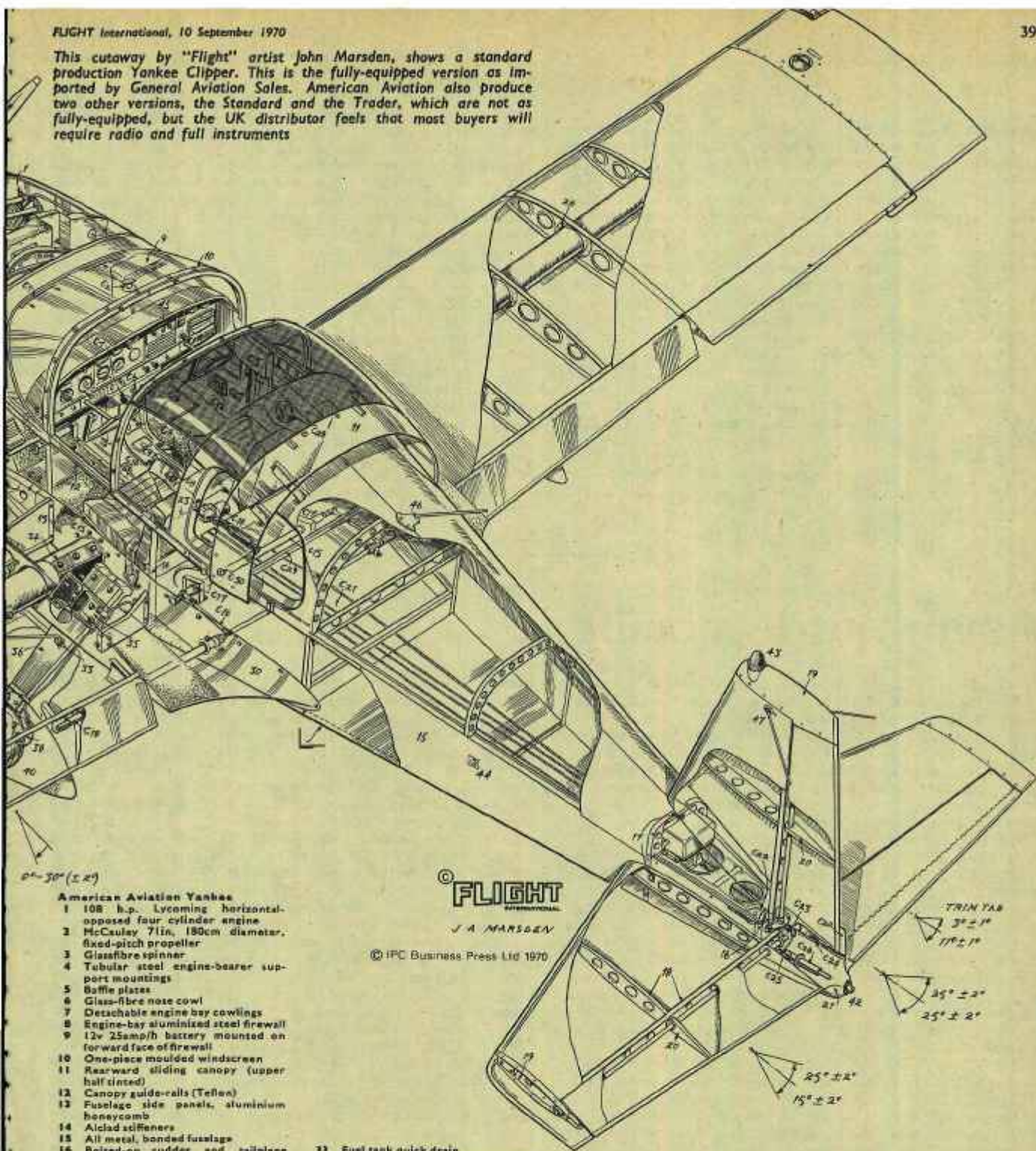
**Weights** Maximum gross, 1,500lb, 680kg; payload, 550lb, 250kg; wing loading, 15.3 lb/sq.ft, 74.7kg/m<sup>2</sup>; power loading, 13.9lb/h.p., 6.3kg/h.p.

**Performance** (Brochure figures) Take-off to clear 50ft, 15m, is 1,615ft, 492m, ground roll 900ft, 274m; landing over 50ft obstacle, 1,240ft, 377.7m, ground roll, 490ft, 149m; rate-of-climb at sea-level, 810ft/min, 4.3m/min; stalling speed, flaps up, 66 m.p.h., 106 k.p.h., flaps down, 55 m.p.h., 92 k.p.h.; maximum speed at sea-level, 144 m.p.h., 232 k.p.h.; cruising speed, 75 per cent at 8,000ft, 2,440m, 134 m.p.h., 215 k.p.h.; range, 75 per cent at 8,000ft, 2,440m, 466 miles, 750 km.

**Price** Clipper version as delivered in UK, £5,800, which includes 380 channel Narco Mk 12B VHF/VOR/LOC, all over paint scheme, sensitive altimeter, omniflash beacon, cigar lighter, eight-day clock, corrosion proofing, dual controls, gyro system, rate-of-climb indicator, outside air temperature gauge, turn and bank indicator, de luxe interior, navigation lights, landing light, pilot heat system, bullet spinner, tinted windows, sun curtain, tow bar, free exchange fine pitch propeller and rough field tyres.



This cutaway by "Flight" artist John Marsden, shows a standard production Yankee Clipper. This is the fully-equipped version as imported by General Aviation Sales. American Aviation also produce two other versions, the Standard and the Trader, which are not as fully-equipped, but the UK distributor feels that most buyers will require radio and full instruments



# American Aviation Yankee

- 1 108 h.p. Lycoming horizontal-opposed four cylinder engine
- 2 McCauley 71in. 180cm diameter, fixed-pitch propeller
- 3 Glassfibre spinner
- 4 Tubular steel engine-bearer support mountings
- 5 Baffle plates
- 6 Glass-fibre nose cowl
- 7 Detachable engine bay cowlings
- 8 Engine-bay aluminized steel firewall
- 9 12v 25amp/h battery mounted on forward face of firewall
- 10 One-piece moulded windscreen
- 11 Rearward sliding canopy (upper half tinted)
- 12 Canopy guide-rails (Teflon)
- 13 Fuselage side panels, aluminium honeycomb
- 14 Alclad stiffeners
- 15 All metal, bonded fuselage
- 16 Bolted-on rudder and tailplane main spar
- 17 Forward mounting bolts
- 18 All-bonded tail structure (left-tailplane may be interchanged with fin and rudder)
- 19 Removable tips (thermo-plastic)
- 20 Honeycomb ribs
- 21 Removable tailcone (thermo-plastic)
- 22 6in. 15cm tubular steel main spar (also serves as fuel tank. 12 imp gal, 54.5lit each wing)
- 23 Continuous through main spar
- 24 All-metal bonded wing structure
- 25 Doubler
- 26 Rib collar riveted to ribs
- 27 Wing attachment bolts (two)
- 28 Tank filler
- 29 Tank end plate (machined casting)
- 30 Glass-fibre wing-root fairing
- 31 Glass-fibre removable wing tips
- 32 Honeycomb ribs

FLIGHT  
INTERNATIONAL

J.A. MARSDEN

© IPC Business Press Ltd 1970

- 33 Fuel tank quick drain
- 34 Undercarriage to wing attachment extruded bracket
- 35 Forged undercarriage to wing bracket attachment point
- 36 Laminated glass-fibre undercarriage struts
- 37 Lower forging attachment and axle
- 38 Single-disc hydraulic brake
- 39 Free-castering to 90° either side of centreline nose-wheel
- 40 Glass-fibre wheel spats
- 41 Pilot hood
- 42 Navigation lights
- 43 Collision beacon
- 44 Static vent
- 45 VHF/com, VOR/nav transceiver
- 46 VHF/com aerial
- 47 VOR/nav aerial

## Cockpit and controls

- C1 Cockpit de-mister outlets
- C2 Outside temperature gauge

- C3 Vertical fuel gauges (both sides)
- C4 Central columns
- C5 Rudder pedals incorporating toe-brakes (optional dual hydraulic brake system available)
- C6 Engine throttle
- C7 Fuel selector panel
- C8 Elevator trim wheel
- C9 Trim tab position indicator
- C10 Flap position indicator
- C11 Flap switch
- C12 Adjustable seat lever (both seats)
- C14 Electric flap motor and actuator
- C15 Flap torque-tube
- C16 Flap drive linkage
- C17 Support bearing

- C18 Aileron torque-tube runs through flap tube
- C19 Aileron stop and balance weight
- C20 Fixed tab
- C21 Control cables and turnbuckles
- C22 Carry-through aileron control pulley
- C23 Elevator bellcrank assembly
- C24 Trim tab servo-arm
- C25 Shear link
- C26 Bungees
- C27 Fully lined PVC cockpit panels
- C28 Cabin speaker panel
- C29 100lb, 45kg capacity baggage compartment (or child's seat)
- C30 Cockpit cover lock

TRIM TAB

3° ± 1°

17° ± 1°

35° ± 2°

25° ± 2°

25° ± 2°

15° ± 2°



## BIG-THREE CHALLENGER...

Further simplicity comes from the 64in, 16.5cm diameter tubular wing spar which provides a torsional and bending member for the wing and at the same time doubles as two 12gal, 54.5lit fuel tanks. The tube is made in three pieces: one in each wing and one that passes through the fuselage just under the seats. (The two fuel gauges—12in, 30cm long, 4in, 12cm diameter pyrex pipes on the cockpit sides—measure the weight of the static fuel at the base of the tank.) The centre tube is curved to achieve the 5° dihedral and the outer tubes fit over the end with two 4in bolts going through the overlap to carry all flight loads. The wing tips are glass fibre and easily replaceable should they suffer from any bout of "hangar rash."

The fuselage construction has been kept very simple. Its focal point is the cockpit which is a box without a lid made up chiefly of 4in, 1.2cm aluminium honeycomb panels. Aluminium angles bonded inside and outside the joints provide strengthening. The tail cone consists of 0.032 and 0.025 gauge aluminium sheet. A single wrap around sheet is bonded to four semi-bulkheads to form a rounded top over the otherwise box section tail cone.

The bonded honeycomb structure allows a 30 per cent saving in parts, according to American Aviation, with a consequent saving in production man-hours. The company esti-

mates that by the time 1,000 Yankees have been produced man hours per aircraft will be down to just over 200.

Before bonding, all the pre-cut metal parts go through an extensive cleaning process beginning with degreasing in trichlorethylene vapour followed by sulphuric acid/sodium dichromate etching and finishing with a double rinse in de-ionised water. Once the parts are stuck together they are heated for an hour at 250°F. Test samples are included with each cooking. Tape adhesive is used for much of the construction and so constant pressure must be held over the entire surface to ensure a good bond. The lower fuselage is placed in a mould and a vacuum bag process provides pressure, while for other assemblies, such as the wing, pneumatically-fed hoses and pads exert an even pressure.

To satisfy the FAA of the strength of the bonding a special cycling test was run during the certification programme. This required the wing to be cycled to 80 per cent of limit load and it was decided that a torsional load would provide maximum flexing of the bonded skins. After 129,000 cycles, a crack in the sheet metal rib developed but the bond joints were not affected. After 210,000 cycles, the crack had progressed to the bond area and was going through the flange, but it was clear that use of conventional construction techniques would have resulted in a much earlier failure because of stress concentrations produced by mechanical fasteners.

The ARB granted a British Certificate of Airworthiness (private category) for the type on July 16.

## Asymmetric accident

**T**HE BOARD OF TRADE has published its inspector's report\* on the accident which occurred to Apache G-ARHJ near Elstree on January 27, 1968. This report states that while the aircraft was taking off from Elstree for a private demonstration flight the port engine lost power. With its undercarriage extended the aircraft started a slow climbing turn to port, but soon afterwards began to lose height. It then went out of control and dived into a reservoir alongside the aerodrome. The three occupants were drowned.

The aircraft had last been refuelled on September 19, 1967, after which it had flown for 3hr 10min. Since its last flight prior to the accident, the aircraft had undergone two Check 2 inspections, one on October 6 and one on December 18. Between the latter date and the day of the accident the aircraft had, according to the maintenance engineer, been prepared for flight (which included running up the engines) several times. A Check 2 inspection, in accordance with the Royal Aero Club maintenance schedule, requires the fuel system water drain traps to be drained and the fuel filters cleaned. On the day of the accident a fitter gave the aircraft a routine pre-flight check, which included a run-up and a check for water in the fuel.

The report quotes the relevant part of the Apache owner's handbook regarding flight after an engine failure during take-off. This details the alternatives of abandoning take-off; landing straight ahead in event of failure just after lift-off and completing a circuit after feathering the dead engine and retracting undercarriage and flaps. The handbook also advises that "pilots of this aeroplane should remain reasonably proficient in single-engine flights."

The inspector states that there was no evidence of pre-crash defect or malfunction of the airframe, or starboard engine. Examination of the port and starboard fuel systems showed that the condition of each carburettor was the same. Both were clean, unobstructed and serviceable, although each had a little corrosion round the diffuser tube. There was a considerable difference, however, in other parts of the two fuel systems. The elements of the starboard fuel system were all in good order—clean and unobstructed; but the port system

was blocked and corroded. The engine-driven fuel pump, which was of a type not fitted with an integral filter, was contaminated with foreign matter which could have interfered with the correct operation of the pump's valves.

The port electric fuel pump was dirty and there was an appreciable build-up of foreign matter (the product of corrosion by long contact with water) on both sides of the pump filter mesh; the filter gauze of the port main fuel strainer assembly was almost completely blocked.

A misfire came during the take-off run while there was more than enough room to abandon the take-off and stop, as recommended in the owner's handbook. When the engine cut out immediately after the aircraft became airborne there was still an opportunity to land immediately in the remaining 500 metres or so without much risk of damage. This would have been consistent with the advice in the handbook. However, at the speed at which the aircraft was moving the opportunity was short-lived. Not having seized it, the pilot was forced into the third course of action set out in the handbook, namely, continuing the flight on one engine. However, although the propeller had been feathered it is doubtful that a positive rate of climb could have been maintained with the undercarriage extended. At some stage after take-off the flaps were extended to the half-way position. The extension of flap increases the amount of lift but it also produces greater drag, and in this type of aircraft the application of half flap would cause a decrease in the rate of climb on one engine. With the undercarriage down, the port propeller feathered, and half flap extended, a loss of height was inevitable and any attempt to climb on this configuration would lead to a loss of airspeed and possibly a loss of directional control with the risk, ultimately, of a complete loss of control as thrust from the starboard engine became the dominant force.

The owner's handbook draws attention to the need for reasonable proficiency in single-engine flight, but the records show no indication that the pilot had kept himself reasonably in practice during the 12 years preceding the accident. Thus it is not surprising that when he found himself having to deal with a major loss of power at a critical stage of the take-off he followed a procedure that was not entirely in accordance with the advice in the owner's handbook and became involved in a situation he could not control.

\*HMSO CAP 342; Price 4s.





...almost the real thing

But on this occasion it was a test shot using a dummy pilot, remarkably similar in almost all aspects to a real life emergency ejection.

Countless test ejections like this have helped to ensure the complete reliability of all types of Martin-Baker ejection seats, an escape system which has saved over **2750** lives.

MARTIN-BAKER  
AIRCRAFT COMPANY LTD.

HIGHER DENHAM, UXBRIDGE, MIDDLESEX.





# SCHNEIDER CREUSOT

In the Aerospace Industry Schneider Creusot Imphy Division, are particularly orientated for the production of:

**HIGH YIELD STRENGTH STEELS**, vacuum remelted in consumable electrode furnaces, notably:

**35 NCD 16  
MARPHY**

for structural and undercarriage components as well as space equipment.

**SUPER REFRACTORY ALLOYS**, forgings, die pressings, castings and rolled components for turbo-engines and rocket motors.

**LIGHT ALLOYS and TITANIUM ALLOYS**, forgings and die pressings for aircraft and rockets.

**ALLOYS with MAGNETIC and SPECIAL PHYSICAL PROPERTIES** for the Electronic Industry.

The hot and cold transformation of these steels and alloys is carried out on powerful forging, die pressing and rolling equipment: drop hammer of 70,000 kg/m, die forging press of 20,000 tons, rolling mill for very wide thick plates, rolling mill for very thin strip.

Sales Office for the  
UNITED KINGDOM

**AFSA LTD.**

3 BUCKINGHAM GATE,  
LONDON, S.W.1

Telephone: 01-834 0231

Telex: 25398



*Concorde*  
Composée de pièces forgées, assemblées et traitées  
pour les conditions de vol les plus sévères, la  
machine répond aux normes les plus strictes.



# SCHNEIDER CREUSOT

**SOCIÉTÉ DES FORGES ET ATELIERS DU CREUSOT**  
DÉPARTEMENT DES PRODUITS MÉTALLURGIQUES

DIRECTION COMMERCIALE PIÈCES ET SERVICES  
84, rue de Lille - 75-Paris 7 - Tél. 555 13 10 et 24 10  
Télégr. CREUSIMPHY Paris - Télex SFACINF Paris 25848 F



# INDUSTRY International

## Products

## Company News

**ML order from Germany** An export order worth over £14 million for aircraft equipment has been won by ML Aviation Company Ltd.

The order, the largest export order ever received by the company, is from the West German Defence Ministry for a version of ML's lightweight low-drag twin store-carrier already being supplied to the RAF, which will be used to equip the F-104G Starfighters of the West German Air Force.

The West German Defence Ministry has carried out extensive flight trials with the carrier over the past year, and the order follows repeated visits to Germany by ML staff and constant on-the-spot support by ML's agent in West Germany, Autoflug GmbH, of Hamburg.

Each of the store carriers incorporates two of ML's advanced-technology ejector release units, Type 119, which are already being supplied to ten overseas countries in addition to being standard equipment in the RAF and the RN.

The latest substantial order brings the total value of orders obtained for ML's current range of armament equipment during the past three years to over £44 million. Negotiations are currently in hand with other countries and further orders are expected.

**Dowty Developments** Dowty Rotol Ltd is showing four new products for the first time at Farnborough this year.

Most distinctive of these is the variable-pitch fan designed for high bypass ratio turbo-fans. The blades, to be made of carbon fibre, are fully feathering, creating an efficient means of thrust reversal which can be maintained until the aircraft stops. First conceived for Stoll, the fans permit optimum use of engine performance, thereby reducing noise levels on approach. The fan under test was designed with the Rolls Royce 410 in mind.

Also designed for Stoll is a carbon fibre-reinforced plastic propeller. A foam-filled carbon fibre box spar strengthens the glass-reinforced plastic blade. The resulting lightness allows a much wider chord and greater diameter, giving slower tip speeds. Lightness is also a feature of the nitrogen-filled liquid spring, designed originally for the Harrier. The gas content, soluble in the oil, practically solves low temperature problems.

The fourth development is a jet pipe servo valve. In the first stage, a jet pipe discharges into two receiving pipes connected to opposing ends of a main spool. Deflection of the jet pipe creates dif-



ferential pressure in the two receivers. Noteworthy among its advantages are its soft failure characteristics. The valve is interchangeable with the conventional flapper valve.

**VFW-Fokker First Report** The importance of European collaboration in the aircraft industry is stressed in the first annual report of the Dutch/German company, VFW-Fokker, whose holding companies are Fokker in Amsterdam and VFW in Bremen and whose formation dates from May 8 last year. The board of management says that "as there is not yet a uniform European company law, it was necessary to realise the merger through a central holding company. As soon as the obstacles in the form of different national company and tax laws have been removed, however, it is our intention to reorganise the companies so as to establish one single company under European law."

Referring to the importance of closer collaboration, the report says that "whereas the United States aerospace industry is presently experiencing a slightly downward sales tendency due to the current cutbacks in Government expenditure, there is a noticeable stepping-up of American export drives and export achievements, in the European market as well. At the same time, the American aerospace industry is also trying increasingly hard to win partners in Europe who will participate in their projects both technically and financially."

"As far as the European aerospace industry is concerned, co-operation across national borders is obviously gaining more and more impetus. Most new projects are being developed and carried out internationally. Thus the European aircraft industry is already working on joint projects such as the

ML lightweight low-drag twin store-carrier, mounted on an F-104G with bombs attached. Below, a close-up of the carrier



Breguet 1150 Atlantic, Transall C.160, Fokker F.28 Fellowship, VFW 614 and the world's first supersonic airliner, Concorde." VFW-Fokker is participating in all these projects, with the exception of the Concorde.

The report refers to the A-300 Airbus as a topical European project and to the Dassault Mercure as a collaborative project undertaken by France, Belgium, Italy and Spain, and in which VFW-Fokker is participating. Referring to joint military projects, VFW-Fokker make mention of the Vak 191B and their share in MRCA.

In a reference to European space programmes, the company mentions the astronomical satellite in which VFW-Fokker is collaborating with Phillips, the third stage of the Eldo launcher, the German Azur scientific satellite and VFW-Fokker's participation in these projects through Erno. Its reports adds: "A factor which might have a bearing on the development of the aerospace industry in the seventies is the export drive of the Russian and Japanese industries." The Japanese "are projecting amongst other things a tri-jet short-haul aircraft for 116-149 passengers—the VS.33. VFW-Fokker is examining the possibility of co-operating on this project."



# Letters

## Britain's ATC Radar

SIR.—Mainliner's article (*Flight*, August 20) criticised the National Air Traffic Control Services (NATCS) and warrants a comment to illustrate that all is not as bad as he thinks. His statement "Britain's ATC radar equipment shows every sign of breakdown" is a gross exaggeration. Britain's ATC (approach control and airways surveillance) radar is maintained to the highest possible standards and shows no sign of breakdown as long as the BoT retains the services of the telecommunications officers (the back-room boys), who rarely get mentioned in any of the magazines. The Linesman/Mediator Project, when fully operational, will be the start of a new era in air traffic control and is designed to eliminate lack of liaison between upper-airspace control and that of the TMA, which Mainliner is talking about.

The 1959 Icao conference voted for the present system of VOR-beacon approach in spite of a far superior British proposal. If Mainliner feels that the existing procedural control is inadequate to cope with situations similar to the day to remember, July 24, he should suggest a change of procedural control through his association. However, let me assure him that the ATC and the telecommunications staff do their utmost to make his task lighter.

Bishopston, Renfrewshire

C. PERERA

SIR.—It is unfortunate that one anonymous pilot be permitted to conduct a continuous onslaught against air traffic controllers in the columns of your magazine. His accusations of apparent deterioration in competence, ignorance, confusion, etc., are not in keeping with the facts. If Mainliner has evidence of such things then he should have the guts to put his name to the articles. Sadly, his invective is laced with an intricate pattern of innuendo, half truth and misconception.

As an airline passenger I can only hope that Mainliner is not a typical or representative airline pilot. It is disturbing to note that he finds the ATC system "beginning to require pilots to adopt unsafe procedures in the interest of expediency." Any pilot who can dismiss the safety of his passengers simply in the interest of expediency just should not be flying a passenger aircraft. Surely Mainliner can at least identify his employers. He owes this to all airline passengers.

We all know that the system would be improved if more equipment were made available. But equipment has to be paid for, in this case by the taxpayer. One could argue that if BOAC had not disposed of £90 million of the taxpayers' money, which was written off, irrevocably lost, then the nation could have afforded the necessary equipment, possibly in triplicate. However, it is patently obvious that the lack of ATC equipment is not the fault of the controllers, but due to a far wider political and economic situation.

As for "an endemic series of radar problems in the Glasgow and Prestwick areas," I would simply ask Mainliner to read his dictionary again.

The practice of maintaining a careful listening watch

is surely desirable at all places, not only "overseas and under-developed locations." At these latter points the "degeneration" of service may have been engendered by the pilots' "do-it-yourself ATC." Perhaps a wider understanding of the situation and an occasional visit to the unit concerned would have been more helpful.

This whole series of articles would have more value if it were pilots' points of view. Opinions of this sort are surely of sufficient importance to be balanced and universal, rather than parochial and demented.

Prestwick, Ayrshire

NORMAN J. ALLEN

## World Aerobatic Championships

SIR.—You must be congratulated on the extensive and balanced coverage which you have given in several issues of *Flight* to the 6th World Aerobatic Championships. There is no doubt that the challenge for the competitors and the organisers, and the problems and complexities for both, were explained in a depth that can only lead to a better understanding of what competition aerobatics are all about. It is with regret, therefore, that I feel compelled to take issue with some comments which appeared under the title "Aerobatics Turning Point?" (August 6 issue).

A basic theme of this article seemed to be that the Aresti system and the size of the competition performance zone were responsible for aircraft reaching excessive speeds and being subjected to very high g loadings. However, one cannot for a moment accept that "only brute force will get an aircraft around the manoeuvres in the space available." Indeed, Neil Williams in his "Captain's Comment" (*Flight*, July 16) makes the point: "... the Aresti system is a clever means of marking an advanced aerobatic sequence and does not require the pilot to manhandle his aircraft." It was quite obvious that it was the pilots who consistently demonstrated controlled, smooth and accurate flying who came high on the list of final results.

The size of the performance zone, far from tending to increase the speed and hence the accelerations used to perform the manoeuvres, will in fact tend to reduce the speeds which aircraft can reach. To an extent, the smaller the performance zone, the slower will be the aircraft, because it does not have the time or the space to build up very high speeds.

Rather odd theories were also advanced as to the speeds which aircraft reached "turning the corners," together with the assertion that they must have been oversteering themselves. I cannot comment on the speeds or stresses reached with the Yak 18s, but to suggest that Zlins "must have been reaching the 330-350 k.p.h. mark" is absurd. None of the manoeuvres performed by Zlins at Hullavington required anything like those speeds, and as for the suggestion that this aircraft needs a very high speed to achieve a vertical roll, it is sufficient to say that 275 k.p.h. is ample.

Furthermore, comparison between the loadings recorded by different types of aircraft really misses the point. Art Scholl may have pulled +9g, but the flying characteristics of his Super Chipmunk are quite different from those of a Zlin, as indeed are those of Bob Herendeen's Pitts Special. To pull as hard as this in a Zlin serves no purpose at all and would merely kill speed, lose height, and jeopardise completion of the sequence.

The essential point is that, whatever the benefits or constraints of the Aresti system in terms of the manoeuvres available for pilots to fly or the scope for artistry and inventiveness, they have nothing to do with the extent to which pilots use their aircraft to the available limits in advanced aerobatic sequences.

Leeds LS17 8RZ

JAMES BLACK

LETTERS for these columns should be addressed to the Editor, "Flight," Dorset House, Stamford Street, London SE1, and must bear the sender's name and address, though the address will not be printed in full unless the nature of the letter requires it. A nom de plume is acceptable only in exceptional circumstances. Brief letters will stand a better chance of publication.

SIR.—After having read the random notes of John Blake about the World Aerobatic Championships, for which he did not choose one of his own countless jokes as a title but a casual remark on the met reports by me, I would like to congratulate him and the Royal Aero



## LETTERS . . .

Club for the organisation of this event, which was in my opinion the best one can achieve in countries like ours without full State support, as they had for the last two contests. Some shortcomings, of course, are almost unavoidable; but most of them occurred this time outside of the control of the organisers, e.g., weather, jurors and judges with 10 per cent of an average competitor's knowledge of the rule book, etc. On the other hand, the idea of the Ford buses provided for each team gave a freedom from officially scheduled sight-seeing, etc, which was badly missed at the Moscow and Magdeburg contests and did much more in favour of a primary aim of the event—which is, also according to the rules (para 1), "to promote friendly relations between aerobatic pilots."

While bringing up several important points on aerobatics in his article, John also refers to the Acrostar as "especially built to compete in Aresti competitions and very little else." This is a misinterpretation of the philosophy of my design, because the basic idea of an aerobatic aircraft has little to do with the Aresti system. The requirements call simply for a type capable of both inverted and normal flying, with low stalling speed, highly stressed and able to achieve high horizontal speeds; and only secondary features such as roll rate in flicks (5°-rule) and stability are more affected by the system.

While the Aresti system with the repetition rule and the limitation in coefficient points in the free style actually prevents better performance aircraft from out-pointing the old Yak- and Zlin-designs, and therefore, does exactly the opposite to what Mr Blake believes, the high stresses involved occur merely from a low thrust/weight-ratio—which demands higher entry speeds for a given vertical manoeuvre—and not from the size of the box, because the present relation of box; to radii still allows, with any of the aircraft used, flying a certain horizontal distance between two arcs. The infringements of the box limits mostly came from wind influence or improper layout of sequences.

The overstressing problem, which affects all aircraft built to "aerobatic" specifications of FAR 23 or BCAR, was actually known for years by all contest pilots, because it is just impossible to fly a round inverted loop with the load limit of 3g, when one needs between 4 and 5g for a positive loop, and this on the better side of these asymmetric wing designs (and this is only the simplest figure of a contest programme). It actually looks somehow funny to me that with a normal aircraft, with which you are not allowed to fly turns of more than 60° bank, the requirements call for a load factor of 3.8g; and with a Zlin you can fly aerobatics on the worse side (inverted) with a load factor of 3. The subsequent overstressing of airframes was therefore taken into account for the Acrostar's +8/-8g normal load; and unless the other designs, as some already have, increase their load factors, overstressing will be present at any contest, box or no box.

Dietikon, Switzerland

ARNOLD WAGNER

## Boom

SIR,—The most beautiful sound I've ever heard.

Haverfordwest,

P. STURMEY

Pembs.

1810hr, September 1, 1970.

## Flying to Farnborough

SIR,—When are we going to have an end to the aeronautical farce? Under "World News" of your August 27 issue you give details of how to fly to Farnborough. Once again we see that RAF Odiham will be open to civil aircraft, etc, prior permission only, landing cards not honoured, transport for ticket holders only, and so on, and what's more it's shut in the afternoons!

We have one of the world's largest shows of advanced

technology aerospace products. It takes place on an airfield with an enormous runway from which there is no flying except for two hours in the afternoon, but it is impossible to visit it with that common-or-garden form of transport called the aeroplane. How do we expect to convince our customers and the rest of the world that aviation is here to stay?

Camberley, Surrey

ROY G. PROCTER

[Unlike Paris and Hanover, Farnborough does not have spare runways which can be used for parking. The whole area south of Runway 25 is cordoned off for the general public and the resident aircraft, as well as the display aircraft, must be parked on the north side whilst allowing freedom to manoeuvre. Odiham lies on the extended centreline of the Farnborough runway and acts as the springboard for the military elements of the flying display; for safety reasons it is not open to visiting aircraft during the period of the flying display.—Ed]

## Support for the Independents

SIR,—There seems to be a great deal of outcry, by BOAC and BEA in recent days, about the formation of a second force airline and the routes which the Government propose to give them. The memory of the public and the corporation do seem to be very short. Perhaps we might bring to mind the BOAC manoeuvre to get British Eagle's routes to the Bahamas by various manoeuvres, and how the company at that time, as a result of this, nearly went into liquidation, and subsequently, a few years later, raised a hue and cry when again British Eagle was prepared to go into competition on the same routes—which in part, in the long run, helped to put British Eagle into liquidation.

Let us take a look at BEA and their formation of Air Tours. Are they not going into competition on the same routes as the charter companies, on routes which were held by the independents? I cannot remember very much hue and cry being raised here, when any of these situations came about at the time, by either the Unions or the Government. In fact there were no conclusions to bring this about.

Looking at today's (August 20) *Flight*, BOAC profits of £21 million show that there is adequate room for the second-force airline to enter, and still leave BOAC making adequate profit. I hope that your magazine will continue to support the independent airline organisations in the coming months, to the advantage of British aviation as a whole.

Camberley, Surrey

J. M. EARLAND, Capt

## Cheers for Caledonian

SIR,—Three cheers for the proposed take-over of British United Airways by Caledonian. I have flown with Caledonian many times in the past, and if its service continues to be as good in the future as it has been in the past, the two State airlines are in for some fierce competition.

Hounslow, Middx

CHRISTOPHER D. PETTIT

## DIARY

- Sept 12-13** Strongbow Trophy Air Race and Flying Display, Shobdon, nr Leominster, Herefordshire.
- Sept 12-13** Shell & BP Flying Safari; Kenya.
- Sept 13** Barnstormers Flying Circus, Netherthorpe, Sheffield.
- Sept 13** Gara Aerea di Regolarita, Bologna, Italy.
- Sept 14** IATA 18th Technical Conference; Miami, Florida.
- Sept 15-20** 5th International Air Cargo Forum & Exhibition (Air Cargo '70). Organiser: Dusseldorfer Messagesellschaft mbH Frankfurt Airport (Hangar 5).
- Sept 17** RAF Air Display, Jersey.
- Sept 19** RAF Stations "At Home", Battle of Britain Day: Biggin Hill, Kent; Coltishall, Norfolk; Benson, Oxon; Finningley, Yorks; Leuchars, Fife; St Athan, Glam; St Mawgan, Cornwall.
- Sept 19-26** International Aerospace Exposition, Delft, Holland.
- Sept 20** Battle of Britain Thanksgiving Service; 11.00 a.m., Westminster Abbey.



# PERFECTION IN DISPLAY

## Planning SBAC's flying show

**A**S THE BULLDOG SPINS GENTLY DOWN like a falling sycamore leaf, or the Jaguar rushes past at a speed that seems to be only decimally short of Mach 1, it is worth pausing for a moment to ponder the problems of putting on a flying display at Farnborough. For two decades the flying at the SBAC Display has been the most technically competent to be seen at any air display throughout the world, and this reputation has come about by meticulous attention to detail in the planning as well as the execution of the show.

The SBAC Show flying committee is established under the chairmanship of the OC Experimental Flying Department at the RAE and has representatives from the Ministry of Technology, Ministry of Defence, SBAC and each of the major participating companies. The first meeting takes place at least six months before the show opens and is principally concerned with looking at the running of the previous event with a critical eye for improvements. Basic behavioural guidelines for the pilots involved have been developed and nowadays require little alteration in the light of previous experience, but these are repeated in the brief sent out to display pilots.

Early on in the working life of the committee, manufacturers are asked to submit their plans for individual displays; but nearer the day each aerobatic act has to be performed to the satisfaction of the committee and these acts, once approved, may not be changed.

Gp Capt W. Morrison is the present incumbent as OC EFD and has the ultimate say in the presentation of the display. It should be noted that, although the show is staged at Farnborough, responsibility for it rests with the SBAC—who, to all intents and purposes, hire the airfield as a going concern and are responsible for the safety of member companies' and Mintech property and personnel.

The shape of the airfield is such as to allow excellent viewing from the terraces to the south-east of the runway; thus the main runway itself becomes the principal line of action. Aircraft making straight passes are allowed to do so along the runway and at heights down to 100ft, but all other displays must be positioned not only on the north side of the runway but in fact north of a line joining the air traffic control tower to the wooded western dispersal—effectively creating a "bomb line" 300yd in front of the public enclosure. Turns at low level must be made away from the crowd and turning manoeuvres are not allowed below 200ft.

### Scope for ingenuity

Despite the apparently tight restrictions there is still scope for much ingenuity in the presentations and several extreme proposals were rejected this year by the flying committee at first sight on paper. At a trade display a balance is necessary between exhibitionism and salesmanship; short take-offs and landings are impressive and appropriate to several categories of aircraft, but for the full effect it has to be made clear to the onlooker that the display aircraft is carrying a representative load. Generally, aircraft are not allowed to occupy the runway for longer than the minimum needed for take-off and landing, so it is not easy to stage the loading of a Stal aircraft directly in front of the public.

Engine test-beds and representative foreign aircraft using British engines and equipment have added interest and variety to the most recent shows; but where these are commercial types, it is difficult to display them in a manner which highlights engine behaviour. Power cuts on take-off and slow speed asymmetric handling show as much of the aircraft's performance as of the engine's—and these manoeuvres must, in any case, be approved by the flying committee.

Gone are the days when advanced prototypes announced their arrival on display with a sonic double bang, but equally impressive runs are achieved by, say, the Harrier and Spey-powered Corsair with an apparently silent approach from the Laffan's Plain end of the runway, partly enveloped in their own cloud, the silence being followed by an ear-shattering departure. The Lightning, also, has used noise to dramatic effect with tight turns making full use of reheat to remain within the airfield boundaries.

Such turns highlight another supervisory problem for the flying committee—that of minimum disturbance to the neighbourhood. While a straight run at high speed can approach from the south-west with little inconvenience, it must finish at the airfield to avoid running over Farnborough's urban area. In the vertical dimension, the demands of local airspace prevent such a high speed run being completed by a pull-up and limitless vertical climb, since controlled airspace lies ominously close overhead.

### Airborne visibility

The weather has often been ideal for the spectator at Farnborough but with an airborne visibility far from ideal as a result of haze. In these conditions, just as much as in the more obviously bad conditions, radar positioning is used to a large extent and, in cloudy or clear skies, the Farnborough controllers are constantly on the lookout for stray aircraft in the area.

Because of the decreasing number of manufacturers flying aircraft in recent years, the spectacular appeal has tended to fall on contributions by the Services, alas this year without Naval representation. At one time the sheer size of the Hunter formations was breathtaking, but this has been replaced by the verve of the Red Arrows, augmented by tactical support aircraft and a profusion of helicopters.

Most of the display pilots know the Farnborough area like the backs of their hands, many having completed the Empire Test Pilots' School course there in years gone by. EIPS used to be a focal point for the show week but now that the school has moved to Boscombe Down and its officers' mess closed, there is a little less of a spirit of reunion—even accommodation is difficult. Generally speaking, the pilots are not much in evidence around the exhibition site, preferring to stay near their own tent by air traffic control, at least until after their demonstration. Most will be standing by their aircraft half an hour before start-up, conscious of the tight programme timing that is the Farnborough hallmark.

Individual performances last for from three to nine minutes and the moment one aircraft clears the "arena" to position for landing, the next performer is cleared on to the runway for take-off. The display is always orientated on the assumption that runway 25 will be in use and occasionally downwind components are accepted rather than reverse this pattern. Touchdowns thus take place immediately in front of the static exhibition, and it has always been a matter of some amusement if someone overdoes an attempted short landing and makes a too early contact in the "bottleneck"—the short stretch of taxiway immediately before the threshold.

Farnborough is neither the biggest nor the most flamboyant flying display in the world but it can justly claim to be the most professionally presented. There are no gaps in the flying, with an aircraft always ready to replace its predecessor; it is the non-stop pace which so impresses the onlooker and this, occurring with the apparent ease of well-oiled machinery, is the end-product of attention to detail in planning as well as execution.



# standby for attitude control

Today's high flying aircraft need a standby system to ensure that the pilot is continuously aware of his attitude.

The Ferranti standby artificial horizon has virtually unlimited pitch range and gives a simple, easy-to-read display of attitude.

A version of this horizon is also available with potentiometer pick-offs on both roll and pitch axes and a static inverter can be provided to enable the gyro to be operated from a d.c. supply.



## Completely Self-Contained

Ferranti standby gyros are ideally suited for civil airlines and business jets of all kinds, especially high altitude, high performance aircraft. They are A.R.B. approved and contained in a standard 3" ARINC case.

Ferranti Limited,  
Aircraft Equipment Department,  
South Hill Park, Easthampstead, Bracknell,  
Berkshire, England, RG12 1RA.  
Telephone: 0344 4202

# FERRANTI

**standby gyro horizons**





# ten badges on the fuselage



## MB 326 aer macchi

The multi-role jet trainer  
chosen by 10 operators  
in four Continents  
has still in the '70  
a career of success  
and efficient service.

The MB. 326 reached,  
in the development of its  
versions,  
a steady optimization  
of performance and systems  
which assures  
a long life of service  
sheltered from a premature  
technical obsolescence.

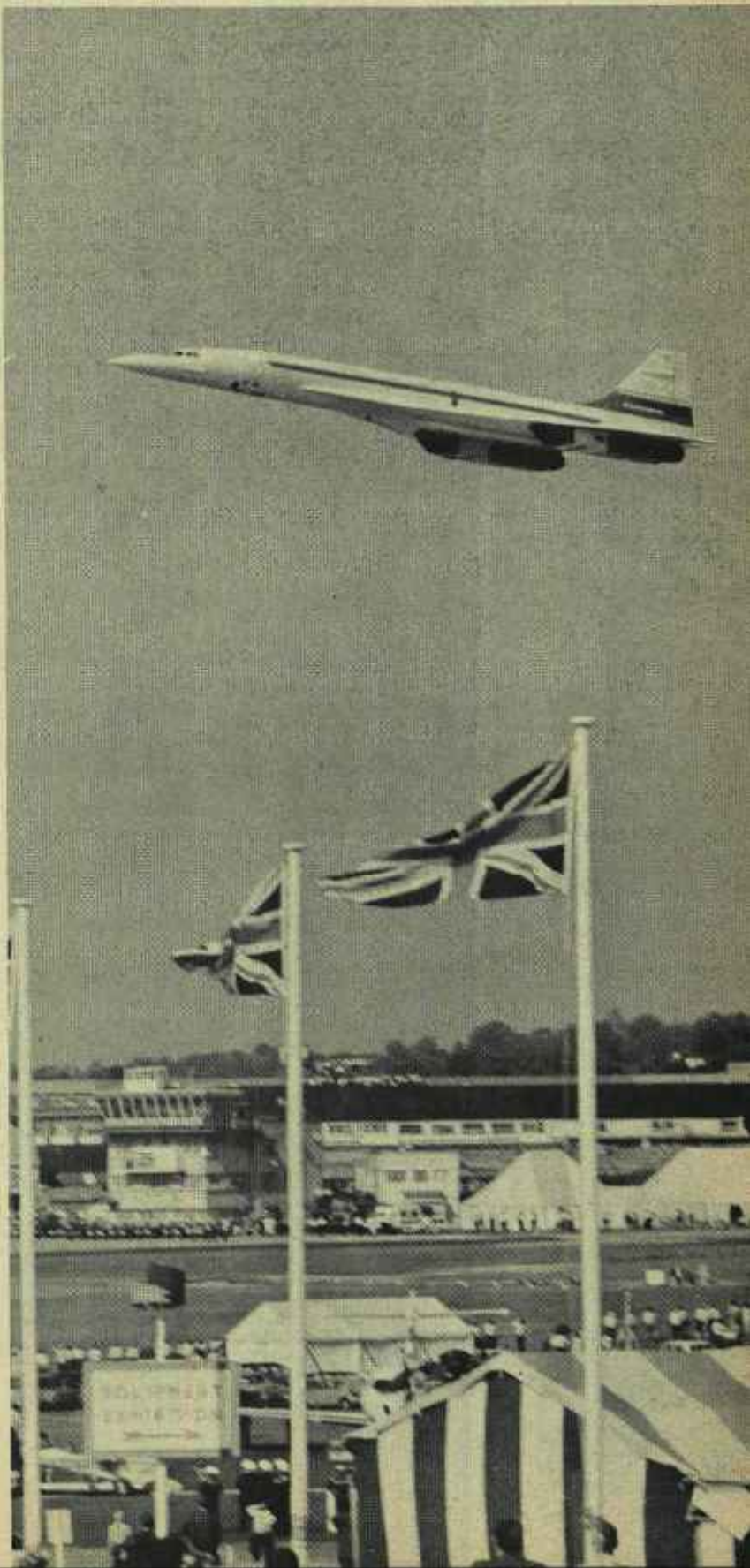
# aer macchi

Aeronautica Macchi s.p.a.  
Varese, Italia



# FARNBOROUGH '70

*IN the air the 27th Farnborough Show will be memorable for the appearance of Concorde, the RB.211 in its VC10 test bed, and the sight of operational Harriers—one in American US Marine Corps markings. But it's not in the air that the worth of British industrial technology is best to be seen. The static display, both indoors and out, is full of evidence of advances in technology, materials and techniques. About a quarter of the stands are devoted to avionics, including sophisticated weapon selection and aiming systems, ever-lighter communications equipment—all of which show an increasing mutual compatibility. Equal advances are to be seen on the stands of the makers of the myriad supporting items—refuellers, safety equipment, airport equipment—and the material manufacturers themselves. Not least, the two principal government agencies, Ministry of Technology and Board of Trade, show their place in the sponsorship and guidance of research and development with comprehensive and well presented stands.*





## COMMERCIAL AIRCRAFT, ENGINES AND V/STOL

### BAC-Aerospatiale Concorde 002

Production Concorde will be fitted with new TRA combined thrust-reversers and noise suppressors which will reduce the weight of the aircraft by 2,000lb, 907kg—the equivalent of ten passengers. Built of Stressskin steel honeycomb and radically redesigned—employing one nozzle for two engines—this new "back end" will be available for 01, the first preproduction Concorde. This aircraft should be flying by the summer of 1971.

Speaking last Sunday night, Mr Pierre Young, chief Olympus 593 engineer at Rolls-Royce Bristol, said that the first three weeks' operation of the new air-data-computer-controlled variable-geometry intakes on 002, apart from a few teething snags, had gone perfectly. Olympus 593s had, he said, flown for 1,800hr without a single shutdown due to engine malfunction, while Mach 2 fuel consumptions of within 0.8 per cent of that specified for production (601/602) engines were being recorded by prototype-standard engines on the test bed. Vapourising fuel systems and annular combustion chambers developed from Pegasus experience for production engines were being bench tested at the moment and should result in smoke-free operation.

During the recent supersonic trials Concorde has been flying on its Elliott Automation autopilot for some of the time. The system, offering course, height, speed, and rate-of-descent locks together with, eventually, automatic landing capability, was designed in conjunction with the French company SFENA.

New leading-edge and intake de-icing equipment for Concorde has been designed by Rotax. Concorde 001 is now to roughly the same build-standard as 002 and has begun taxi trials at Toulouse.

**BAC Three-Eleven** Major hope for the British airframe industry in the '70s, the BAC Three-Eleven is shown in model form. The aircraft is powered by two of the projected Rolls-Royce RB.211-61 engines of 50,000lb, 222kN thrust. Latest figures are:

**Span**, 147ft, 44.8m; **Length**, 183ft 7in, 55.9m; **Height**, 43ft 3in, 13.2m; **Max T/O weight**, 303,000lb, 137,441kg; **Max payload**, 69,000lb, 31,298kg; **Accommodation**, 200-300 passengers (6-9 abreast); **Under-floor cargo volume**, 3,400 cu ft, 96.27m<sup>3</sup> up to 16 LD2 containers; **Range**, up to 2,500 miles, 4,000km; **Take-off**, can use 5,000ft, 1,500m runways.

Typical seating arrangements (all with full meal service) are: **European scheduled**, 245-seat, 8 abreast, one class, 34in pitch; **European IT**, 300-seat, 9 abreast, one class, 30in pitch; **US trunk**, 204-seat, mixed class. First class: 36 seats, 6 abreast, 38in pitch. Coach: 168 seats, 8 abreast, 36in pitch.

A decision on whether the aircraft will go ahead now rests with the Treasury. The Ministry of Technology and Board of Trade both appear to be supporting the aircraft.

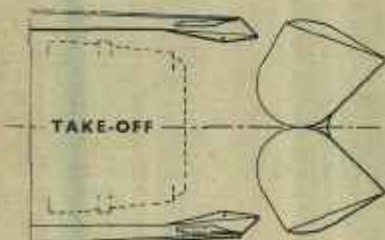
The industrial programme will be based on international risk-sharing collaboration with companies in the United States, Eastern and Western Europe, and the Far East.

The American market for wide-bodied twins is now anticipated to be for 480 aircraft by 1980 and 1,180 by 1984. BAC

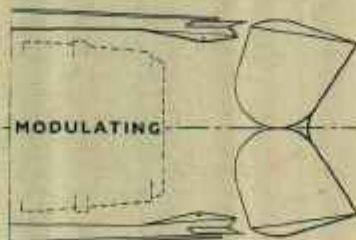
expects to take 20-25 per cent of the total worldwide market, assuming at least one American competitor is launched within two or three years. BAC has now spent £3 million of its own money on this project, which would cost the Government £75 million to cover half the development costs plus a £30 million loan to finance production learning, plus £60 million for the associated Rolls-Royce RB.211-61/62 engine. The latter should be producing 52,000lb, 232kN within 18 months of service.

**A-300B** The big news on the Airbus front this week is from Hawker Siddeley and the A-300B consortium. As we went to press (Monday) nothing new had been heard about whether the Three-Eleven would gain Government support.

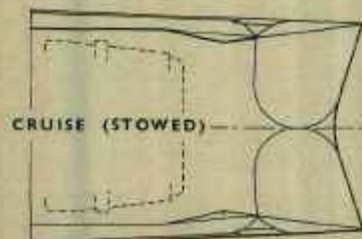
Following hard on the heels of the Air France order for six A-300Bs and options on ten (at a cost of £5 million each without spares) Hawker Siddeley has proposed a new version tailored specifically to BEA requirements and to be funded by the British Government. The aircraft would seat 298 passengers (as compared with the accepted mean for the other A-300B variants of 262) and would have a 16ft, 4.86m longer fuselage. The A-300B-7, as it is called would be powered by two Rolls-Royce RB.211-61/62 engines; the latter will deliver 52,000lb, 232kN by 1975, endowing the aircraft with a 2,000-mile, 3,210km range with 298 passengers. This compares with a 1,380-mile, 2,220km range with 262 seats for the standard CF6-50-powered aircraft. GE is also working on uprated engines which



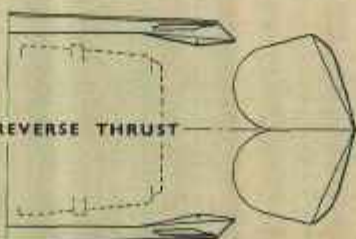
(a) BUCKETS AT 0°, (BETWEEN 15° and 25°) DOORS FORWARD



(b) BUCKETS, LESS THAN 15°

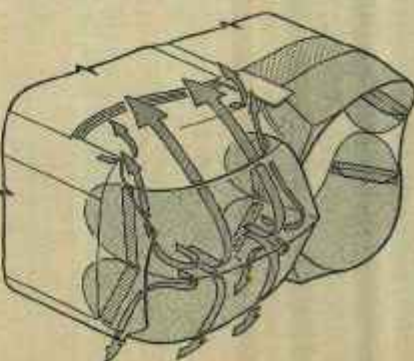


(c) BUCKETS STOWED (0°) DOORS AFT



(d) BUCKETS FULLY DEPLOYED

The new Concorde thrust-reverser and nozzle design, with one nozzle for two engines. First flight will be on preproduction 01





would confer the same performance.

BEA has forcefully stated that it wants the Three-Eleven. If the airline were required to order the A-300B it would for political reasons have to be Rolls-Royce-powered. The Hawker Siddeley request, on behalf of the rest of the Airbus consortium of Aérospatiale, Deutsche Airbus and Fokker, is therefore for the British Government to pay £18 million to cover the development costs of the new variant which would contain British engines and equipment to the extent that the aircraft would be 50 per cent British by value. The Rolls-Royce engine (the same as that proposed for the Three-Eleven) would cost the Government another £60 million to develop.

Seven or eight airlines may, it is claimed, be interested enough in the A-300B to place letters of intent within six months. The requirements of these airlines may be as high as 135 aircraft by 1982. This excludes all potential sales to British airlines, for which sales Hawker Siddeley would have design liaison leadership—Britain being their geographical sphere of influence. Having a Rolls-Royce-powered option could boost sales of the A-300B by 40 per cent.

Meanwhile Airbus Industrie, the joint manufacturing company being set up by Aérospatiale and Deutsche Airbus, has still to be formed. Technicalities in the contract have still to be sorted out but these are expected to be cleared up within "a few weeks," according to Hawker Siddeley. The Air France order should be confirmed by the end of the year, when the airline will start to make advance payments for the aircraft.

With the advent of the latest proposed stretched A-300B, the wide-body twins have come full circle: both this aircraft and the Three-Eleven have now grown back to the same size as the old A-300—abandoned because it was too big. The emergence of BEA Airtours last year with its guaranteed high load factors may have been a force behind this trend.

BEA says it wants the Three-Eleven, but the A-300B consortium is dangling a financially attractive, though politically embarrassing, carrot before the Treasury which could save the £100 million development costs of the Three-Eleven and substitute £18 million. The proposal went in on August 22. Engine costs would be an additional £60 million in either case.

**Hawker Siddeley HS.144** This year the HS.144—which began life as the DH.126 project of ten years ago—is depicted as a T-tailed aircraft with the engines mounted well forward on the fuselage. Predicated around the Rolls-Royce Trent, which is not being actively developed at the moment, the aircraft lacks a suitable powerplant. The 9,000lb, 40kN thrust Trent is probably still on the small side, but the design now appears firm and if a board decision were taken to go ahead, and a suitable powerplant could be found, then production could start within a few months. The aircraft would be able to carry mixed traffic and would have built-in airstairs and an APU.

**BAC One-Eleven** The One-Eleven 475 aerodynamic prototype has just flown (see *Flight* last week, page 369). This particular aircraft, which is essentially the wings and powerplants (Speys) of the Series 500 combined with the fuselage of the Series 400, does not have the rough-field "soft" undercarriage of the production models; this is illustrated on the BAC stand together with a frightening array of miscellaneous objects arranged into a simulation of a runway.

Also in model form is a mixed-traffic One-Eleven 500 with a large 120in by 73in, 305cm by 185cm cargo door on the port side just ahead of the wing. It is shown with ten standard 108in by 88in, 274cm by 223cm containers and 54 seats in the rear cabin. The cargo conversion now available off the production line or for retrospective fitting on any One-Eleven model is based on VC10 experience and modifications would be made by the BAC Aircraft Services Group. A re-

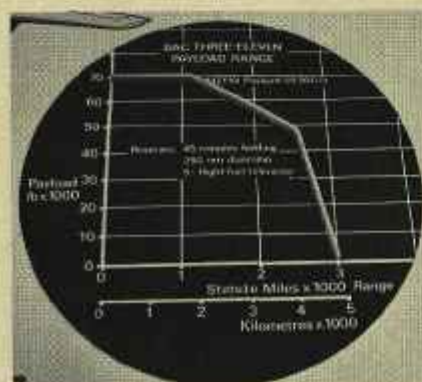
## SENSOR

The Paris Salon is likely to be held on a two-tier basis after 1972, with a static show at Le Bourget and a flying display at an airfield outside the Paris area.

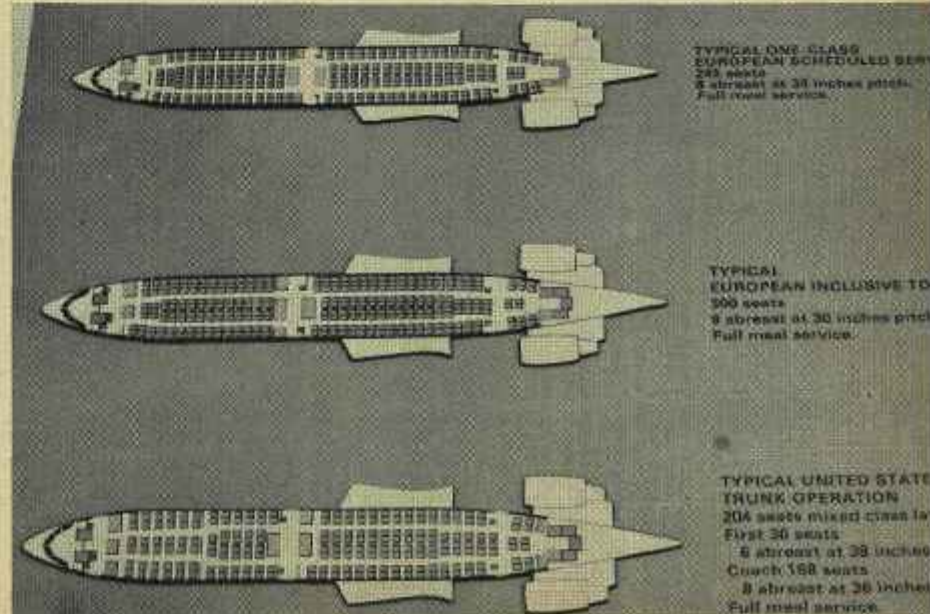
A three-engined stretched development of the Islander is due to make its first flight as this report goes to press. The third engine—another Lycoming IO-540-K—is mounted on top of a new, strengthened fin. The fuselage is stretched forward of the wing to increase seating capacity from 10 to 16 seats. The result is an Islander with 50 per cent more payload and 100 per cent more power in the engine-out certification case. The prototype "Trislander"—officially the Islander Mk 3—is a modification of the prototype and was completed in six weeks. It may appear at the Farnborough show depending on progress of the initial tests.

The German Government is prepared to put up £20 million towards development of the Rolls-Royce RB.211-61 engine for the A-300B-7 on the basis of a BEA order. Hawker Siddeley would be design authority on the B-7 to overcome BEA's resistance to buying a "consortium" aircraft.

The Harrier is carrying loads of up to 8,000lb in development trials. Development of the Pegasus 15 of 25,000lb thrust is envisaged to improve specific excess power for combat manoeuvrability as well as payload-range performance and supersonic level speed. The combination of new operational requirements arising from US service and the Impetus which McDonnell Douglas will give the Harrier development are expected to lead to an accelerated product-improvement programme. The advanced Harrier is designated HS-1184.



Latest BAC Three-Eleven payload-range diagram and seating layouts.







Top, the A-300B wing mock-up is well advanced at Hatfield. Above, work on production-development A-300B wing skins, one of which is shown on the Hawker Siddeley stand

## FARNBOROUGH '70...

movable false floor is used for freight-ing. This will save weight during passenger operations. It will bolt on to the existing seat rails.

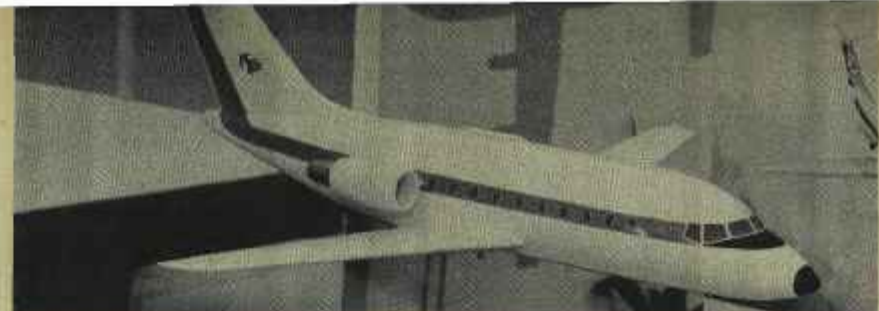
**Rolls-Royce RB.211** A mock-up of the Dash 22 engine fitted with Hyfil carbon fibre fan blades is shown but the company is unwilling to discuss the -61/62 variants of 50,000lb, 222kN to 52,000lb, 232kN thrust being proposed for the Three-Eleven and A-300B. The only information being released—that the engine uses the same fan as the -22, has a revised compressor and an uprated gas generator—has already been reported in *Flight*.

A TriStar flight-standard engine has flown for 13hr in the VC10 test-bed and 75 per cent of the TriStar flight envelope has been explored. No endurance flying will be done in the VC10 (which is scheduled to appear at the show) until the TriStar flies, probably in November. Further information about the RB.211 may be available next week.

**Rolls-Royce M45H** First flight of this twin-spool turbofan in the VFW 614 is expected in May 1972 with a type rating due in December of that year. A derivative in the 15,000lb, 67kN thrust class for V/Stol aircraft and using a variable-pitch fan developed by Dowty is being studied (see V/Stol report).

The following data applies to the standard engine for the VFW 614:

Bypass ratio, 2.85:1; Pressure ratio, 18:1; Take-off thrust (ISA sea level), 7,760lb, 34.5kN; Corresponding s.f.c., 0.45lb/lb/hr;



Cruise thrust (ISA, 20,000ft, Mach 0.65), 2,745lb, 12.2kN; Corresponding s.f.c., 0.72lb/lb/hr.

Five of the six bench development engines have now run and 800hr of testing has been accumulated.

**Rolls-Royce Trent** Future developments of the 9,980lb, 44.5kN Trent turbofan—the first three-shaft engine to run—could boost thrust to around 15,000lb, 66.7kN. It might then be more suitable for the HS.144 feederliner project. A bench test engine is on display. Development continues on low priority.

**Dowty Rotal variable-pitch fan** A totally new concept and one which bridges the gap between propeller and fan technology is a variable-pitch fan shown on the Dowty Rotal stand and, diagrammatically, on the Rolls-Royce stand.

Developed jointly by the two companies this 31-blade fan (represented by a model, matched to an 800 s.h.p. engine and providing 1,500lb, 6.7kN of thrust) could bring dramatic field-length reductions to Stol aircraft.

The new fan concept, proposed for a 15,000lb, 67kN version of the M45H turbofan (the M45S) being considered by Rolls-Royce and Snecma, has reverse-thrust and feathering capability. A 3,000lb, 13kN fan has also been proposed for executive jets.

The unit enables reverse thrust to be held right down to zero speed with no re-ingestion problems, and thus measurably reduces landing distances. The variable pitch also allows optimum take-off and cruise settings by effectively changing the bypass ratio—nominally 10:1 to 12:1. High-fan mass-flow at low speed will give good propulsive efficiency, while for cruise it will be reduced. The ratio of take-off to cruise thrust is high. Minimum-noise settings for the approach could be investigated. Fast response times are a feature of the design.

Right, rough field of brick and bottle for the One-Eleven 475 simulated on the BAC stand together with a drawing of the undercarriage. Below, mixed-traffic One-Eleven model

The engine location on the HS.144 feederliner project still appears to be flexible. The aircraft has now reverted to a T-tailed layout with unspecified engines on the rear fuselage

Reverse thrust, obtained by pushing the blades past the fine-pitch stops, does not create the expected gas-generator stalling problems. This has been verified by several hundred hours of running on a modified Astazou test bed. Because of the blade twist, reverse thrust is only generated by the tips, while the hubs are essentially at 90° to the free stream. It has thus been found that air can enter the gas generator freely and undisturbed from the rear of the short fan cowl. The gas generator intake lip profile is critical. See photo on this page and drawing on page 415.

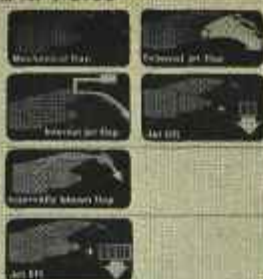
**BAC Stol projects** The leading BAC contender for Mintech funds for V/Stol feederliner projects is based on four M45s with variable-pitch Dowty Rotal fans. No model or artist's impression of the aircraft is on show but a four-engine high-wing design is the front runner at the moment. Other studies make use of two engines plus lift fans.

**Dowty Rotal carbon-reinforced propeller** The propeller is still very much to the fore as an efficient thrust producer for V/Stol. Dowty Rotal is showing a broad-chord, four-bladed, carbon fibre-reinforced, 9ft, 2.7m diameter, glass-fibre propeller tailored to fit and tested in the SR.N5 air-cushion vehicle but suitable for V/Stol aircraft. The propeller has a carbon-fibre spar surrounded by a



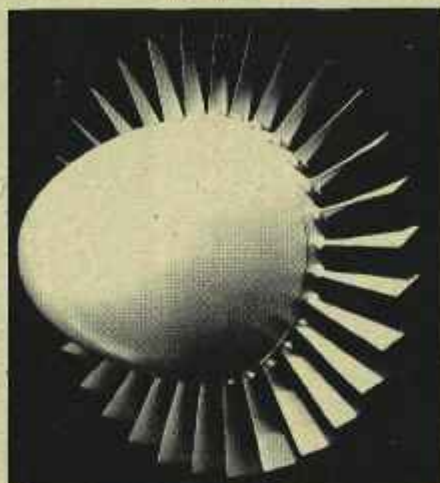


## STOL specialised propulsion



## multifunction propulsion unit

## VTOL specialised propulsion



Top, Rolls-Royce V/Stol concepts. Above, reverse thrust down to zero speed is a major advance made possible by the same company's variable-pitch fan

foam-filled g.r.p. shell and sprayed with polyurethane to prevent erosion. The propeller has been developed as a private venture and is not specified as yet for a developed HS.748 as some reports have indicated.

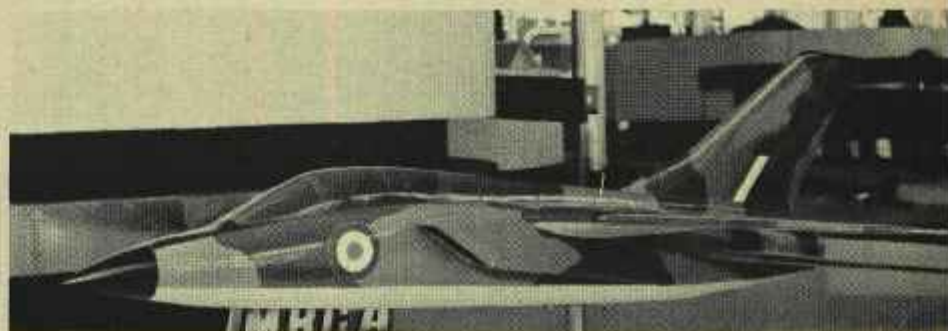
Noise must be low for Stol aircraft and is a function of propeller tip speed. But to reduce tip speed and maintain thrust the chord must be increased. Twisting moment at the hub increases as the fourth power of the chord so the blade must be light, strong and stiff—hence carbon fibre.

**Westland tilt-wing projects** Probably powered by four Rolls-Royce RB.410 (otherwise known as M45S) turboshafts the WG.22 project might carry 100 passengers some 450 miles at 450 m.p.h.

Also shown as an artist's impression is a 25-passenger V/Stol feederliner project able to carry its full passenger load over 150 n.m., 280km at 345 m.p.h., 555 k.p.h. **de Havilland Canada DHC-7** Latest estimated performance figures for this aircraft, powered by geared UAC PT6s:—**Balanced field length**, 2,000ft, 610m (current transport-category certification, 7.5° glide-slope, 35ft reference); **Take-off distance**, 1,220ft (32°C, 36,000lb, 16,300kg); **Distance to 35ft**, 1,670ft, 508m; **Landing over 35ft**, 1,140ft, 346m; **Ground run**, 750ft.

**Hawker Siddeley HS.141** No changes to the configuration of this important Vtol transport aircraft, powered by RB.202 lift fans and two RB.220 propulsion turboshafts, have taken place since the Hanover show (see *Flight* for May 7). A model of this elegant project appears on the Hawker Siddeley stand.

## MILITARY AIRCRAFT, ENGINES AND V/STOL



Potentially Europe's largest aviation programme, civil or military, **MRCA** is now in evidence throughout the exhibition in one form or another. A large model on the BAC stand reveals the outline of this British/German/Italian multi-role fighter, though not so accurately as some of the representations seen a few months ago at Hanover.

Projects of this political and technical magnitude are not easy to launch, and now that the first major hurdle (the agreement to proceed to prototype stage, signed on July 22) has been passed, there is a very noticeable surge of confidence. Because of Italy's chronic political problems, an extension to August 31 had been granted, but there is still no sign of a decision. But pressure from her partners to get on with cutting metal is extremely heavy, and it is possible that an ultimatum will be forced if the delay is likely to exceed a few weeks.

It is noteworthy that the German operational role has undergone a change of emphasis, from close air support to battlefield interdiction. The significance of this is the bias away from certain types of targets and operations, leaving room for the development of another aeroplane, the Alpha-Jet strike/trainer. The naval role is now becoming more prominent, and the aeroplane will be fitted, for this and other purposes, with the HSD/Matra Martel TV/radar missile.

BAC's other front-line collaborative aeroplane is **Jaguar**, and no fewer than three of the prototypes are to be found at Farnborough, A-03, M-05 and S-06. All are single-seaters; the loss of the first prototype Jaguar in France has now left only one two-seater which, at the present time, is heavily engaged on its engine development programme. A-03 is a tactical-support aeroplane for the French Air Force. Close inspection shows that the engine air intake has been considerably modified, from wedge-type to pitot type. The former was originally specified because it gave better performance above about Mach 1.3. But tests at RAE, confirmed by BAC, have shown that the performance of the pitot intake in a Jaguar installation would be

substantially better than at first thought. A-03 was modified, and the results obtained in France appear very encouraging. Whether the intakes will be changed on production aircraft will depend on further flight data and cost estimations.

M-05 is the French naval Jaguar, which recently completed initial trials on the aircraft carrier *Clemenceau*. The give-away feature, on the ground, is the extendable nose oleo to give a greater angle of attack for shipborne operation. It is fitted with an under-nose camera mounting. S-06, the first British prototype, is also modified. In this case an extension has been made to the fin, increasing its height. This aircraft is engaged on weapon trials, and the fin extension is a precaution against the destabilising effect of the wing and fuselage stores. With a possible 10,000lb warload, all external, the effect on directional stability can obviously be quite large.

A further prototype, a British two-seat trainer, B-08, will fly next year, bringing the number of development aeroplanes built to eight.

A veteran of many Farnborough displays, the Hawker Siddeley **Harrier** is seen, for the first time in Britain, as an operational squadron aeroplane. The two examples on display in the static park are a two-seat Harrier T.2 and a single-seat GR.1. The T.2 has a distinctively shaped fuselage in which, to satisfy the RAF requirement for good visibility for the occupant of the rear seat, the forward section has been re-profiled. To compensate for inertia the puffer jets on the rear fuselage are now mounted on a long beam, where they give increased control effectiveness. The particular aircraft on view is the second production T.2, two prototype two-seaters having been lost due, it is understood, to now corrected problems associated with the powerplants.

HSA is building a two-seat Harrier



## FARNBOROUGH '70 . . .

Left, the first British Jaguar, S-06, shows off its extended fin. Below, the two-seat Harrier T.2, with prominent tail boom. Beneath, a single-seat Harrier in USMC markings, with two ventral 30mm gun packs well displayed



for demonstration purposes. Seeing may be believing, but the ability to give customers a ride in this unique aeroplane is in fact the best sales ploy. The single-seat example sports the American "star and bar" insignia on its engine intakes, a reminder that the Harrier is the subject of the most significant military aircraft sale in recent years. The delivery of the first of 12 aeroplanes to the United States Marine Corps is shortly forthcoming, and negotiations are under way between HSA and McDonnell Douglas for the licence-production of over 100 Harriers.

All Harriers now being delivered to the RAF sport blue and red roundels with the white omitted following camouflage tests at dispersed sites. Armament trials have now been completed with the single-seat Harriers with combinations of under-wing stores commonly used by the RAF. It now remains to demonstrate the compatibility of the various American stores (Snakeye and Sidewinder, for example) with the aeroplane.

Unique in another way is HSA's Nimrod, the western world's first pure-jet sub-killer, making its Farnborough debut. The Nimrod betrays its Comet ancestry more in the air than on the ground, where the capacious weapon-bay and sombre grey finish attest to its effectiveness. The Nimrod has recently gone into service with the RAF, where its comfort, speed and automated detection systems provide a tremendous advance on its piston-engined predecessor, the Shackleton. The Nimrod may have an operational life of as much as 30 years and it is designed to take advantage of new equipment—particularly new powerplants—as they appear. Thirty-eight of these potent aeroplanes are being built

under a £90 million fixed-price contract, and South Africa is one of many countries showing great interest in it.

Cost-effectiveness again, this time from BAC, with the longest-serving aeroplane in the flying display—the **Canberra**, now in its twenty-first year. In BAC's words, no other aircraft carries so much so far at so little cost, sentiments which appeal to hard-headed air forces. The beautifully re-manufactured Canberra in the static park (and a matching model on BAC's stand) for the Argentine Air Force is a tribute to the continuing effectiveness of this splendid aeroplane.

The Aermacchi **MB.326K** is a single-seat strike version of the well known Italian trainer family. The example on show in the static park, I-AMKK, is fitted with a Viper 540 of 3,360lb static thrust; the definitive powerplant will be a derivative of the newly developed Viper 600, the 632 of 4,000lb thrust. This aeroplane has two 30mm cannon built in, while the impressive array of

under-wing stores includes an SUU-11 7.62mm General Electric minigun pack, with the six revolving barrels clearly visible. Another pack contains two standard 7.62mm guns.

The **Soko Jastreb** and **Galeb**, for light-attack and training, are reminders both of the influence of Britain's engine industry abroad and of the extreme difficulty in setting up national propulsion programmes. The British formula in this class is the **Jet Provost Mk 5** and its more powerful export version, the **BAC 167 Strikemaster**. The first is represented statically with prominent strakes under the nose, making for a more predictable spin, and outer leading-edges covered with an extremely rough-texture finish for the same purpose. The adjacent BAC 167, bearing the temporary markings G-AHYT, is one of a batch for Singapore. The first of 100-plus Viper II-powered Mk 5s, with their pressurised cockpits and air-conditioning, have now joined the RAF, while the higher-



powered 167s have been sold to seven air forces abroad, emphasising the continued popularity of this formula.

One of a batch of 26 new-production **Buccaneer S.2s** for the RAF marks the entry of this still advanced aircraft as a "longshoreman." Together with some 70-odd marine Buccaneers, they will provide a striking force with better payload-range than that of their more glamorous contemporaries, the Phantoms, and a better ride "on the deck."

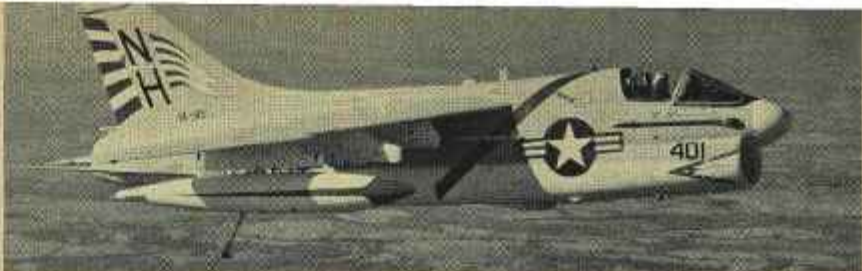
American participation comes by courtesy of two Ling-Temco-Vought **Corsair IIs**, an A-7D from the USAF and an A-7E from the USN, both powered by Rolls-Royce/Allison TF41 Speys of some 15,000lb thrust each.

Hawker Siddeley is responsible for one of the very few completely new shapes—the **HS.1182**, a single-engined (or, if required, twin-engined) strike trainer, seen in model form. The firm has been working for some time on advanced training aircraft, with built-in combat capability. The HS.1182 is designed to fly two one-hour training missions without refuelling. If adopted by the RAF, it would come in at post-Jet Provost level, and would lead up to Jaguar. All work at the present time is company-financed, but Hawker Siddeley feels that there is a large market for a "1980" fighter/trainer. No specific powerplant has been selected, but the Rolls-Royce/Turbomeca Adour and the R-R military version of the Viper 500 are obvious candidates. Of course, for some applications, an American engine might be more acceptable.

The single British aero engine company Rolls-Royce, which is now responsible for supplying the industry, has many powerplants on display which repay close study. The most important engine is the Turbo-Union **RB.199** three-shaft augmented turbofan for the MRCA, the multi-role combat aircraft. Turbo-Union is a consortium of three firms: Rolls-Royce, MAN Turbo (Germany) and Fiat (Italy). The work split is as follows: fan, combustion chamber, h.p. turbine, combustion chamber, turbine casing, reheat jetpipe and bypass duct to be built by Rolls-Royce; intermediate compressor, intermediate casing, gearbox, high-pressure compressor, intermediate turbine and thrust reverser to be managed by MTU; low-pressure turbine, exhaust diffuser and variable nozzle to be managed by Fiat.

A feature of the powerplant is its modular construction, not only necessary for a product which needs to be designed and tested under dispersed conditions, but operationally desirable because it is cheaper and easier to assemble and maintain in service. The first engines are due to begin bench-running early next year. At the present time Italy's position *vis-à-vis* MRCA is equivocal; if Italy pulls out of the project, then the design effort will have to be redistributed in accordance with the work-sharing principle.

The Small Engine Division at Leavesden is placing considerable emphasis on the Gnome series. The latest of these is the **M.1400** of 1,500 s.h.p., which finds a home in the Westland Sea King. Con-



Top, an LTV A-7E in Britain for the first time. This example comes from the USS "Kitty Hawk." Above, the new single-seat Aermacchi MB.326K will use a military version of the Viper 500



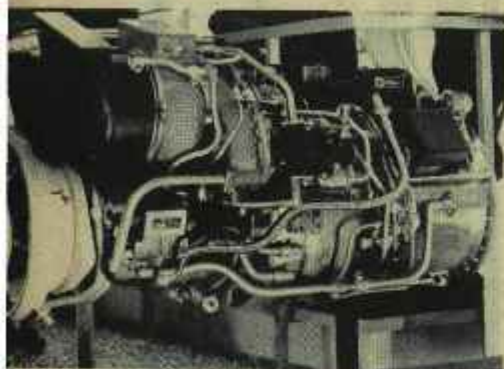
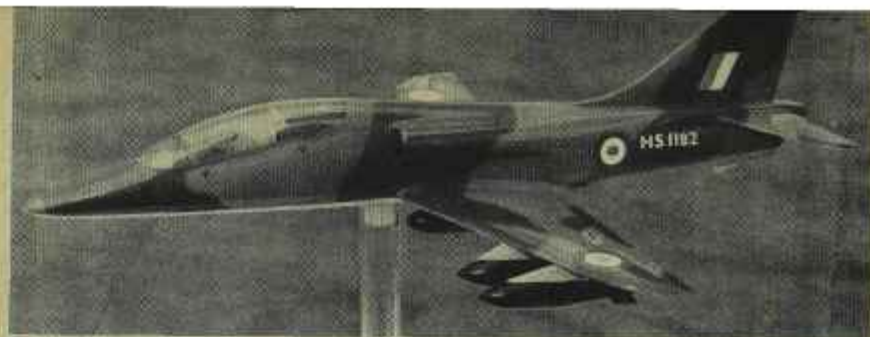
Right, close-up of the installation-trials Buccaneer S.2 with three dummy Martels and reverse-streamline tracking and guidance pod. Below, two BAC 167 Strikemasters for the Singapore Air Force



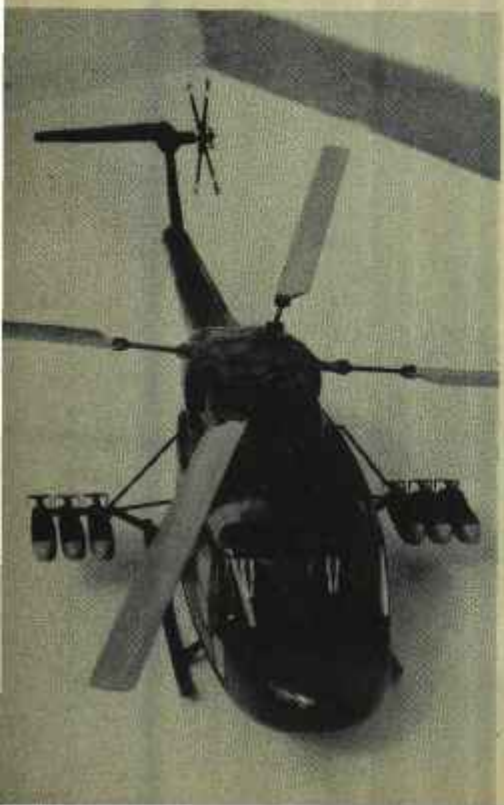


## FARNBOROUGH '70...

Right, first public appearance of the private venture HS.1182 strike/trainer. Although no national commitments exist, the design closely follows known RAF preference, notably in respect of visibility for the rear occupant. Below, an actual BS.360 free-turbine shaft engine for the WG.13 helicopter



Below, model of the WG.13 with six BAC Swingfire missiles. Swingfire is a Royal Armoured Corps missile, but is being adopted for air-ground use. A Westland Scout helicopter in the BAC missile park has four outrigger-mounted Swingfires. Right, the heaviest British helicopter is the Westland Sea King, which has power-operated, automatically folding blades



siderable interest attaches to the uprating of this engine, originally sponsored by Australia, and a new version (designated M.1400-2) will shortly be running. This will have a maximum cruise rating of 1,700 s.h.p., improved s.f.c. and better performance maintenance "hot and high." As applied to the Sea King, the -2 engines would enable the aircraft to be flown off water (after an emergency landing) single-engined at high weights.

Another modular-construction engine is the BS.360, under development for the Westland/Snias WG.13 Lynx helicopter. An actual engine, as opposed to chromium models, appears on the Rolls-Royce stand.

The non-reheated Rolls-Royce/Allison TP.41 (Spey development) has undergone steady development and is now rated at 15,000lb thrust. It powers the Ling Temco Vought A-7D and A-7E Corsair II flown from America to take part in the display.

Collaboration with Klockner-Humboldt Deutz has produced the little T.112 air-portable combined shaft-power/air-supply gas turbine. Its application is the VFW VAK 191B V/Stol experimental aeroplane.

Britain's stake in the helicopter field is moving rapidly towards 100 per cent internationalism, with licence building and collaborative design/development/production as the two themes. The largest helicopter built in Britain is the Westland Sea King (represented at Farnborough by two examples XV666 and XV671), a product of the licensing formula. Sixty of these twin-Gnome H.1400-engined ASW (anti-submarine warfare) aeroplanes are being built for the Royal Navy, and have been in service for some months. The Westland production line will also build 22 Sea

Kings for West Germany, where they will be used for SAR (search and rescue), and six for India for ASW.

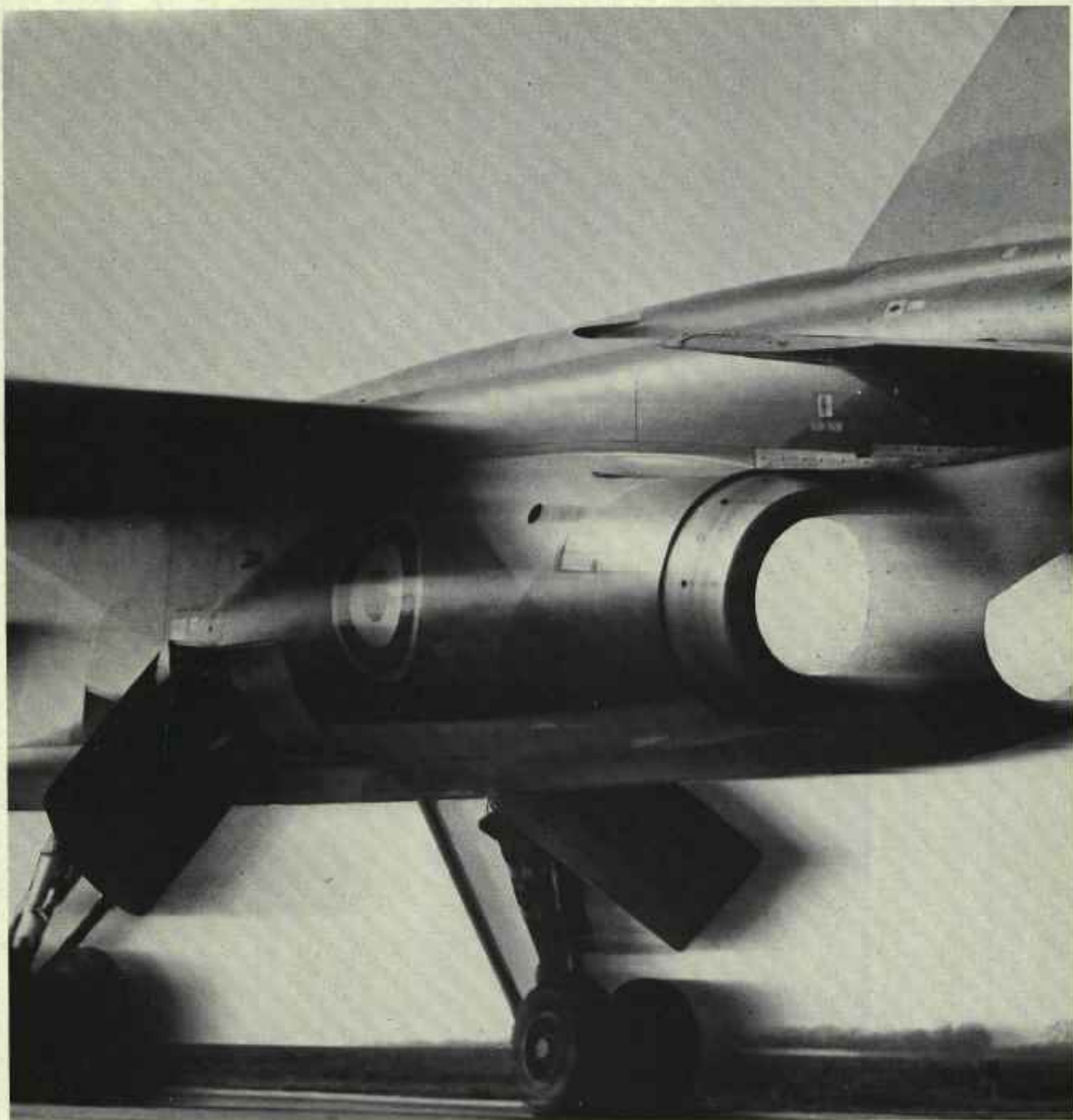
Two of the three helicopters which form the Anglo-French package deal are to be seen in the static park. The Aero-spatiale/Westland SA.330 assault helicopter, 40 of which are shortly to join RAF Air Support Command, is represented by XW241. The SA.341 light observation machine is also to be found in the static park. The first overseas order for this helicopter was received recently by Vought Helicopters Inc, the Snias agent in America. It is expected that the production order for the SA.341 will amount to about 400 aircraft for Britain and France, and it appears that some of the ill-feeling engendered by the French cancellation of the 150 WG.13 gunships (which not so long ago imperilled the entire deal) has now been smoothed over.

The third ingredient of the package is the WG.13 Lynx. The mock-up of this British-led helicopter is not on view, although it was shown at the Paris Air Show last year. But a considerable part of the Westland indoor exhibition is devoted to this 8,000lb utility helicopter which is destined for the RAF, Royal Navy, Army and Royal Marines, besides the French armed forces. Considerable areas, where non-structural loads are present, will be made of plastic, and the company is actively pursuing the development of carbon-fibre laminates and their application to helicopters. Printed circuitry applied to control panels is another innovation.

The simplicity of the rigid and semi-rigid rotor layouts is apparent in the full-scale rotor head at the company's stand. This rotor has now begun flight-testing on a specially modified Scout (not at Farnborough). Meanwhile an airframe







## **From take-off to touchdown...Jaguar trusts in Dowty**

For boost power we supply the engine reheat equipment. At take-off and touchdown Messier Dowty landing gear gives Jaguar the support it needs. Just one of over 200 aircraft types we support with a 24-hour service.



**DOWTY**

CHELTENHAM · ENGLAND







# our business is minding other people's...

Minding your business means more to Plessey than just selling you products. It means using our know-how at all stages to maximise reliability of your equipment. We call it product support.

## Prevention and cure:

Plessey prevention starts almost before the product is born. When it's on the drawing board; when you're making the purchasing decision... this is when our product support starts.

We advise you on the initial provisioning requirements and train your operators and engineers. We make you au-fait with any special tools needed. We give you manuals telling you the how, why and where of the equipment and systems chosen.

And should a cure be needed, you'll find we've been keeping track of your equipment's progress. Whether the aircraft is in Fiji or Finland we'll be there. We operate a round-the-clock, round-the-world service, supplying spares and, if necessary engineers, in the minimum of time. It's all part of our highly developed product support network. All part of a very advanced organisation.

One way and another we're highly developed and thoughtful people at Plessey. And the word has got around.

Over seventy different types of aircraft flying with airforces and airlines over the world depend on our systems or components.

*Plessey Dynamics make much of the major electrical and mechanical equipment any aircraft needs.*

*It could be electric actuators; pumps; engine starting systems; aircraft lamps; generation systems; or metallic flexible hose and ducting;... but if you don't know exactly what we do make, please ask us.*

*Plessey is a world leader in the aerospace systems industry. Our production, development, research and product support programmes are geared to meet all present and future demands.*

*For further information please contact, Plessey Dynamics Group, Product Support Division, Eastern Avenue West, Romford, Essex, RM7 7NL, England.*

*Tel: 01-478 3040 Telex: 262484. Or in the USA—*

*Plessey Airborne Corporation, 1414 Chestnut Avenue, Hillside, New Jersey, USA. Tel: (201) 688-0250 Telex: 710-985-4667. Representation throughout the world.*



**Plessey Dynamics**  
Product Support





# NORD 262

26 / 29 SEAT TURBOPROP TRANSPORT

## now on the British register

The British independent carrier DAN-AIR SERVICES LTD introduced the now A.R.B. certificated NORD 262 into scheduled service on U.K. routes in July 1970. Airlines in 10 other countries also operate the jetprop NORD 262.

The versatile NORD 262 offers • profitability on low density local service routes • pressurized accommodation for up to 29 passengers and baggage • 200 knot cruise • 500 n.m. range  
For full details write to :

### aerospatiale

37, Boulevard de Montmorency PARIS 16<sup>e</sup> FRANCE

DÉPARTEMENT VENTE AVIONS COMMERCIAUX  
2, rue Béranger, 92-CHATILLON (FRANCE)



test-rig containing two BS.360 free-turbine engines of 900 s.h.p. each, rotors and transmissions has been moved to the Royal Naval Air Station at Yeovilton, a few miles from the Westland plant, for testing. The first WG.13 is expected to fly before Christmas.

As predicted recently in *Flight*, Sikorsky is negotiating with Westland with a view to licence-production of the Lynx in the event of its being selected for the US Navy's Lamps (light airborne multi-purpose system) requirement for which an off-the-shelf purchase is foreseen.

Evidence of basic research in helicopter aerodynamics comes in the form of a model on the company's stand, which illustrates the vortex pattern formed by the circulation of air through a rotor system, as predicted by computer. This technique allows an analysis to be made of the complicated way in which flight loads interact with the aircraft and its systems. Specifically, it will enable data on aerodynamic performance, structural loads and the exchange of loads between rotor and fuselage, and rotor and flight-control system, to be obtained.

An intriguing notice gives details of a new Westland project, the WG.21. This appears to be a ground-attack convertiplane stemming from the WE.01 (now dropped) and WG.22 projects. There may be those who might not see the applicability of such an aircraft in such a rôle, but Westland nevertheless claims that a 22,000lb-26,000lb, two-crew, 530kt rotorcraft is highly manoeuvrable at all speeds, has good engine-out safety and low vulnerability to ground fire.

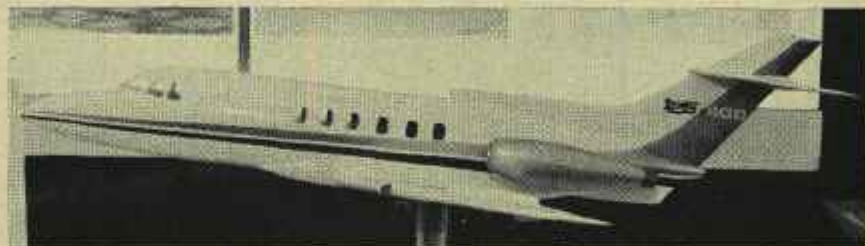
## GENERAL AVIATION

Shown for the first time is a model of the BH-600 on the Hawker Siddeley stand. It has minor external differences from the well established BH-125, such as a ventral fin and slightly longer nose. Development work is proceeding on the BH-200 but the final design of the aircraft has not yet been decided. Designers and engineers from Beech and Hawker Siddeley are working on various possible forms, based on the criteria of short-field performance and low price. The aim is not to come face to face with the Citation, Mini-Falcon, Corvette and Lear jet, but to fill a slot in the market not already occupied. With the market in its present rather depressed state, it may be a little while yet before the final BH-200 design emerges.

This low ebb in the general-aviation market seems to be reflected in the exhibits—or lack of them—in this area of the industry. The brightest light still seems to be the *Islander*, which continues to occupy a unique slot in the market. A new stretched version with a third engine is about to fly (see *Sensor*). With increasing emphasis on military sales, several air forces have shown interest in the idea of a coastal patrol rôle for the



Above, Scottish Aviation's Bulldog prototype complete with Scottish lion and repainted since its Beagle days. Below, the Beech-Hawker BH-600 model on the Hawker Siddeley stand. Longer nacelles give room for the Viper 600 engines



*Islander* for which a lightweight radar would be specified. The company claims that with tip tanks a maximum endurance of eight hours could be offered. Britten-Norman can also offer lift-down windows and an internal layout including rest bunks and cooking facilities. Countries with sensitive frontiers might welcome such an aircraft.

The Swedish Government is looking at the *Islander* for three possible rôles: parachute training, artillery spotting and search. In the last rôle, *Islanders* would be used for an initial search, calling in helicopters only when a sighting had been made; this is claimed to be more economical than the use of helicopters alone. Britten-Norman has benefited from the recession in sales in the USA and has found itself selling in areas normally dominated by US manufacturers. In the static park and flying display the *Islander* is shown with power uprated to 300 h.p. and furnished as a six-seat executive aircraft; another *Islander* displays an interior by Alar of Lisbon, while a third is shown in the flying display in the para-dropping rôle. The *Nymph* now has 160 h.p. but this project is waiting for the market to regain some of its former buoyancy before plans for kit production can advance.

Glos-Air shows the *Airtourer* with the O-240 engine but the aircraft has been withdrawn from the flying display pending aerobatic trials which are still required by the ARB.

The Campbell *Crick* claimed the distinction of being flown into Farnborough, instead of arriving on a trailer. This tiny aircraft must be one of the smallest types to feature in an SBAC

display but it is selling in export markets. Equally small, the Wallis WA.117 is a potential rival in the field now that Airmark is to put the type into production.

Under its new ownership, the *Bulldog* prototype no longer carries its Swedish Air Force colours; however, deliveries to Sweden are the priority task of Scottish Aviation who do not intend to offer the type in the civil market until production is further advanced. Development work includes double-slotted flaps to meet a Swedish army-co-operation requirement.

Short's *Skyvan* is set for a new lease of life following certification at 13,500lb all up weight. The decision to make the jump over the 12,500lb weight barrier was taken in the interest of offering better payload/range capability and the company is showing a demonstration aircraft at the new weight and fitted with 22 passenger seats. After the SBAC display this aircraft is to undertake a programme of evaluation flying with British Air Services which will involve 23 cities in the United Kingdom. A new military order is imminent.

The one wholly new aircraft to be seen at the show marks the return of the name of Cierva. The CR.LH-1 helicopter has two counter-rotating rotors mounted co-axially and powered by two 205 h.p. Continental IO-360 engines. Major components for the aircraft come from CIBA (A.R.L.) Ltd who are exhibiting a complete forward fuselage structure and from C. F. Taylor (Metal Workers) Ltd. The prototype taking part in the flying display first flew in August 1969, and it is intended to market this attractive five-seater in 1972.



## STATIC HIGHLIGHTS

### Missiles

The missile industry adds a healthy contribution to the British aviation scene, and just as importantly makes itself increasingly felt abroad. The three companies mainly concerned with missiles all have something new to show.

Hawker Siddeley Dynamics has two missiles, **Taildog** and **Ship-martel**. Taildog is seen for the first time at Farnborough, although its public debut took place at Hanover earlier this year. This extremely important missile is financed partly by the British Government and partly by HSD. It is a short-block medium-range air-to-air missile about 10ft long and 6in diameter with six small fins. It is designed for close-in air combat, where conventional air-to-air missiles have neither the manoeuvrability nor the ability to be used at short ranges necessary in this type of warfare. HSD describes it as midway between a bullet and a missile. There is a possibility that Taildog will satisfy an American requirement, and HSD and TRW have formed a partnership to develop it.

The same company is also showing a full mock-up of Ship-martel, a development of the Anglo-French missile. Ship-martel is characterised by the presence of the booster stretch which is essential to get the missile up to speed before its own motor takes over—a standard Martel, of course, has the benefit of being air-launched at probably 500kt, whereas Ship-martel is launched from a standing start, as its name implies. There is now to be a Royal Navy requirement for a surface-to-surface missile of this type, for which the French Exocet is the present obvious candidate.

The **Ikara**, designed for Australia, will now be fitted also to Leander-class ships of the Royal Navy, and HSD is showing a full-size trial round of this torpedo-carrying missile.

The **Blowpipe** missile, presently shown at Farnborough only as part of the canister, is now seen on the Shorts stand in its actual form. The shoulder-mounted Blowpipe system weighs about 40lb and is about the same size as an automatic rifle. The radio-controlled **Seacat** and its twin brother **Tigercat** are on view; the former is a completely ship-borne installation with a launcher and tracking system. Seacat is also shown in section form to display its simple guidance system and massive warhead.

Certainly one of the most impressive of all the ground displays is BAC's guided weapon-park with examples of **Bloodhound**, **Thunderbird**, **Rapier**, **Vigilant** and **Swingfire** on display, together with their associated launching and tracking equipment. Great emphasis is

placed on Rapier, which is due to enter service with the RAF and the Army this year. Earlier this year Iran placed a £47 million order for Rapier systems for air-field defence. A particularly new piece of equipment is being offered for two Rapier users. It is an all-weather dual tracking radar system which will allow the missile to be used under non-visual conditions.

A new missile makes its first appearance—**Atlas** (anti-tank laser-assisted system), a joint project of BAC and the Belgian firm Fabrique Nationale d'Armes de Guerre. This is designed for infantry use against tanks and such-like targets. The target is illuminated by laser beam and the missile fired in the approximate direction of the target. At a certain stage in its flight the missile picks up reflections from the target and these are caused to activate a bonker (explosive charge) on the missile, which re-aligns the flight path to the target. A laser is used because it is easier to maintain security for the missile operator.

### Space

Numerically the strongest exhibitor is BAC, which has models of a new scientific satellite, **Cos-B**, and the communication satellite **Intelsat 4**. BAC is the main overseas contractor to Hughes on the latter and will assemble, integrate and test two of the four spacecraft which have been ordered under a \$74 million contract. Intelsat 4 will relay 6,000 simultaneous two-way telephone channels, or 12 colour TV channels. As a member of the Cosar consortium (BAC, MRB, ETCA, Selonia, and Snias) BAC will investigate this cosmic-ray satellite under a study contract from Esro. A successor to Ariel 3, **UK-4** is the second British satellite and follows closely the design of its predecessor, which was designed to carry scientific experiments.

The same company is also building the first "technology satellite," **X-3**, for Black Arrow, which will be launched next year. At the time of writing no details have yet been given about the failure of the third Black Arrow about a fortnight ago, but it is thought unlikely that this will have any long-term effects on Britain's national research programme.

Hawker Siddeley Dynamics is showing a model of the Edinburgh University-Liège experiment which will be flying aboard **Esro TD.1A** early in 1972. The TD.1A satellite will be built by the Mesh consortium, which numbers HSD among its members. It will be Europe's first attitude stabiliser satellite. HSD is also the prime contractor for the **Esro IV**

satellite, which will be placed in a 300km by 1,000km elliptical polar orbit. Also on show on the HSD stand is a model of **Esro II** which, designed for six months' life and launched on May 17, 1968, is still operational.

### Systems

The Board of Trade stand is devoted to air traffic control but the accent is not as might have been expected on Mediator. Instead, the history of approach control is shown, ranging from a daily log from Croydon to the latest plans for computer-assisted approach sequencing. A working display, driven from a Marconi simulator, shows how six widely varying types of aircraft can be picked off the Epsom and Garston stacks and controlled so as to arrive on final approach at Heathrow at three-mile spacing. Touchwire inputs are shown for adjusting speed and descent data for the computer. An adjacent display shows the live situation at Heathrow on a 75-mile range presentation, with video overlay to indicate reporting points and major ground features.

Among the new equipment to be seen on the Plessey stand is the **airborne weapon control system** which, following development in the Harrier, is now to become standard in the Jaguar. A working display shows how selection is made of a particular store or weapon to be dropped, showing that the pilot's action is monitored by the computer which rejects an unworkable selection—for instance an unfused store. Weapon release can be either manual or automatically controlled by the attack system. Also on show is the **Type 377** combined UHF/VHF which is intended to become the standard communication equipment for the RAF.

Sperry has on show the **Stars** flight system which is now likely to be put into production by the UK end of the company for sale in Europe. However, greater interest surrounds the twin gyro platforms; the **SGP 500** is shown as a possible standby unit to back up the inertial platform of the Panavia MRCA; the company's latest development in VG/DG platforms halves both the length and the weight by comparison with its predecessor.

The Vickers Hydraulics division of Sperry is showing for the first time a vane-type fuel pump with emphasis on its tolerance to contaminants, examples of which are shown beside the pump.

Three items from Normalair Garrett have not been shown previously; cabin pressure control for the VFW 614 is

Continued on page 414



on is

e people

Everyth





# Operating an airline is your business

**keeping your aircraft flying is ours!**

- Aircraft maintenance and overhaul
- Full design and conversion services
- Component overhaul
- Ground support equipment manufacture
- Non-destructive Testing
- Systems engineering



**AVIATION TRADERS (ENGINEERING) LTD.**

MUNICIPAL AIRPORT · SOUTHEND-ON-SEA · ESSEX · SS2 6XZ

Telephone: Southend-on-Sea 49471 **AH** A MEMBER OF THE AIR HOLDINGS GROUP

---

SEE YOU AT FARNBOROUGH 1970 | **STAND 62 INSIDE**  
**STAND K1 OUTSIDE**

---



## FARNBOROUGH '70 . . .

First issue of the "Flight" Farnborough Show Daily appeared on the opening day and is due out each morning with the exception of the final Saturday and Sunday. The Daily contains up-to-the-minute details of new products and sales announced at the show, reports of press conferences, and news of other business transacted during the exhibition. Daily print order is 6,000; each issue has, on average, 12 pages—a total production of 360,000 pages during the week. Copies are being air-

mailed each day to the British aircraft industry's customers, including the technical heads of the world's airlines and air forces, civil aviation authorities abroad, foreign air attachés in London, and British air attachés overseas. "Flight" gratefully acknowledges the assistance in the Daily's production and distribution at the show of Rotaprint Ltd; Thomas Collaters Ltd; Ministry of Defence and Air Training Corps; and the Royal Aircraft Establishment.

# FLIGHT

INTERNATIONAL

## Farnborough Show Daily

Printed by Rotaprint and published by IPC Transport Press, Dorset House, Stamford Street, London S.E.1. Copyright IPC Transport Press 1970. All rights reserved.  
 News Editor: John Bentley. Editorial office in the Press car park. Copy deadline 1300 daily.  
 Distributed to every exhibitor, and by air mail to the world's aircraft purchasers.  
 Published Monday to Friday inclusive, September 7-11, 1970

Farnborough Monday, September 7, 1970

### Stretched Airbus announced by HSA

A stretched version of the A-300B was announced by Hawker Siddeley Aviation (Stands J and L) on the eve of the show. Identified as the B-7, this variant is 'anglicized' primarily to meet the needs of the British European Airways, which was given full details of the proposal two weeks ago.

The B-7 has a lengthened fuselage to carry 298 passengers, compared with 261 in the basic B-1 variant of the A-300B. Engines would be two Rolls-Royce RB.211-61s of 50,000lb static thrust, the same power plant as proposed for the BAC Three-Eleven. HSA also mention the 52,500lb static thrust RB.211-62 as being available for the B-7 eventually.

British equipment, such as avionics and cabin fittings, could also be used to bring the total British content of the £5 million aircraft to over 50%. The proposal has full Airbus Industrie backing but has been originated by Hawker Siddeley. Launching costs of the airframe alone are estimated to be £18 million, which the British government is being asked to provide. In return, HSA would have design liaison leadership on this variant. Launching cost of the RB.211-61 series of engine is put at £60 million.

### BAS to evaluate Skyvan

A new development of Shorts' Skyvan makes its debut at Farnborough today and brings one step nearer the establishment of ultra-short-haul air services in Britain. The new aircraft, seating up to 22 passengers, emerges as the result of ABE certification of Skyvan at the new maximum take-off weight of 13,500lb (6,125kg).

This 1,000lb (450kg) boost over Skyvan's previous maximum permitted weight in commercial operations means more versatility and profitability for Shorts' STOL transport, now widely used throughout the world. In its new de luxe passenger form, Skyvan is the largest STOL commuter airliner available in the world today.

Continued over . . . . .



## FARNBOROUGH '70 . . .

Continued from page 412

by an electro-pneumatic controller incorporating a manual override, but the smaller components on the stand are dominated by the Garrett-designed cold-air unit for the DC-10. This has been designed to handle 140lb/min but capability for development up to 210lb/min has been allowed and in this form the unit is intended to be supplied for the BAC Three-Eleven. At the higher rating two units will be required to cater for this installation. Another interesting exhibit is a 70lb/min capacity cold-air unit making use of air bearings. This unit is the first of its type in Europe and is flying successfully in a BAC One-Eleven.

Seats to be seen on the Martin Baker stand include those for the Starfighter Phantom and Jaguar, and a display panel records that the company's ejection seats have now saved 2,780 lives, 164 this year.

Among the undercarriage and hydraulic assemblies displayed by Automotive Products, a leading place on the stand is taken by examples of the servo units supplied by the company for the VAK 191B—complex units for a complex project.

S. Davall, principally known for its crash recorders, also displays this year an ingenious collator for producing air traffic control flight strips after flight plan data has been printed out on the

strips by computer. The machine produces the strips cut and mounted, ready for use. The printed circuit is the core of much of the electronic hardware and Permal shows a range of epoxy resin copper-clad laminates for this purpose; copper foil can be bonded to one or both surfaces of the base. The company also has on display a metal rotor blade for a Campbell Cricket. An advance in personal flying equipment is the **Dyn-a-Mike** from Aimed, a moving-coil microphone which incorporates a pre-amplifier. The unit is interchangeable with carbon microphones and operates off supply voltages between 12V and 28V. Other personal equipment is shown by Airtour Products, one of the few new exhibitors this year.

In the outside equipment exhibition Airtech is showing its new lightweight air-transportable air traffic control tower, the **Type MCT-101**, made of light alloy insulated with glassfibre and designed to accept equipment for direct ground-to-air traffic control. Auto Diesels is displaying for the first time its **STAD A260** twin gas-turbine air starter, developed to provide the pneumatic output required by major new aircraft (including the Tri-Star, 747 and Concorde) for engine starting, air-conditioning and component checkout. Aviation Traders (Engineering) Ltd is showing a new mobile baggage-handling conveyor (**CKC600**) and a

freight elevator (**Hylo Mk V**), the former the latest product in ATEL's range of equipment for wide-bodied jets. Driklad is showing its first fully developed and approved helicopter cover, for the Westland Scout. The type will in due course be available for other helicopters. Martin-Thomas exhibits its **Hi-way** hydraulic servicing platform, designed for jumbo jet-sized aircraft, and reports that an overseas operator of 747s is showing strong interest in this equipment. The Pyrene Co, also catering for jumbo jet requirements, uses the display to introduce its **Pathfinder** airfield fire-fighting crash truck, which they describe as the largest and most powerful vehicle of its type ever to be built in the UK. Zwicky is showing a 300gal drinking water bowser, designed to a BEA specification and mounted on a Ford Transit chassis.

## MONDAY'S FLYING

This year's flying display opened on the dot at 1430hr on September 7 with the **LTV A-7D Corsair**, one of the team of foreign aircraft sponsored by Rolls-Royce, and appearing by courtesy of the United States Navy. Also Spey-powered, the **Fokker F.28 Fellowship** was airborne after a remarkably short ground run and following a quiet down-wind pass showed its outstanding manoeuvrability in steep turns with its petal air brakes out, ending with a very short landing. The Viper-engined **Soko Galeb**, a new version of this trainer, was put through an immaculate aerobatic display by Maj I. Stener. Spey power appeared

Continued on page 416



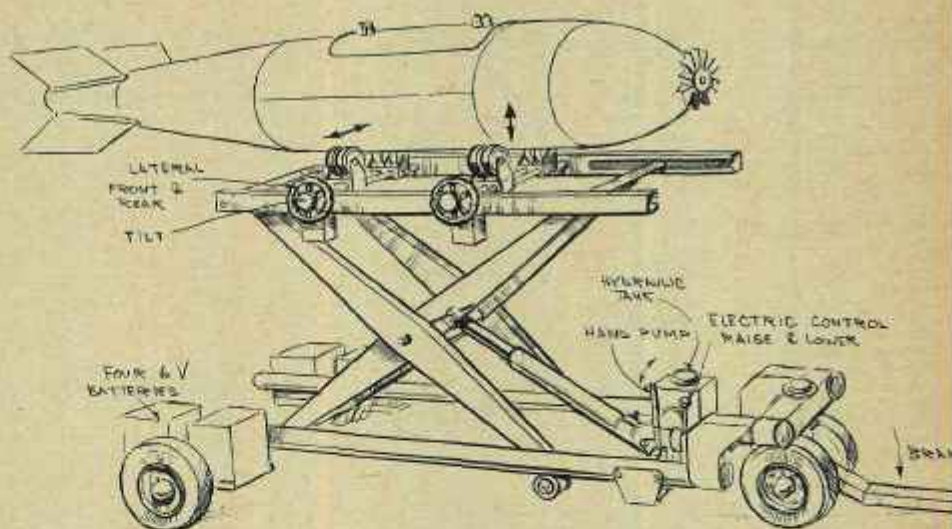
Three of the overseas aircraft sponsored by Rolls-Royce. Viper-driven are the Macchi MB.326G (left) and the Soko Galeb in the foreground (below), while the Grumman Gulfstream II, behind, uses Speys to achieve peak performance in the executive jet category



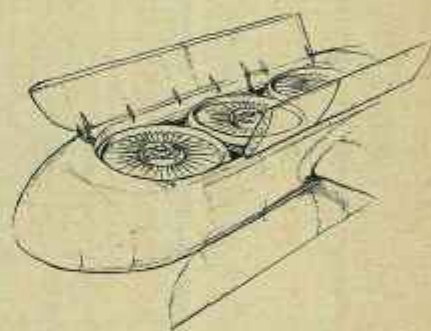
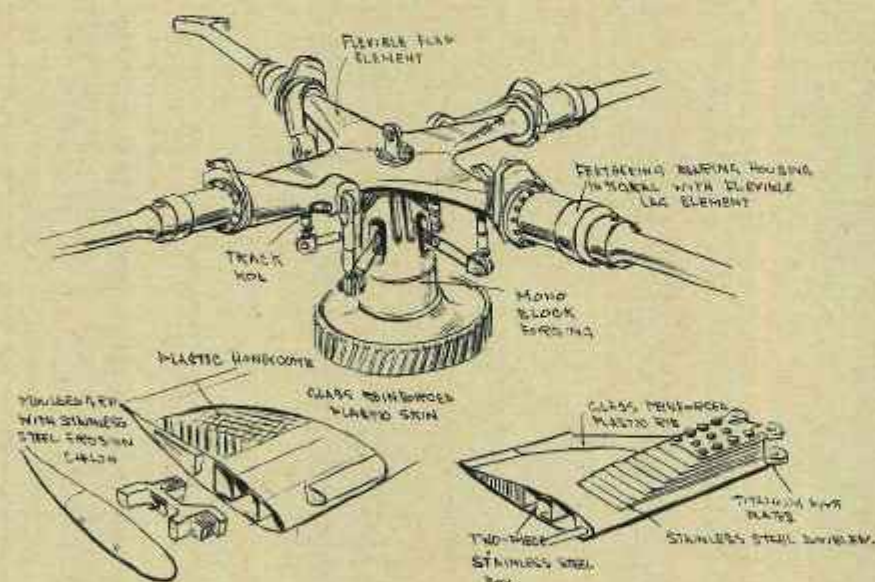


# SHOWGROUND SKETCHES

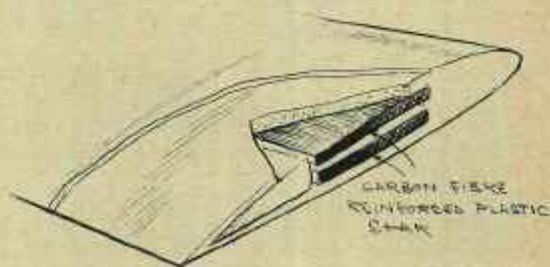
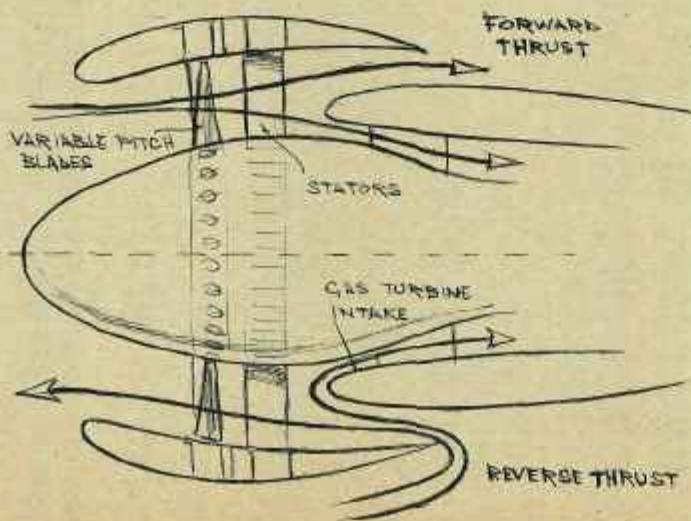
On this page "Flight" artists John Marsden and Frank Munger get to the bones of some of the more interesting exhibits.



Right, the ML air transportable weapon handling trolley and, below, the rigid rotor head for the WG.13 helicopter



Above, typical RB.202 lift fan installation. Below left; with the Dowty Rotol fan in reverse pitch, gas generator flow is not seriously disturbed because reverse thrust is only generated by the fan tips. Below right, section view of the Dowty Rotol carbon fibre-reinforced propeller





## FARNBOROUGH '70...

again in the 19-seater **Grumman Gulfstream 2**, quietly displayed, in a manner befitting an executive aeroplane, by ex-US Navy pilot R. K. Smyth. Then **Viper 540** power was exemplified again in the **Macchi MB.326GB** flown by Lt-Col Franco Bonazzi, who rolled this well proven trainer effortlessly with 3,000lb of external stores, then did  $3\frac{1}{4}$  turns of a spin.

The **Sepecat Jaguar** aborted its take-off, an unlucky Farnborough debut following its vigorous demonstrations in practice sessions; but Anglo-French collaboration was immediately reaffirmed by the second British public appearance (the first was at the Queen's Birthday fly-past last year) of **Concorde 002**, flown by Brian Trubshaw and John Cochrane. The **Olympus 593s** were putting out a good deal of smoke but, as has been announced, combustion-chamber modifications are in hand; during a second, handsome low run, the appearance of 002 was described as "one of the greatest moments of all Farnboroughs;" and third and fourth runs were made possible through the Jaguar's non-performance.

Basis for a printed circuit. These examples of double-sided copper-bonded laminates shown by Permali Ltd make use of an epoxy glass base

From the Anglo-French SST to the Anglo-French helicopters; the **SA.330 Puma** and **SA.341 Gazelle** appearing in what is traditionally known as the Westland Circus, led by chief test pilot Ron Gellatly in the **Wasp**; after him came Bernard Pasquet in the 341, Roy Moxam in the **Puma** and Mike Ginn in the **Sea King**, each taking his solo turn while his three colleagues hovered in the background before turning to the right to depart in line astern.

The **Airmark WA.117** autogyro signalled its recent entry into the commercial field with a demonstration by "Pee Wee" Judge, then the **Bulldog**, which he used to fly with Beagle, having taken off earlier, entered at high level flown by John Blair. Scottish Aviation showed that this trainer has lost none of its agility.

**Harriers**, the T.2 flown by Duncan Simpson and the GR.51 by Sqn Ldr Don Riches, demonstrated the extreme versatility of this classic Hawker military design—the same type hovering and flying just below Mach 1. The GR.51 simulated re-arming with **Sneb** rockets while the T.2 demonstrated its speed, both Harriers making a concerted final bow, sitting on their lift.

**Hawker Siddeley's 748** flown by Stuart Grieve showed some of the reasons why this docile airliner has been commercially so successful all over the world—a tight, smooth demonstration. Its big brother the **Trident 3B** (three **Speys** plus a **Rolls-Royce RB.162** booster) was quietly demonstrated in the de Havilland manner by Pat Fillingham. From the same Hatfield stable, the **BH-125** (223 of

which have been sold) was flown in its latest—400B model—form by Mike Goodfellow.

"That flying operations room" (as commentator Charles Gardner described it) the **Hawker Siddeley Nimrod** opened its weapons-bay doors fully during a very tight and well-positioned low-level demonstration by Tony Blackman.

The **DHC Twin Otter** flown by G. H. Northrop water-bombed a simulated fire, dropping a total of 5,000gal in two runs to show its Canadian fire-fighting capability, then made a neat short landing despite a by now 90° cross-wind.

The **Campbell Cricket's** debut at Farnborough—30 have now been sold abroad—was made by J. P. Metcalfe. Following it, the **Britten-Norman Islander** and **Nymph**—the latter another SBAC Display newcomer—were shown off respectively by Jim Bernie, who displayed the aircraft's low-speed handling, and H. Kendall.

Tim Ferguson of BAC demonstrated an Argentine Air Force **Canberra** with external stores in a welcome return of the type (which has brought in £85 million of exports) to a Farnborough display, rolling to show its docile handling characteristics over a wide range of speeds. It was followed by the **BAC Striker**—another export success—flown by David Eagles, who demonstrated the aircraft's excellent aileron control in a tidy aerobatic sequence. Close after it the **BAC One-Eleven 475** took off and landed in a commendably short distance at maximum landing weight, flown by Roy Radford—a "self-contained aeroplane for the remoter, poor strips," as the commentator put it.

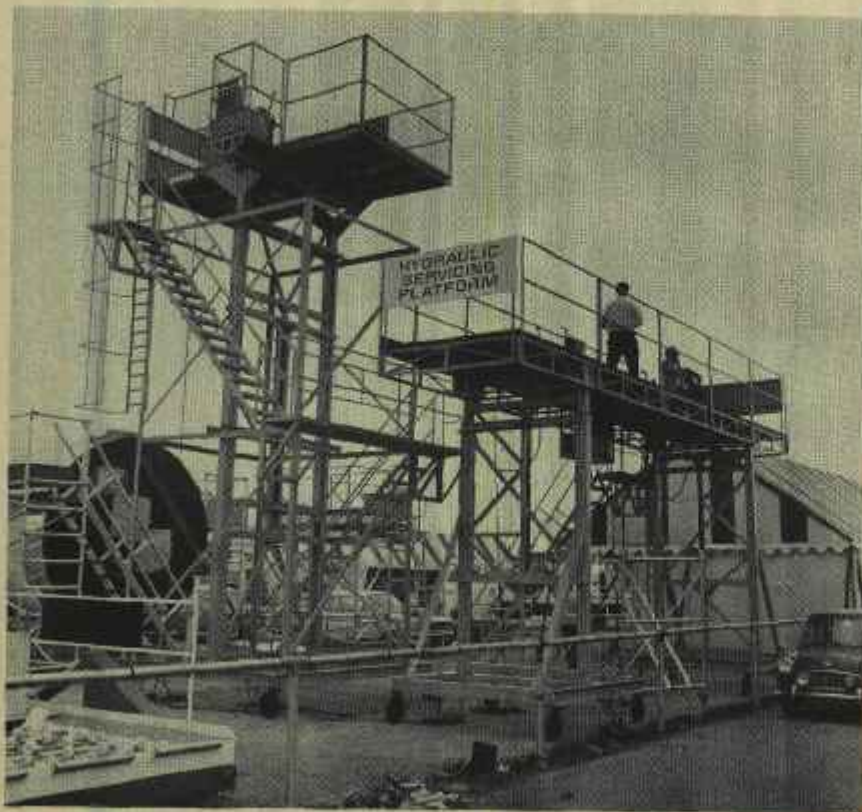
**Shorcs** showed their military and their civil **Skyvan** (the latter flown by T. Woods, the former by Don Wright); the military disgorged 15 troops from Odiham after a very short landing; the latter is going on a British Air Services tour following the SBAC Display.

The **Cierva CRLTH.1** development prototype was flown by K. M. Reed on its public debut, concluding the manufacturers' part in the display and leaving the sky clear for the Services' demonstration—Air Support Command **Phantoms**, Belfast, **VC10**, **Hercules**, **Andover**, No 1 Sqn **Harriers**, **Wessex** in a tactical attack and support demonstration, finishing with a manifestation of four **Harriers** from behind the cover of trees.

Strike Command's contribution was opened by a **Lightning F.3** flown by Flt Lt "Oscar" Wild—a superb solo aerobatic display; this was followed by a **Victor** tanker with **Buccaneer**, **Phantom** and **Nimrod**—a beautiful piece of close formation flying.

The Army came next, with five **Sioux** of the **Blue Eagles** helicopter display team, led by Capt Ron Mallock; then the Services' display was impeccably concluded by the **Red Arrows** RAF **Gnat** team under the leadership of Sqn Ldr D. Hazell.

Last but by no means least in the 1970 display, the **VC10 RB.211** flying test-bed made its appearance—an augury of powerful things to come in British aero engines.





## INTERNATIONAL EXPERIMENTAL AIRCRAFT ASSOCIATION ANNUAL FLY-IN 1970

## OSHKOSH



Gate to Mecca

**A**N AIRFIELD MANAGEMENT able to successfully undertake the removal of its FAA-size, five-storey control tower in one piece, from one spot on the field to another over a mile away, obviously thinks big and acts big. Hence it is appropriate that when the International Experimental Aircraft Association decided to remove its annual International Sport Aviation Convention from Rockford there should have been an affinity in thought with the alert citizenry of Oshkosh, Wisconsin, at whose Wittman Field, from August 1 to August 7, a new meaning for the local saying of "Oshkosh B'Gosh" was found. B'Gosh it was big and B'Gosh there were 608 amateur-built, restorations, and warbirds present apart from the countless hundreds of factory built cooking types parked in line after line, many with tents alongside as their owners camped out for the biggest sport flying fun week ever.

Apart from the aircraft an added breather was a campsite filled to overflowing with 10,000 campers and without a single piece of paper to be found on the ground despite the barbecues, corn roasts, trailers and tents from all corners of the USA and Canada. This year, it was bigger than ever, despite the move—akin almost to moving the fixed installations of a military airbase on to a site which in March 1970 consisted of ploughed fields, and which four months afterwards had roads, flattened furrows, wiring, water and electrical supplies together with a hangar store and several miles of safety snow fencing. The astounding feature of the whole site was that the majority of the work involved was done by voluntary labour by gangs of EAA members who thought nothing of giving up their weekends in below-zero temperatures to fix culverts, make picnic tables and do any other chores right up to the last minutes when the whole deal started with a literal big bang a day or two before the event as Paul Poberezny, the genial International EAA president, gave a foretaste of the raz-a-mataz to follow when he fired

---

Text by **HAROLD BEST-DEVEREUX**

Photographs mainly by **HOWARD LEVY**

---

off the afterburners and pulled away almost vertically in a Starfighter after a low pass to inspect the work in progress.

To be one of the first half-dozen airborne arrivals was an amazing sensation. There it all was, neatly laid out and comparatively quiet, but it was not long before the taste buds began to operate as a near-genuine Fokker Triplane, appropriately registered N1917, taxied up alongside to be followed by the minute El Chuparosa biplane of the king of prop carvers, Ray Hegy, whose 15ft, 4.5m, span biplane had, as for many years, sped him from Marfa, Texas. Thus, long before the opening, a hundred aircraft were already parked and withstood the onslaught of a spar-cracking tornado which soaked the whole area and gusted through the display tents at over 60 knots (the story about the USA always having good flying weather is just another myth), but all was well after an alarming half-hour.

By good management, this year's Oshkosh started on a Friday and this arrangement certainly served to even out the executive load in handling thousands of movements and lessened the crescendo of previous years at Rockford where the week-end coincided with the end of the convention and threatened to burst at the seams.

Despite the big move and the inevitable gloomy prognostications of some, the affair turned out to be a greater success than ever. Aircraft movements for the week totalled a shattering 31,653 with Thursday, August 6, returning a score of 7,174 during daylight hours and mostly without radio. These totals





## OSHKOSH . . .

did not include movements at the nearby Fond du Lac airport reserved for EAA International Aerobatic Club aerobatic programmes. The general radio silence and alert pilot discipline coupled with excellent runway assistance from FAA-manned local control vans showed once again that if you must make like a successful bird don't base yourself on the talkative parrot with its poor L/D. Movements would in fact have been greater on the Monday and Tuesday had it not been for the cross wind on the north-south runway in use for convention traffic; the east-west was handling jets and turbo-props. Nevertheless each of these days returned over 4,000 movements without accident by FAA definition. Three bent props and a bumped leading edge was the total for the week. Over 100 aircraft in the homebuilt category were prevented by a hurricane in the south from making their destination at Oshkosh. Several Canadians hit weather, but the nostalgic Miles Hawk Major of Father John McGillivray made it and showed once again that some of the old types become more beautiful than ever—Fred Miles can be proud.

To the technically minded 1970 showed a heartening proof of the success of the homebuilt aircraft movement when it is allied with a sound commonsense approach to building and certification. The Americans have a traditional respect for the rights of the citizen and this coupled with a practical ability to find simple and uncluttered answers to technical problems gives a formidable answer to the "do-gooders" attitude towards light aeroplane development. Additionally the freedom to try ideas produces a form of aeronautical down-to-earth "boss sense" which breeds men and not mice.

Following the trend noted last year, the cult of the true sportplane was evident in the lines of Pitts Specials including the "Butt Buster" as seen by so many at Hullavington in the hands of Gene Soucy. That this type of aircraft has arrived can be in no doubt following its performance in the international aerobatics contest. Also at Oshkosh was Betty Skelton Frankland who many will remember put up such a show at Gatwick over 20 years ago in her Pitts "Little Stinker," now retrieved and flying from Betty's private strip. On the showing to date, need there be any doubt that the type has proved its airworthiness and strength? If ever an aircraft deserved type certification on proven merit here it is.

The Hullavington aerobatic contest naturally became a star topic at Oshkosh and International EAA justifiably made

Above, left, executive pilot Bruce Panzl won the award for outstanding finish and paint design with his standard Pitts Special. He took one year eight months to do the building

Above, two prizes were won by the D'Apuzzo Senior Aero Sport built by Al Pfouts of Ohio. The engine is a Continental E-185-1 modified to produce 225 h.p. Gross weight of the two-seater is 2,100 lbs, 952 kg. It took over four years to build the aircraft and cost nearly £4,000

Left, this single-seat Scorpion helicopter was built by Bruce Warren and is noteworthy for its enclosed cabin which earned the award for best workmanship in a helicopter. A 100 h.p. Evenrude engine gives a cruising speed of 70 m.p.h., 110 k.p.h. and a climbing rate of 1,650ft/m, 8m/min

much of the fact that all participants in the American team were EAA members flying homebuilts and that five of the first seven individual pilots placed were EAA members. Great was the rejoicing and the US team members were filled with praise for their reception in the UK. A particular topic was the airmanship of Neil Williams in his Zlin episode (see *Flight*, June 18, page 993).

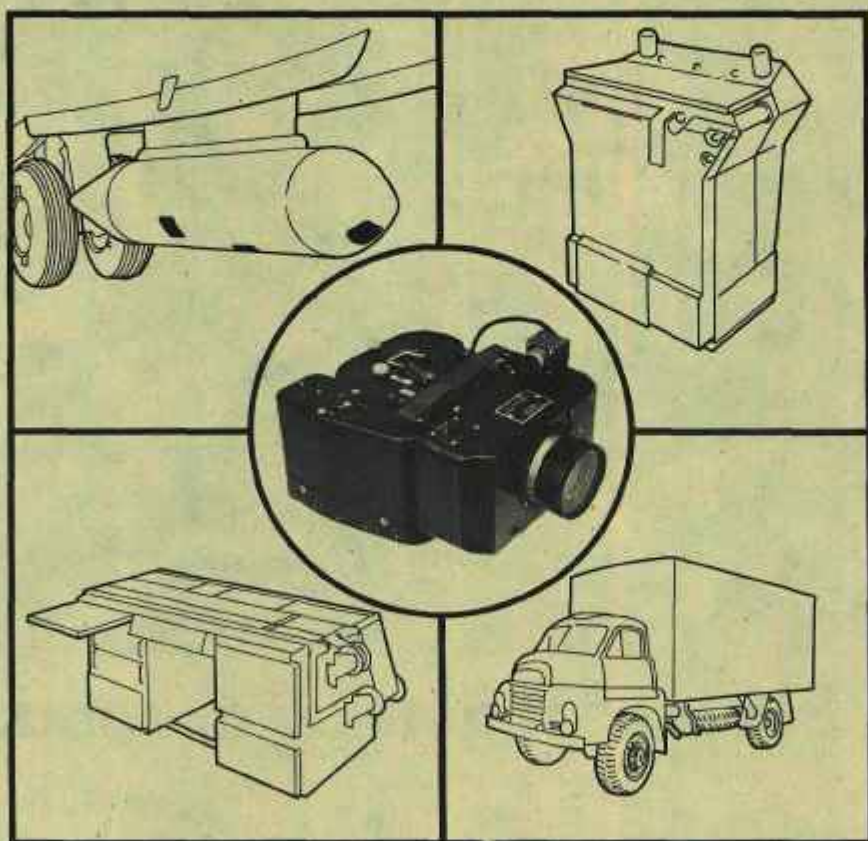
Although the aerobatic sport biplane is an impressive and potent part of the current scene, the variety at Oshkosh left no doubt that it would be difficult to find a gap unfilled in the spread of aircraft types to suit all tastes from the minuscule and much debated "Jeanie's Teenie" with VW power right up to the booming war birds exemplified by P-51 Mustangs and F8F Bearcats brought by the slightly better-off type of EAA member. The preservation of aviation history is taken as a serious pursuit at Oshkosh as was evidenced by the famous Lockheed Vega "Winnie Mae" and "Spirit of St Louis" paint schemes on sister airframes of each type. The Ryan was the same aircraft that visited the Paris Salon a few years back and its pilot on that occasion, Frank Tollman, made many an enthusiast reach for his camera at Oshkosh as he gave a creditable imitation of a real duck receiving a charge of buckshot in the pants as he zoom-climbed his beautifully painted Grumman Duck, complete with aft-mounted machine gun, external stores, and a US Navy paint scheme redolent of the days of Cagney and Clark Gable. To English eyes, comment was superfluous on the beautiful JM-R- marked Spitfire, finished as befitted the dignity and rank of its earlier pilot, Air Chief Marshal Sir James Robb. The Martlett and Hellcats come well into the category of "throat lumpers" to ex-British Navy types; but parked alongside, and looking ridiculous in comparison with 16ft span biplanes nearby, was the last word; a real solid and gigantic Grumman TBM-3 Avenger resplendent in USN markings and owned by Leo Volkmer of Dallas, Texas. Numerous private Harvards (funny that they could not be certified in the UK), the raucous P-64 of the EAA museum, and a new museum addition, the Curtis P-40, made the line-up of 110 warbirds and specials a never-to-be-forgotten sight.

The pressing problem at Oshkosh was to find time—time for the information forums by experts; time for flying aircraft, time for photography and just saying hello and joining in "bull sessions." Time for sleep could be mostly discounted while eating became a simple matter of snatched opportunity. One of the most enthusiastic but elusive activities was the Pazmany performance measuring team who set up their performance measuring programme well before breakfast each



Stand 33  
Farnborough

# Photographic Reconnaissance Systems



# Vinten

-completely





## Our big bird is getting around.

Already chosen by the U.S. Air Force and Marine Corps, and the German Army and Austrian Air Force, the CH-53 is looking for more jobs.

It has proved its capabilities in logistics support, search and rescue operations and airborne emergency standby at manned

spacecraft launches. The free world's fastest transport helicopter, it can airlift 38 troops 100 nautical miles at speeds to 200 mph, and has carried 14½ tons at 138 mph. It can climb and bank with the agility of helicopters only one-tenth its size.

With so much going for the

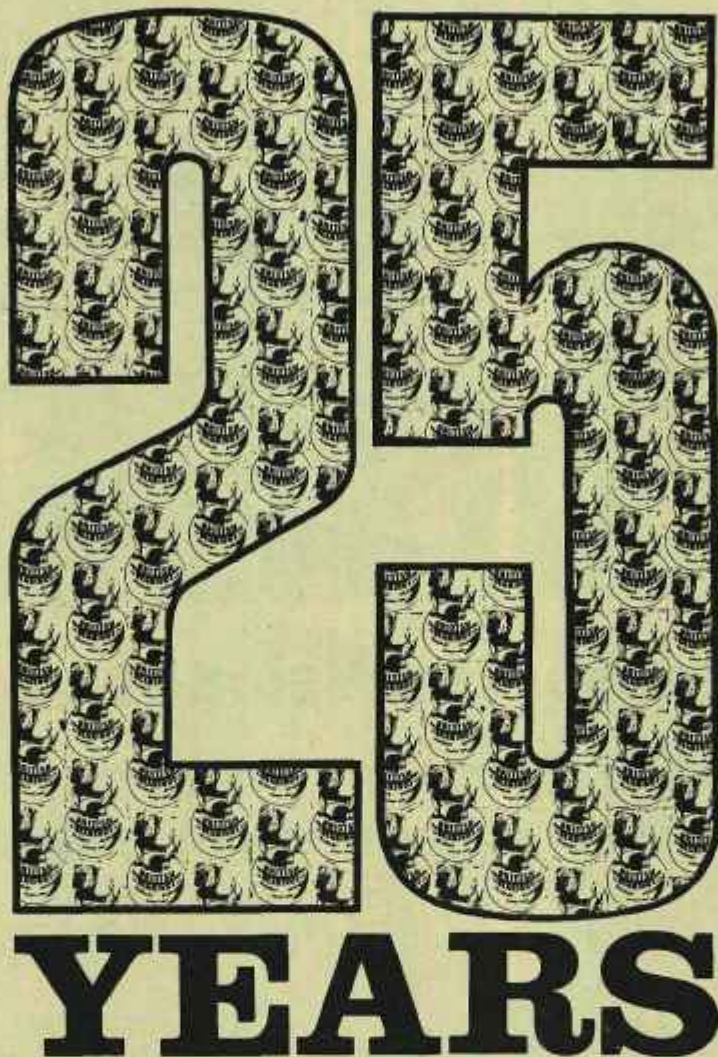
CH-53, we think you'll see a lot more of it.

Contact Brown and Dureau Ltd., P.O. Box 24, So. Melbourne VIC 3205, Australia.

**Sikorsky Aircraft**

**U  
A**  
DIVISION OF UNITED AIRCRAFT CORPORATION





# 25 YEARS

The British Manufactured Bearings Company Ltd., are Britain's only specialised manufacturers of precision miniature bearings. August 1970, marks the completion of 25 years in business, serving not only Aviation and Avionics but a complete cross-section of industrial application. Sizes available in our comprehensive inch and metric range are from 1mm. up to 6.35mm. Most types can be provided in either corrosion resistant steel or high carbon chrome. Pivots bearings, thrust bearings, flanged bearings, sealed bearings, phenolic retainers and spindle bearings ensure that our manufacturing programme covers the wide variety required by our industrial network. Substantial investment in the latest equipment and techniques have enabled B.M.B. to increase output considerably, in addition to maintaining the rigorous quality demanded by today's instrument bearing standards. B.M.B.'s policy for the '70's is to increase the range of sizes available and to install additional equipment, and where necessary to modify existing machinery to suit a unique industry or customer application. The combined total of over 80 years experience in the bearing field will continue to ensure that B.M.B. expands as a compact, aggressive and independent manufacturer producing consistent quality at reasonable prices.

**BRITISH MANUFACTURED BEARINGS CO. LTD.**  
**SOLE SELLING AGENTS: B.M.B. (SALES) LIMITED**  
**Fleming Way, Crawley, Sussex. Tel: Crawley 28765**





## Britten-Norman Islander BN-2A

### 'THE AIRCRAFT'- DESIGNED WITH OPERATORS IN MIND

UNMATCHED IN RELIABILITY • PERFORMANCE • VERSATILITY • ECONOMY

Present Islander operators include:-  
Aurigny - Loganair - Humber - G.K.N  
Westward Airways - Northern Executive  
Rig Air - Thurston Engineering - B.K.S  
Island Air Charter - Ireland West Airways  
British Parachute Regiment - Bristow  
Helicopters - Mr. Peter Cadbury

**Capt. Harold Fry of Westward says:-**

*"The only aircraft versatile enough  
which could be used profitably on  
short haul type operation."*

**Mr. Peter Cadbury says:-**

*"To me the 'ISLANDER' is the general  
purpose, safe and economic flying and  
is the sophisticated successor to the  
RAPIDE, which used to be my  
favourite aeroplane during the war."*

# FA



**FAIROAKS AVIATION SERVICES LIMITED**

Fairoaks Airport • Chobham • Woking • Surrey • England

Factory Appointed Main Distributor - BRITTEN - NORMAN BN-2 ISLANDER

Telephone: Chobham 7285/6

Telex: 85601



## OSHKOSH . . .

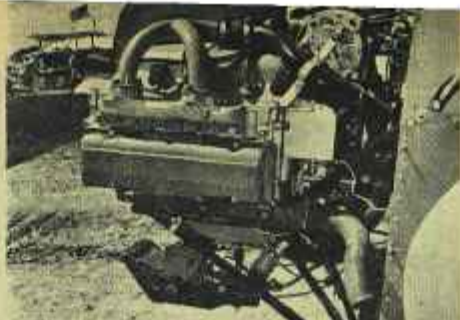
morning. Nuts, bolts and gadgets were displayed by the ton in the commercial stand marquees and few if any could contain the burning pocket sensation against the urge to buy at prices to encourage the construction of a homebuilt.

Of aeroplanes to fly there were many, the problem being to have pilot, owner and craft all together at once. Nevertheless it was possible to try a variety although several succulent morsels had to be left for another occasion. To ride around the countryside in a sedate Gipsy Moth was a nostalgic and beautiful experience, too soon over; while for sheer thrill, apprehension and gaiety all rolled into one, the "Breezy" open structure pusher with the pilot perched as on a pre-war Dangling glider took some beating. A Breezy story, vouched for by many, concerns the landing in a nudist colony of one of these structures and the subsequent joy ride given to a shapely female which caused an innocent Piper Cub nearly to Lomcevak as it was formatted upon.

For a long time it has been stated that the rugged EAA biplane is heavy and that 90 h.p. upwards is essential. N7524U, owned by Chuck Everson, proved, however, just what this design can do on a Continental A-65. The secret is, as in all aircraft, to build light, and this aircraft is one of the most pleasant little biplanes possible for the modest pilot. Somewhat hotter but just as agreeable was a try at the Baby Great Lakes, also with 65 h.p. and needing no more to achieve a brisk and sprightly performance. The tail end is powerful, the span is 16ft, 5m, and it is all very near the ground. Equally it is very strong and stiff and gives a necessary impression of strength as one looks out at the silly little lower wings. The example tried had a free swivel tail-wheel and diabolical, non-standard brakes best left alone unless looking for a bull fight. In the air, the aircraft was delightful and sensitive and anybody wishing for a Comper Swift replacement could well think about this vest pocket reduction of a famous design renowned for years in the two-seater aerobatic field.

Some years ago Jim Bede produced a small side by side two seat design of radical construction and this is now well known as the American Yankee. As a production aircraft it is no longer strictly a homebuilt but the chance was not to be missed. The Yankee is a fun aircraft, nicely made and presented and the cabin arrangements were found to be excellent. For once the phrase "all came easily to hand" really meant something. The ground steering on a freely swivelling nose wheel was very good and the airborne performance akin to a real sports car. The Yankee zips along and can be turned steeply on the proverbial small coin, feet off, and it was easy to make feet off tight pylon eights and hit the slipstream. Now

The first of Steve Wittman's new formula V racers was shown at Oshkosh. The engine is a 1,600cc VW developing 60 to 65 h.p. Ignition and manifold are modified and there is a 1ft, 0.3m shaft extension. To improve cooling, the cylinder heads have been slightly redesigned. A wooden wing is used, covered with plywood and the fuselage is fabric-covered tubular steel. There are 4 or 5 "V-Witt" racers under construction. Top speed is estimated as 150 m.p.h., which is 240 k.p.h.



Above, a 1966 70 h.p. Corvair Corsa car engine is fitted in this two seat Pietenpot Aircamper built by Byron Petersen. Construction is all wood. It was built in Hawaii and later shipped to Torrance, California. It was flown the 2,300 miles, 3,700 km from there to Oshkosh

that this type is in commercial hands, Jim Bede is forcing on with his BD4 and having an impressive activity in selling kits of materials. One EAA member in the UK already has one on its wheels.

One of the more pleasurable flights at Oshkosh was to fly in an old friend, the Liberty Sport biplane. Flown several times previously from the front, this year ARB test pilot Darrol Stinton did the work and the aft cockpit was tried for size. This aircraft was built in the true early spirit from chalk lines on the floor, some quick sketches, and the previously mentioned "hoss sense." The ARB seemed impressed!

Many aircraft are honest without exact explanation being possible, but having met Jim Keheler, designer of the Lark owned by the trusting Bob Voto, it was easy to understand





## OSHKOSH ...

how this delightful aircraft was conceived. The Keheler Lark is a mid-wing strut-braced monoplane and classic in every way. It is far from being a midget, having a roomy cockpit, a big enough sliding canopy and grosses at 855lb, 388kg, when fitted with a 75 h.p. Continental. As a one-place aircraft it would seem to have many features suitable for European use with its two-piece wing, steel-tube fuselage and fabric covering. Conversation with the designer brought forth that, although 4130 specification tube is called for, it is not essential, and English T.45 is completely adequate. In the air the Lark lived up to its name and was an easy aircraft to fly. Controls were firm and positive, the elevator load increased towards the stall and in steep turns. The stall was straight as a die at 53 m.p.h., 85 k.p.h., and sitting on the deck with a straight roll-out was comparatively child's play.

Unfinished, but taxied into the aircraft park and due to fly later this year was the new Wittman Formula V racer and sport plane. Breathing Wittman simplicity all over, this design seems a sure fire winner for those who cannot think in terms of blowing up Formula One engines and the expense involved. The VW engine in this aircraft is a model of ingenuity and is mounted with the gear box flange forward. A simple magneto is mounted aft and a large cone extends forward some 12in from the gearbox flange. This cone houses a prop shaft of sensible proportion and has a heavy duty bearing adjacent to a standard prop hub. The weight penalty is about 16lb, 7kg, but this is what Steve Wittman has saved by using a titanium landing gear and the resultant shark-snout nose line with improved exhaust flow facility is beautiful as well as a means of gaining efficiency. It was nearly ready but not quite and will be a must for next year. The two-piece wing on the Wittman incidentally uses a similar root end attachment to the pre-WW2 Bonzo and the pre-WW1 Bleriot—look no bolt! The spar stub sits in a housing and the wing is held by the landing and flying wires from spanwise shift.

As in previous years the aerobatic programme each evening

was superb with the Pitts Specials really letting their hair down and Art Scholl with his Super Chipmunk more in his element without the restriction of compulsory figures and judges watching. Still the smoothest was Bob Hoover who each day gave a beautiful P-51 show and then leaped straight into his Shrike Commander for his famous "two feathered" programme which on one evening must have made him, in the prevailing conditions, the only man to seemingly execute an ILS approach inverted and with both stopped. Bob's P-51 was unfortunately just about written off during servicing operations when an oxygen bottle exploded prior to a high altitude cross country flight away from Oshkosh.

Two new items were put into the aerobatic display this year. Bill Father and Corky Son Fornoff flew two Bearcats in such tight formation that it made the seasoned gasp. Their other act of an along-the-runway cross over with matched 16-point rolls was unbelievable but true; it must have been done with large mirrors.

A Breezy aerobatic programme was an experiment that could well be forgotten for future years. The Breezy is fun enough in its normal rôle but as in all things there are limits.

All in all the International EAA Sport Aviation Convention lived up to its tremendous reputation and proved yet again the integrity of amateur-made and operated aircraft built sensibly with voluntary discipline of the highest standards and the world wide fellowship of its members all dedicated to helping the movement be they novice, professional or genius. The grass roots aviation movement showed at Oshkosh where the future can lie and that sport aircraft have a significant potential in aviation affairs with over 3,000 homebuilts flying and 8,000 under construction. If proof were needed one only needs to consider the magnitude of the current effort at Oshkosh, this year—illustrated with such performances as Colonel Sam Burgess who made a 50-State tour, including Alaska, and ending up at the Convention, in his homebuilt Bül33 Jungmeister N258H, built in Hawaii; or Pete Bowers flying 25hr each way in his homebuilt Fly Baby from Seattle, not to mention many others whose flights by homebuilt aircraft were measured by thousand-mile distances.



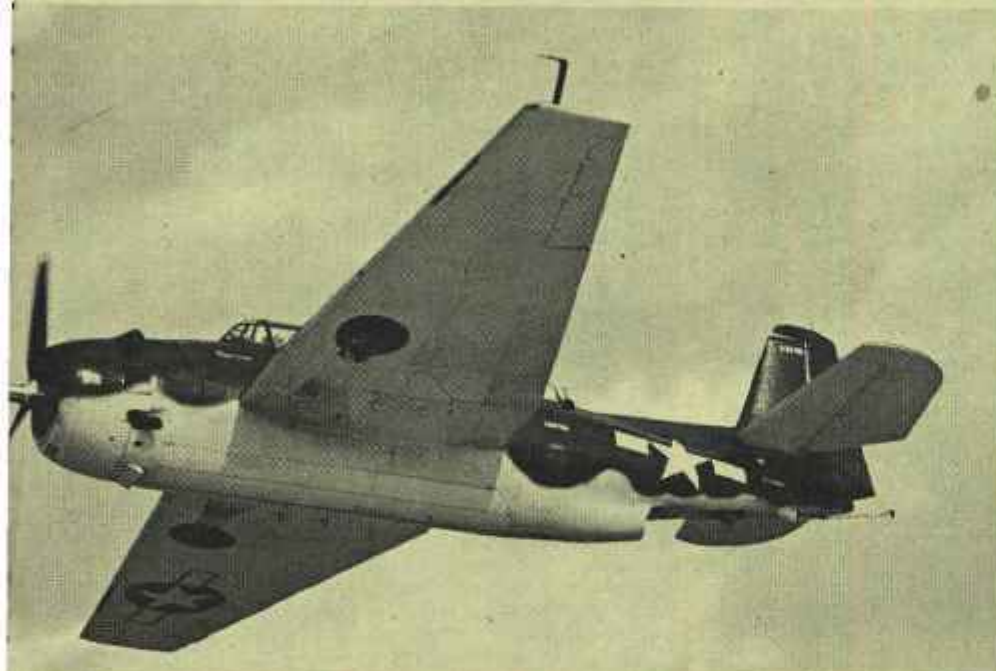
Left and above, a Knight Twister Imperial with a racing aerofoil developed by Twister designer V. Payne and built by flying instructor, D. Fairbanks. Engine is a 135 h.p. Lycoming O-290 D-2. Below left, a Jeanie's Teenie Mark 2 built by Cal Parker. This version has a less angular layout than earlier ones. Construction is all aluminium with VW power. Below, Sam Burgess built this Jungmeister in Honolulu







Above, Robert Ladd has made further modifications to his Taylor Monoplane, fitting it with retractable main gear using go-kart wheels, tyres and brakes. Power for Monoplane is a 42 h.p., 1,500cc VW and the aircraft received the award for the outstanding contribution to low cost sport flying



Left, this General Motors-built Grumman TBM-3 Avenger is owned by Leo Volkmer and it won the Classic warbird award for Navy-painted aircraft

Below, Fred Geschwender has developed a converted Ford 289 cu in car engine for aircraft use with a view to fitting it to Jurca-designed scale Second World War replicas. The prototype engine develops 180 h.p., but it is claimed that it is capable of development to 320 h.p., at the same weight. Some slight changes will be required in the drive train before first flight later this year

Right, The award for the best all-metal aircraft went to Richard Walen, who built this Standard T-18. The aircraft has Alumigrip paint and a hand-carved, leather interior with rolled and pleated seats. It has a 135 h.p. Lycoming which gives it a cruise speed of 170 m.p.h., 270 k.p.h. Bottom right, Wiley Post and Charles Lindbergh were perpetuated by these two near originals based at Oshkosh. Lockheed Vega, "Winnie Mae" (right) gained Grand Champion antique award for second year running. Left, the Ryan Monoplane





## Suiting the spaceman

**D**OVER, the small capital city of Delaware, USA has few worldwide claims to fame, but one of them is out of this world. At the ILC Industries plant in delightful Pear Street, the Apollo astronauts are frequent visitors to be fitted with the latest in space wear. Spring 1970 saw the introduction of the new Apollo spacesuit, the A7LB—the only contribution to Dover fashion's spring collection.

At ILC Industries are made the complete 57lb Apollo spacesuits, except for the portable life support systems (PLSS) used by the lunar walkers. With over ten years' experience in the research, development and manufacture of air-inflated assemblies, pressure vessels and life support systems, ILC came into the space scene in a big way in 1962 when they were contracted by Nasa to provide one of the most essential pieces of Apollo equipment.

That they were preferred by Nasa to the makers of the Mercury and Gemini space suits is an indication of the amount of work their present vice-president, Leonard Shepard, has done in preparation for lunar exploration. He foresaw the swift approach of manned spaceflight when he joined ILC in 1951 and spearheaded a research study into the human needs of life support, especially on the Moon.

The task is a responsible one and the staff is perpetually

reminded of this in a number of ways. In particular, a special card with the inscription "You are making my world in space" with the appropriate astronaut's photograph and autograph remains attached to a spacesuit until it is safely delivered to Houston, after which it is proudly displayed on the wall of the assembly room among other work incentive aids from the astronauts, Nasa and the ILC management.

Women predominate in the assembly room, doing all the cutting, sewing and finishing of the suit to the exact specifications and personal requirements and preferences of each astronaut. The environment is not unlike that of the rag trade and is seemingly inappropriate when one considers that the boots, gloves, inner layers and outer garments all lying around on tables and hanging in cupboards are going to sustain the life of a human being on the Moon.

The Apollo spacesuit is made up of several layers of the most expensive and modern materials yet produced, each suit costing about £6,200. With its associated PLSS, it is described as a manpowered vehicle with a self-contained environment rather than a pressure suit. Three suits are made for each astronaut. One is the flight suit, another is for reserve and the third is for use in ground training under normal pressure conditions. About 150 suits have been made already and every astronaut has been to Dover to be measured for his suit and has returned periodically to try it on and recommend modifications or additions. Some astronauts prefer dials, straps, etc in different places and as much as possible is done to accommodate their requests. Each spaceman has a non-flying double employed by ILC to model his suits.

Of the three-man Apollo crews, the command module pilots remain inside the spacecraft at all times and their suits do not need lunar EVA protective covering. Any lunar orbit EVA from the command module is not likely to require redesigning of the suit, as circumstances would be similar to an EVA from a Gemini craft.

The CMP suit includes a cotton flying suit which is worn at all times during a flight. On top of this come five layers which make up the pressure suit (PGA—for pressure garment assembly) consisting of a lightweight fabric comfort liner, overlaid with a neoprene-coated nylon cloth. The latter acts as a bladder material, serving as an impermeable layer to contain the suit pressurisation oxygen. Over this is a nylon fabric to restrain the inner layer.

The top two layers are recent additions to the design. Fireproof teflon-coated nylon yarn and glass fibre fabric are worn as a result of Accident Board recommendations following the deaths of Grissom, White and Chaffee in the fire of 1967.

The fire squashed Pear Street like a sledgehammer. Although tragic in circumstance and consequence it resulted in some good. It led to virtual redevelopment of the lunar extra-vehicular activity (LEVA) suit. As a result of the subsequent pause in the programme, ILC had time to implement their designs for much more reliable lunar wear.

Initially the LEVA suit was to have comprised a radiation protection garment, similar to those worn on Earth by scientists in radioactive laboratories, to be worn over a Gemini-type EVA spacesuit. The astronauts were to be connected to the lunar module by their oxygen/communications umbilical line and would have been able to walk only as far as the tether would allow—highly limiting in lunar exploration. The protection would be in the form of slip-on trousers, jacket, boots, gloves and "welding-type" helmet.

Continued on page 423

The complete Apollo Lunar excursion suit, including the PLSS pack. The suit alone weighs 57lb on Earth







## The flight weight connector

PVW connectors are lightweight miniature circular environmental connectors used in exacting aerospace applications where weight is at a premium.

Designed to meet the stringent performance requirements of NAS 1599, but with a weight saving of up to 25%, the PVW also complies with MIL-C-83723 (U.S.A.F.), British specifications BES/SST/ELC/321/PP 8 EL 2112 Pattern 602, French specification NFL-54-130 and German specification LN 29504.

The PVW connector is interchangeable and intermountable with MIL-C-26482 types, permitting the upgrading of existing systems.

Superior environmental resistance characteristics are provided by an interfacial seal with raised barriers, a peripheral seal and a wire sealing integral grommet. The use of high grade fluorinated silicon elastomers provide excellent resistance to a wide variety of fuels and oils over the temperature range  $-55^{\circ}\text{C}$ . to  $175^{\circ}\text{C}$ . ( $-65^{\circ}\text{F}$ . to  $350^{\circ}\text{F}$ .). Higher operating temperature performance can be achieved by using silicon elastomers (Mod. Code 22).

The crimpable contacts are standard NAS 1600 type and comply with the performance requirements of BS 2G 178. The contacts are inserted and extracted

from the rear, based on our original Little Caesar<sup>®</sup> rear release retention assembly, using an inexpensive plastic tool which is supplied free with each connector. Standard crimping tools, MS 3191-1 or MS 3194, are utilised.

**Cannon Electric (G.B.) Ltd.,**  
Lister Rd., Basingstoke, Hants.  
Telephone: Basingstoke 3171.

Factories in Los Angeles, Santa Ana and Anaheim, California; Phoenix, Arizona; Australia, Belgium, Canada, France, Germany, Italy and Japan.

® Registered trade mark, International Telephones and Telegraph Corporation.  
© 1970 Cannon Electric (G.B.) Limited.

# ITT CANNON

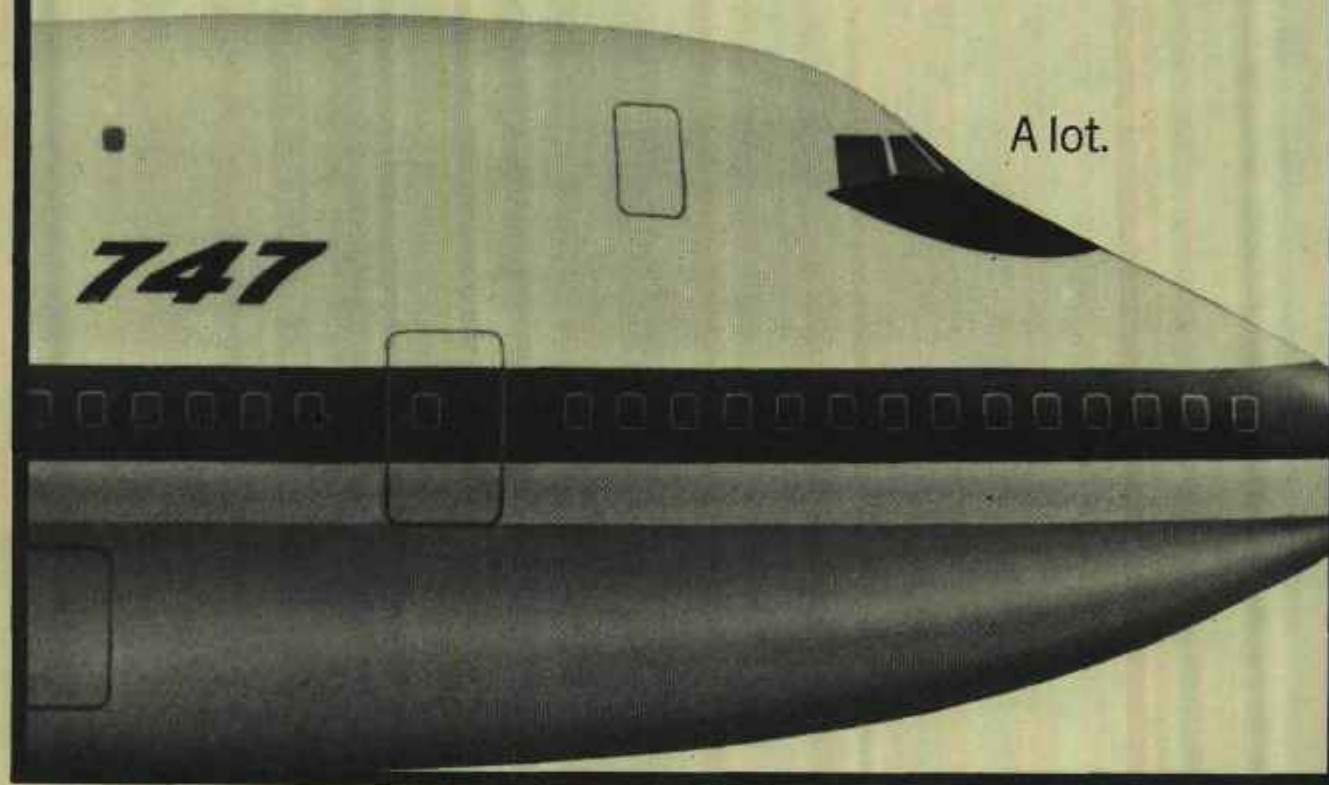


How much advanced technology do we  
put into small-aircraft air conditioning?



A lot.

**747**



Now small aircraft, too, are getting the benefits of Hamilton Standard air conditioning with our advanced "3-wheel" design.

This simple design combines circulating fan, compressor and turbine rotor on a single shaft. Result: Big dividends in cooling efficiency. Reduced

weight. Lower maintenance costs.

Contact us, and find out how to get those same benefits in the new aircraft you're planning, large or small.

**Hamilton Standard**

**U**  
DIVISION OF UNITED AIRCRAFT CORPORATION  
**A**





## YOU HAVE THE AIRCRAFT... WE HAVE THE WEAPONS!

Constantly matching the increased performance of modern aircraft, MATRA aeronautical productions comprise a particularly complete arsenal of weapons. They range from non-guided armaments to the most sophisticated tactical missiles (Air-to-Air, Air-to-Ground, Ground-to-Air). For the past twenty years the Company's synthesis teams have acquired an experience which is perhaps unique in the study of complex systems and their development. Their competence and their imaginative flair, have contributed to MATRA's pre-eminence and leadership in this field.

and earned the Company an enviable reputation. New equipments and new systems are right now entering upon their development phase for the 1970-1980 generation. Henceforth, MATRA is synonymous with « advanced techniques ». Should you wish to be better informed on the activities of the MATRA Company, simply get in touch with our External Relations Department. Avenue Louis-Breguet - 78-VELIZY - FRANCE.

# ENGINS MATRA

In the forefront  
of advanced techniques

AEROSPACE TECHNOLOGIES, INDUSTRIAL ELECTRONICS, AERONAUTICAL WEAPONS, AUTOMOBILES.



# AIRCRAFT FERRYING~ WORLDWIDE

Any type . . . any distance. Light aircraft or commercial transports, propeller-driven or jet-qualified, experienced crews available to ferry them to any part of the world. Eagle Flying Services and Eagle Aircraft Services together possess long and varied experience of operating conditions and requirements worldwide. We can provide comprehensive services covering modification and equipment to ARB, FAA or other standards . . . installation of ferry tanks . . . fitting of avionics, radio and safety equipment . . . swift, economical, 100 per cent reliable ferrying to any destination you name.

## EAGLE FLYING SERVICES LIMITED

Leavesden Aerodrome, Watford, WD2 7BY.  
Tel: Garston 75233 Telex: 261502

## R. M. R. ENGINEERING

TRING · HERTS  
Telephone : 3338/9

## A.G.S. SUPPLIES

CONTRACTORS TO H.M.  
GOVERNMENT & LEADING  
AIRCRAFT CONSTRUCTORS

LEADING SUPPLIERS TO  
THE AIRCRAFT INDUSTRY  
OF A WIDE RANGE OF  
A.G.S. PIPE LINE COUPLINGS,  
UNIONS, BOLTS AND ROD  
END BEARINGS, SEVERAL  
HUNDRED IN NUMBER.  
WE CAN OFFER KEEN  
PRICES AND GOOD  
DELIVERIES, MANY FROM  
STOCK

C.I.A., A.R.B. and A.I.D.  
APPROVED



# AMBLA VYNIDE

Flame-resistant to aircraft specification

**Ambra A308F** for seating and arm-rests  
**Vynide V325F** for the top of the fuselage,  
side panels and backs of seats  
**Vynide V327F** for side panels  
and backs of seats  
**Vynide V6F** for seating and arm-rests

Users of flame-resistant 'Ambra' and 'Vynide', vinyl coated materials from I.C.I. include among others Aer Lingus, B.A.C., B.E.A., B.U.A., Hawker Siddelay, P.I.A., B.O.A.C., Kuwait Airways, M.E.A., Air Malawi, Caledonian, C.P.R., Gulf, Guyana.

Stocked by sole I.C.I. distributors to the aircraft industry:

## John Cox & Son Limited

Coxorian Works, Carlisle Road, London, N.W.9.

A.R.B. Approved.

'Ambra' and 'Vynide' are trade names of I.C.I. (Hyde).

## FARNBOROUGH

THE HIGHLIGHTS OF 26 SBAC SHOWS

Charles Sims

The story of the Farnborough Air Show is the story of the growth of an industry. The achievements of the past 40 years are recounted through the outstanding men, machines and ideas of each succeeding SBAC show, emphasising the event's prominence in the face of international competition and the British lead in aviation.

77 photos 45s

## ADAM & CHARLES BLACK



THE  
**TEAL**  
IS HERE

Thurston's safe simple amphibian makes  
a new dimension to sport flying

Details: DEMONSTRATION from SOLE AGENTS  
(excluding Scandinavia)

CASTLEMAIN (MARINE) Ltd., 6 SOUTH STREET, CHICHESTER, ENG.  
Tel: Chichester 87671 Grams: Marine, Chichester Telex: 86213



# BUY SUD - AVIATION ALOUETTE

**HELICOPTERS for  
SAFETY  
RELIABILITY  
ECONOMY**

In use in 60 Countries  
5-place or 7-place  
For executive travel or aerial work



*The 7 seater Alouette III*

For full information, UK Sales, call or write to:

**Helicopter Sales (Continental) Ltd.**

4 YEOMAN'S ROW - LONDON - SW3

Telephone: 01-589 6052 or 6076

Cables: ALOUETTE LONDON SW3

#### HELICOPTER CONSULTANTS

Charter contracts negotiated  
Contractors to HM Government  
Finance, training and  
insurance arranged



## T.M.A. Titanium is VITAL for V.S.T.O.L. ....

... like these forged compressor rings used in the Pegasus engine and also the forged and rolled titanium alloy bars supplied for the V.S.T.O.L. Harrier Fighter airframe and systems components.



**HIGH  
STRENGTH  
TITANIUM ALLOY  
HAND FORGED COMPRESSOR  
SPACER RING SET**

In fact Titanium is vital to progress and innovation in aero space technology.

T.M.A. have been manufacturing high quality forged and rolled Commercially Pure Titanium and Titanium Alloy products for almost 20 years. If you would like to know more about us, and about this versatile light, strong and corrosion

resistant metal, then write for our brochure on properties and forms to:

#### TITANIUM METAL & ALLOYS LTD



2 Metal Exchange Buildings,  
Leadenhall Avenue,  
LONDON EC3V 1LD.  
Tel: 01-626 4521

Works: Sheffield.



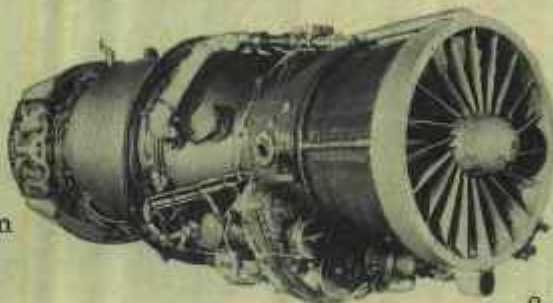
# New Castrol 325 is a significantly better aviation oil.

## But why take our word for it?

A new oil has been added to the range of Castrol aviation products. Castrol 325.

And already this new oil has earned unqualified approval from Rolls-Royce. They now recommend its use in all engines for which Castrol 3c is approved.

While retaining all the attractive features of Castrol 3c, 325 has certain distinct advantages.



In brief, it displays improved anti-wear characteristics, lower coking propensity, better high

temperature performance, and extended storage stability.

Castrol have a highly advanced range of aviation products, like Castrol 98 and Castrol 205 Gas Turbine lubricants, and Aerosafe 2300 fire resistant hydraulic fluid.

Products that are used by major airlines the world over.

And that's significant, isn't it?




**Castrol 325**

Write for further details of Castrol 325 to  
Aviation Dept., Castrol Limited, Burmah-Castrol  
House, Marylebone Rd. London N.W.1.

Name

Address





ILC, in association with Hamilton Standard—the makers of the PLSS—were able to begin making the complete LEVA suit, together with the fireproofing requirements; incorporating all the lunar exploration needs as well as ILC's latest developments.

The lunar-walking spacemen wear integrated thermal micro-meteoroid (ITMG) garments to provide fireproofing and to give protection against radiation and withstand small particles that could puncture a thinner suit and kill the occupant within seconds through lack of oxygen.

Beneath the ITMG comes the PGA which, coupled with the PLSS, provides the necessary ventilation, pressurisation and communications functions independent of the spacecraft on the surface of the Moon—or in space for planned EVA's or an emergency. The PGA basically consists of the same layers as the CMP's suit but beneath the lunar-walker's suits are liquid-cooled garments in place of the CMP's constant-wear garment. This LCG is made of an elastic nylon material which supports a network of tubing through which cooled water flows to keep the astronaut comfortable.

To improve the flexibility and to accommodate body movements special convoluted bellows have been incorporated at the joints of the shoulders, elbows, wrists, thighs, knees and ankles. These convolutes, not included on the Gemini and Mercury suits, reduce the effort required to move joints, a problem that can be easily demonstrated by bending an inflated sausage balloon.

A gold-plated visor to reflect the heat and radiation, and thick enough to be impenetrable by micro-particles make up, with thermal boots and gloves, the remaining parts of the LEVA suit. White outer visors over the forehead and ears can be pulled over the eyes to provide extra sun shielding. Although not used by Armstrong and Aldrin, the two ear shields were used by Conrad and Bean during the Apollo 12 EVA. The forehead shield was incorporated in the suits that were to have been worn by the Apollo 13 lunar-walking crew. Also to be used for the first time on this ill-fated flight were internal drinking containers. These were included on recommendation from the Apollo 12 crew whose only discomfort while walking on the Ocean of Storms, so they said, was thirst.

#### US-ITALIAN LAUNCH AGREEMENT

Italy is to launch American satellites under a contract between Nasa and the Aerospace Research Centre, SRA, of Rome University. The contract, implementing a memorandum of understanding signed in February of last year, will offer use of Italy's San Marco launch platform in the Indian Ocean.

The initial launch is planned for late November or early December of this year, the first by a foreign country of a US satellite. To date, such a situation has always taken place in reverse, but San Marco is ideally sited for placing satellites into equatorial orbit. This will enable Nasa to use the \$14 million Scout launcher instead of the considerably larger \$44 million Delta rocket.

The Italians will assemble, test and launch the US supplied rockets and satellites, and will provide some tracking and data collecting services. Nasa reimbursement for the first launch will be \$546,000, £227,500.

The launch site resembles an offshore oil drilling platform with a separate control platform nearby. It is positioned in Formosa Bay, 3 miles off the coast of Kenya, and about 2½° South of the Equator. The Italian launch team has received considerable training at Nasa's Wallops Island base, during which a satellite was successfully orbited in 1964. A second was launched from San Marco in 1967.

The inaugural firing will be the first in a group of three, and will carry one of a series of Small Astronomical Satellites, SAS-A. This 320lb satellite, costing about \$9 million, £3½ million, should spend at least six months in a 330 mile, 528km,

circular orbit, during which time it will slowly rotate in order to scan the entire sky. Complete coverage would be achieved every six weeks. A primary task would be to map celestial X-ray sources for detailed observations, probably by another SAS in 1972.

SAS-B will be the payload of the third launch, late in 1971, and this will study celestial gamma ray sources. Nasa is attaching some importance to this mission because of recent discoveries of high energy gamma rays in the Milky Way. These two spacecraft are unique in that each contains an independent, separately built, research instrument section which is fitted to a common system of mission support equipment.

A Small Scientific Satellite (SSS) will be placed in orbit during the spring of 1971 by the second firing of the series. It will measure space phenomena such as aurorae, magnetic storms, and electric current and acceleration of charged particles in the Earth's magnetosphere.

#### CLOUD CLEANING

Experiments to trigger off the lightning in potential thunderheads are being carried out by Nasa in conjunction with the US Environmental Science Services Administration, Essa, in a project named Mighty Mouse.

During a six week period, beginning last week, 175 modified aircraft rockets will be fired into electrically charged clouds over Cape Kennedy. Each of the 5ft rockets will carry an aluminium sphere of three to five inches in diameter. Static electricity should build up in the sphere and eventually generate a bolt of lightning. Rockets will be fired into each cloud until it is totally de-charged.

The project is the direct result of a lightning strike received by the Apollo 12 rocket just after lift-off. The spaceship was reportedly responsible for the strike which momentarily knocked out the power in the command module.

#### SPACE AWARD

The Soviet Cosmonauts Andrian Nikolayev and Vitali Sevastianov are to receive the Daniel and Florence Guggenheim International Astronautics Award for 1970.

The announcement was made by Dr C. Stark Draper, President of the International Academy of Astronautics. The Award is given each year by the Academy to individuals who have made an outstanding contribution to space research and exploration through work done in the preceding five years. The Award is accompanied by a stipend of \$1,000.

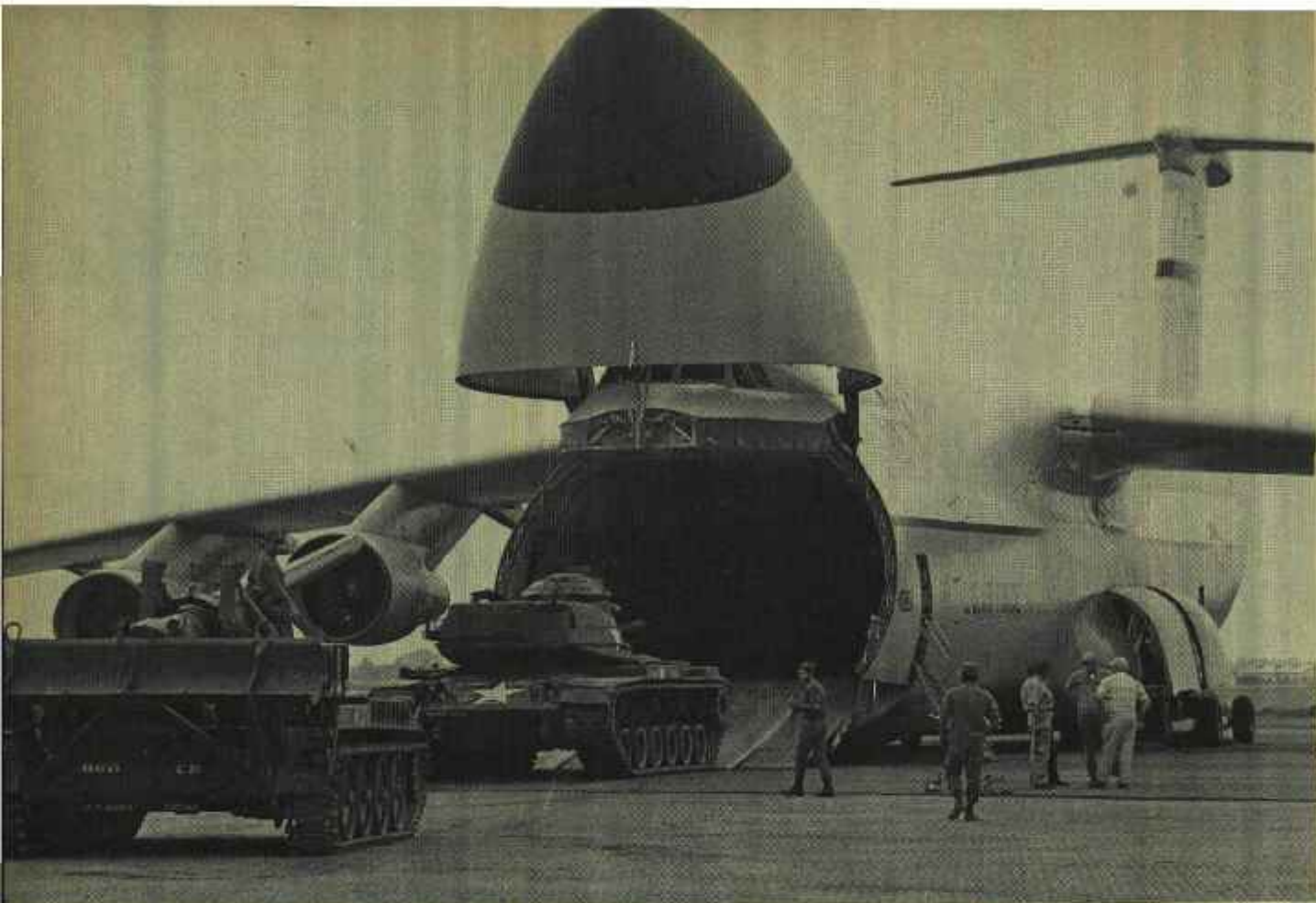
Experiments performed during the flight of Soyuz 9, lasting 17 days and 17 hours, in June 1970 constitute a milestone in manned space flight. The medico-biological results obtained are particularly valuable for research on the effects of space conditions on the human organism. The mission accomplished by Nikolayev and Sevastianov included experiments with manual and automatic navigation methods and systems for the orientation and stabilisation of the spacecraft; scientific geological and geographical observations and photography of land and water surfaces of the Earth; observations and studies of atmospheric formations of the snow and glacial layer of the Earth, and scientific studies of the physical characteristics, phenomena and processes in circumterrestrial space.

The first Award was made in 1961 to Sir Bernard Lovell (UK), and in the succeeding years to Dr J. A. Van Allen (USA), Professor Marcel Nicolet (Belgium), Dr W. O. Fenn (USA), Professor Matyslav V. Keldysh (USSR), Dr Robert R. Gilruth (USA), Professor J. E. Blamont (France), Professor Zdeněk Světlík (Czechoslovakia), and Dr Charles A. Berry (USA).

#### GOVE SALE

The Eldo Tracking Station at Gove, Australia, is to be auctioned on October 20. The station is used for tracking Eldo, British and some US rocket launches. However, because of the high maintenance costs of Woomera, Eldo is to carry out all future launches from French Guiana, leaving the limited Black Arrow programme as sole user. If Britain continues to maintain Woomera independently, which it appears to be doing at present, it would probably have to build its own tracking station or rely totally on some other independent system.





**DEFENCE**

## The Missile Balance

WITH CONTINUED DEPLOYMENT of SS.9 intercontinental ballistic missiles, the Soviet Union now has superiority in land-based ICBMs. As reported in *Flight* last week (page 381), Russia recently launched two SS.11 ICBMs from a site on the Russian mainland into the Pacific Ocean and each of these missiles detached three components which fell into the sea separately. The Soviet Union has additionally flown an SS.13 ICBM. News of this flight was given by the US Secretary of Defence, Mr Melvin R. Laird, at a press conference on August 26. The SS.13 is similar to the American Minuteman. The missile flown landed in a Pacific target area 575 miles, 925km, north-west of Midway Island. Mr Laird declined to give any further details about this test. Prior to the double SS.11 firing, the Soviet firings of multiple re-entry vehicles had all been conducted with the SS.9. The latest version of the Minuteman, Minuteman 3, carries a

multiple independently targetable re-entry vehicle (MIRV) warhead and the first ten of these weapons were deployed in June of this year.

Mr Laird said that the multiple vehicles of the S.11 firing were the first seen with that system, and commented: "If they deploy this kind of object and if it does have three weapons, it would accelerate the Russian number of targetable warheads by three times. We know they have well over 700 SS.11s in being." He declined to speculate as to whether the triple payloads put up by the SS.11s were actually weapons or experimental rockets, or whether they could be guided towards separate targets. He said that the DoD was still busy studying information gathered during the flights and at the target area, where a US Navy ship watched three objects from each ICBM plunge into the sea.

The continued Soviet deployment of SS.9s and Russian superiority in land-

*Warload for a C-5A Galaxy: a US Army main battle tank (105,500lb, 48,000kg) and a 175mm self-propelled gun (61,200lb, 28,000kg) which showed at a Pope AFB/Fort Bragg, NC, demonstration that the aircraft can load and fly ordnance which up till now has had to be deployed by slow surface methods*

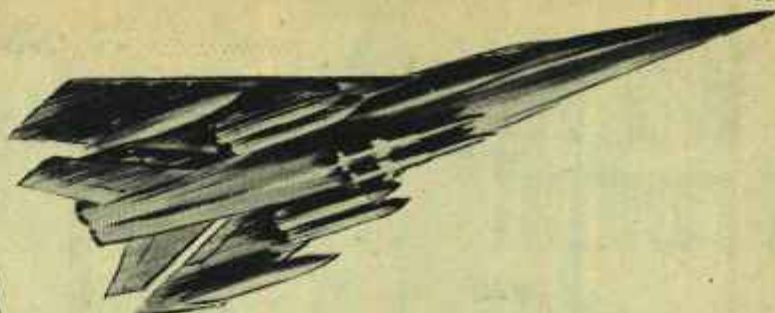
based ICBMs is referred to in *The Military Balance 1970-71*,\* issued last week by the Institute of Strategic Studies. In its summary of the current ICBM situation, the Institute says: "The Soviet Union has continued to deploy the 20-25 megaton SS.9 ICBM and now has 240 operational: a three-warhead system has been tested and may now be available for them. Soviet land-based ICBMs now outnumber those of the United States by 246 and construction of Soviet Y-class ballistic missile nuclear submarines is at the rate of 5-10 a year. But the United States has gone into a new technical era with multiple independently targetable re-entry vehicles (MIRVs). It has started to deploy a three-warhead system on the powerful Minuteman 3. It is converting submarines to take the Poseidon ten-warhead MIRV, now being tested and scheduled to become operational in January 1971. It thus promises to increase its warhead

\*The Institute for Strategic Studies, 18 Adam Street, London WC2N 6AL; 13s or \$2.50, post free.



SBAC EXHIBITION 1970

**Stand 17**  
OUTSIDE EQUIPMENT  
DISPLAY M



*See the latest developments  
in weapon loading, carriage & release -*

## ML AVIATION COMPANY LIMITED

White Waltham Aerodrome, Maidenhead, Berkshire, England.

ALSO ON DISPLAY: M.L. Mu-Meter Runway Friction Recorder, Aircraft Handlers,  
Air Transportable Trolleys, High Speed Helmet Assemblies, Automatic Electrical  
Test Sets, Solid State Auto Selectors, Flexible Moulded Cable Systems

Tel: Littlewick Green 3361

Telex: 84568

# Corrosion!

**PLUS-GAS.**

has helped industry for  
30 years. Do *you* know the  
full range of our products?  
Consult the Anti-corrosion  
Specialists on *your* corrosion  
problem.

Write to:  
**PLUS GAS COMPANY LTD.,**  
Stirling Road, Acton, London W.3

Telephone: 01-992 0093/7.

Telegrams and Cables: Abfluids, London W.3.

Telex: 261509.





# We've got around



# to some square thinking.

**( JUST FOR THE RECORD )**

*½ ATR 01-01-1 in compliance  
with ARINC 573 now in  
production for Air Canada's  
Lockheed Tristar and  
Boeing 747 aircraft*



Thinking two years ahead is something we take in our stride, in producing our new Flight Data Recorder 01-01-1 in compliance with ARINC 573 in ½ ATR format, utilising the latest technological advance in composite plastic material.

Manufacturers of Process Monitors, Digital Probes and the proven complete 3RB Data FDR system.

## AIRCRAFT SUPPLIES LIMITED

506 WALLISDOWN ROAD  
BOURNEMOUTH  
HANTS

Tel: Bournemouth 52511  
Telex: 41236



See us on  
Stand 53

SBAC Show  
FARNBOROUGH

## C. J. FOX & SONS LTD

FOR THE AEROSPACE INDUSTRY

Sole UK  
Distributors of  
**Briles Mfg. Div.**  
**of Omark Industries**

Sole UK  
Distributors of  
**Hartwell Corp. Inc.**

Sole UK  
Selling Agents for  
**Kaynar Mfg. Co.**  
Selling Agents for  
**the Parker Seal  
Co. Inc.**

## NOTICE

We would be pleased if you would  
note that our new address is:

**130 Preston Drove**  
**Preston Park**  
**Brighton Sussex. BN1 6FJ**  
**Tel: Brighton 500277/8**  
**Telex: 87642 Answer back**  
**"Eyebolts Brton"**

## C. J. FOX & SONS LTD





lead over the Soviet Union. Soviet armed forces and defence spending go slowly up; in the United States expenditure has gone down from some \$79,800 million in 1969 to \$74,000 million in 1970 and is planned to fall further still."

On August 31 the DoD announced that the US Army had successfully intercepted a missile for the first time with its Safeguard anti-ballistic missile system. The Assistant Defence Secretary, Mr Daniel Z. Henkin, said that a target Minuteman missile was launched from Vandenberg AFB, Calif, and a Spartan missile, part of the ABM complex, was fired from Kwajalein Atoll, 4,200 miles (6,760 km) away in mid-Pacific. The Minuteman nose-cone was intercepted outside the Earth's atmosphere, Mr Henkin said, but he would not state at what altitude this occurred. Neither the Spartan nor the Minuteman launched carried explosive warheads. The successful interception was determined by ground instrumentation which calculated that the Spartan's final stage, which operationally would carry a nuclear warhead, passed close enough to the Minuteman target to have caused its destruction.

The Safeguard system uses two missiles: the 55ft-long, 16.7m Spartan has a range of several hundred miles and is the primary rocket for intercepting enemy ICBMs. The 27ft-long, 8.2m Sprint has a range of 25 miles, 40km and is designed to intercept enemy missiles that elude the Spartans. The Sprint has not yet been tested against a live missile. The US Army had previously tested the Spartan by aiming it at points in the sky: the recent successful interception was the first time it was actually fired at an incoming missile.

In April of this year, the Army released statistics showing that fewer than 60 per cent of these two types tested until then had been completely

successful. The Spartan had been launched from Kwajalein Atoll 15 times—11 of these launches being completely successful, two partially successful and two of them failures.

The Sprint had been launched 38 times from the White Sands missile range in New Mexico, 19 of these launches being completely successful, nine of them partially successful and ten of them failures.

By "partially successful" the Army meant the ABM had completed some of its test objectives. However, none of the partially successful ABMs would have been capable of intercepting an enemy missile.

The ICBM balance between the Soviet Union and the United States is one of the main themes of the new issue of *The Military Balance*, and at a Press conference last Thursday, September 3, the director of the ISS, Mr François Duchene, said that as a broad distinction the USSR had over the past year ("cut-off time" for preparation of the annual

*Danish Draken: one of the 46 Saab 35 Drakens for the RDAF, the first of which have now been delivered (see news item on page 426)*

booklet is July 1) multiplied its delivery vehicles, while the United States had been multiplying warheads with the development of MIRV—for example Minuteman 3 with three warheads. He commented that the USA had taken "a qualitative leap" into the era of the MIRV (multiple independently targeted re-entry vehicles). In the seaborne sector of the nuclear deterrent forces, Polaris, he commented, had posed "an extraordinary problem" for the Russians.

This parallel increase in missile power on both sides has taken place against the background of the Salt (strategic arms limitation) talks which were recently adjourned in Vienna and are due to be resumed at Helsinki in October.



*Harriers for RAF Germany: a line-up at Wittering of No 4 Sqn aircraft—bearing the squadron's insignia—before they left for Wildenrath*







## DEFENCE

## Canada's Surplus CF-5s

A TOTAL OF 74 new Canadair CF-5s for the Canadian Armed Forces, part of an order for 115 placed four years ago, are to go into storage as soon as they are built because they are surplus to CAF requirements. One Canadian newspaper correspondent has described this dead-end production as "a bizarre testament to the vagaries of defence procurement."

The reason for the decision not to put these additional CF-5s into service is, according to a Canadian Government explanation, that defence requirements have now changed.

Up to now a total of 41 CF-5s have gone into service with two squadrons (433 at Bagotville, Que. and 434 at Cold Lake, Alta) and with the Armed Forces Engineering Test Establishment at Uplands, near Ottawa.

By the beginning of this year the CAF had all the CF-5s it could handle or needed, but the Defence Department was committed to its contract with Canadair and continued to accept the aircraft, which were inhibited as soon as they came off the production line. About 20 of these CF-5s will be held in reserve to supplement operational losses, but there is an uncertain future for the remaining 54. They might be sold to other Nato air forces or assigned to the three squadrons of the Canadian Air Wing in Germany, or they could be scrapped.

The CF-5s were originally ordered in 1966 on the basis of requirements outlined in the Government's Defence White Paper of 1964 when the CF-5—Canadian-built version of the Northrop F-5 Freedom Fighter—was considered to be ideal for Canada's peace-keeping

role in the 1970s. However, under the administration of Prime Minister Pierre Trudeau, a review of foreign and defence policy has taken place which has given Canadian peace-keeping a low priority and Canada is reducing its Nato commitments. Among the resulting changes the number of CF-5s to be put into service was reduced from four squadrons—three operational and one training squadron—to two—one training squadron (at Cold Lake) and one operational squadron (at Bagotville).

Canadair is also supplying NF-5s, a version of the CF-5, to the Royal Netherlands Air Force, which has not reportedly shown any interest in the surplus Canadian CF-5s.

## Phantoms for Israel

DELIVERIES OF McDonnell Douglas F-4 Phantoms to Israel are being continued by the United States to maintain a balance of power in the Middle East area. The US Defence Secretary, Mr. Melvin Laird, said at a Press conference in the Pentagon last week that the original US-Israeli agreement, made during President Johnson's administration, was ambiguous as to whether the United States would replace fighters lost in combat with Egypt. But Mr. Laird said that the United States had maintained the commitment it had made and had not "backed away from" the commitment it had to maintain a balance in the area.

In 1968, President Johnson agreed to sell 50 Phantoms to Israel and about four were delivered each month; Mr. Laird said that these aircraft had not been fully delivered when the cease-fire proposal was made, adding: "I think it was understood that those commitments would be met."

Officially, the United States, in the person of President Nixon, has refused to discuss these arms deliveries since early this year or to respond officially to Israel's request for 25 more Phantoms and 100 more Skyhawks.

## Denmark's Draken Deliveries

FIRST THREE of the 46 Saab 35 Drakens ordered by the Royal Danish Air Force landed at the RDAF base at Karup in Jutland on schedule on September 1; they were flown in from Linköping by Danish AF pilots who have been under-

going training in Sweden, and were received by the chief of the RDAF, Maj-Gen Nils Holst-Sverensen.

Denmark's Draken orders were placed with Saab in March and July 1968 and include one squadron (20 aircraft) of F-35 fighter-bombers, one squadron (20 aircraft) of FR-35 fighter-reconnaissance versions and six TF-35 two-seat trainers. The Danish Drakens differ from their Swedish counterparts mainly in having increased internal fuel, larger weapon-carrying capability (9,000lb of external stores), new avionics and an arrestor hook.

## Spain's Phantoms

SPAIN'S DEFENCE AGREEMENT with the United States, under which the latter retains the right to the Polaris submarine base at Rota and air bases at Saragossa and Torrejon for another five years, and in return for which Spain is getting various forms of aid and military equipment, has received an official Spanish welcome in the publicity organ *Spain Today*.

In its August 24 issue the visit by Sr. Lopez Bravo, the Foreign Minister, to Washington to sign this new Spanish-US defence pact (a journey which was kept highly secret at the time) is recalled: it took place on August 6 and the US signatory was Mr. Rogers, Secretary of State.

Under the terms of the new pact the United States is lending Spain about £50 million to buy military equipment, including 36 Phantoms and an unspecified number of transport aircraft. The Spanish Air Force and Army are both being supplied with helicopters, while the Navy will receive about 14 surface ships and two submarines.

## Australia's Turana

A SMALL TURBOJET-POWERED target aircraft called the Turana is being developed by the Australian Department of Supply for use by the Royal Australian Navy, deliveries to whom are due to begin in mid-1971. Turana is being developed on the basis of the Ikara anti-submarine guided missile system, plus experience in manufacture of the Jindivik target drone. Production will be undertaken by the Government Aircraft factories. Turana will be powered by a Microturbo Cougar turbojet and its rocket boost motor is being designed and manufactured in Australia.

## Marconi Radar for Argentine Navy

THE TWO Type 42 destroyers recently ordered by the Argentine Navy will be fitted with target tracking radars by Marconi under a £3 million-plus contract awarded to the company. It is the first export order received for this radar, the Type 909, which is possibly the most advanced of its type in the world. Each ship will have two such systems, which will be used in conjunction with Hawker Siddeley Dynamics' Sea Dart missiles; they will automatically acquire and track targets and illuminate them for the semi-passive homing system of the Sea Darts. Both ships will be operational by the mid-1970s.

RAF Strike Command's Blue Steel air-to-surface missile with which its Vulcans are armed. This example was seen making a rare public appearance at Chivenor's recent open day







# Straight and Level



**R**OLLO FREELUNCH and I arranged to meet at 9 o'clock on the Scruggs stand, in front of the sixth brochure cupboard from the left, on the opening morning of the show. There was, he said, something he particularly wanted to tell me.

To avoid being sidetracked on my way through the exhibition hall I wore my new baseball hat pulled down well over my ears.

I arrived on time. No sign of the great man. "I think you will find him in the company chalet," vouchsafed a young woman almost as beautiful as the girls on the *Flight* stand.

In the chalet they thought he was in the Press Tent and in the Press Tent they thought he was on the stand.

When I got back I was amazed to find the entire aeronautical press of the world assembled in front of the sixth brochure cupboard from the left. As I approached there was a deafening roar, the stand parted, and the world's aeronautical press disappeared from sight in a ball of orange flame.

The door of the brochure cupboard opened and out stepped Rollo. He pressed a button on his mauve shirt. Within seconds electronically actuated



Watch it lads or they'll be wanting that Queen's Award back

rams supplied by Scruggs Total Aerospace Systems Capability Ltd moved everything back into place.

I discarded my disguise. "Sorry I'm late, Rollo—they told me you were at the chalet but when I got there . . .

"—My dear Brian, think nothing of

it. I want you to meet our Total Aerospace Systems Capability marketing director. Follow me."

"The name's Roger."

"—Terribly sorry, dear boy. Now this is absolutely exclusive to you, Ronnie. What was the name of your paper again?"

"The Times", September 2

"Daily Mail", September 2

Concorde  
'thunder  
crack' at  
1,140 mph

By ARTHUR REED,  
Air Correspondent

Boom?  
No, just  
pop  
pop!

Thank you, I had a delightful week on the beach . . . (Benoist Hydro-biplane stuck on a river bank between Omaha and New Orleans, 1913. The pilot was Anthony Jannus)



● Sorry Grandad, there isn't a New Types Park. You're thinking of when the SBAC show was at Hendon, in the thirties or whenever it was. Those were the days when they designed, built and flew a new prototype in six weeks at a cost of less than £10,000. Now it takes six years and £10 million just to write a specification and the old experimental departments are full of mock-ups.

Today the New Types Park is in the exhibition hall, on the stands of the equipment manufacturers. That's where the exciting progress takes place now. But a black box just hasn't got the glamour of, for instance, the prototype Bulldog . . .

—Speak up laddie, I can't hear you—there's something flying over. . . . Gad! It's the prototype Bulldog! Or should we say Highland Terrier now?

● That Welsh bloke says that the proposal to transfer routes is "non-negotiable." Dead right it's non-negotiable. The elected Government of this country has said that's the way it's going to be, and that is that, look you.

"I'll knock his leek about his pate, upon St Davy's day" (*Pistol*, Henry V Act IV Scene I).

Roger Bacon



# FLIGHT

INTERNATIONAL

**PRESS DAY**—Classified Advertisements "copy" should reach Head Office by **FIRST POST THURSDAY** for publication in the following week's issue subject to space being available

## CLASSIFIED ADVERTISEMENTS

Advertisement Rates 2/6 (12sp.) per word, minimum £1.00. (£1.50). Paragraph is charged separately, name and address must be counted. Semi-display advertisements £9.10.0 (£9.50) per inch depth. All advertisements together with remittance should be addressed to **FLIGHT International Classified Advertisements Dept.**, Dorset House, Stamford Street, London, S.E.1. Telephone 01-928 3333. Telegrams/Telex Blasspres Ldn, 25137.

Postal Orders and cheques sent in payment for advertisements should be made payable to **FLIGHT International**, and crossed "A. Co."

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers For the convenience of private advertisers, Box Number facilities are available at an additional charge of 2 words plus 1/- extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to Box 0000, c/o **FLIGHT International**, Dorset House, Stamford Street, London, S.E.1.

The Publishers retain the right to refuse or withdraw advertisements at their discretion and do not accept liability for delay in publication or for clerical or printer's errors although every care is taken to avoid mistakes.



## Aircraft For Sale

**MOONEY 20A.** Four seats, retractable, C of A until 1971. Full panel. VHF/VOR/ADF. Macross auto-pilot. £1,550. Any car or plane taken in part-exchange. Phone Terry Stewart, 01-952 4111. [0222]

**CHEROKEE 140.** New C of A. 4-seater, 2 years old, fully equipped; 2 VOR/ILS/ADF, 2 VHF Receivers. Glideslope, 2 Altimeters, in first-class condition. Offers to Cun-Mech Engineers Ltd, Poynton Road, Sheerwater, Woking, Surrey, Woking 4024. [0137]

**BEAGLE PUP 130** for Sale. Delivered early 1969. 300hr only, C of A Jan. 1971. Every optional extra, including VOR/ILS/ADF/VHF, Transceiver and Glideslope, 4 seats, and long-range tanks. £7,750. Leading facilities can be arranged. Apply Box 1937/9. [0126]

**CESSNA 441B.** 1968. 700hr left on engine. Cessna Nav/Com 300 radio, gyros, lights, corrosion proofing, etc. Club C of A till July '73. £4,000.—Westair Flying Services Ltd, Blackpool Airport, Tel: Blackpool 42860. [1833]

**CESSNA 172.** 100hr total time, new three-year C of A. Airways radio, like new, £7,950. **HELICOPTER.** Hiller 12B. Excellent condition. Very recent C of A. radio, lots of life. £8,750. **GEN-AVIA LTD,** Alexandra House, Guildford, Surrey. Phone Guildford 60061. [0261]

**NEW 1970 CESSNA ROCKET.** Would consider part-exchange. Fuel inject., 5 cyl. 210 h.p. full airways equip. 2 Nav/Com., GND., LOC, marker, ADF/PO. 3-year C of A. £13,400. Telephone Haslemere 3971. [0370]

**CHEROKEE 180C.** 404hr TT, new C of A, two 360-channel VHF, two VOR/LOC, one ADF, STOL, marker receiver, two altimeters and heated pilot. Condition as new. £7,500 o.n.o. Tel: Biggin Hill 4132. [0763]

**AUSTER D.6.** 480hr TT, new C of A, 180 Lycoming, one 360-channel VHF, two VOR/LOC, one ADF, STOL, performance, 4-seater. Beautiful condition. £3,500 o.n.o. Tel Biggin Hill 4132. [0763]

FOR a really top-grade Tiger Moth with new 3-year C of A, electric intercom, blind flying panel and glider hook all for £1,100 or offer, contact Seales 3125 or Lowestoft 61809. [1739]

**1966 CESSNA 172.** Public Transport C of A June 1971. 360 VHF/VOR, total time 1,080hr. 120hr remaining on engine. Beautiful condition. £8,975 o.n.o. North Norfolk Timber & Building Co Ltd, Mill Lane, Pothorpe, Norwich. Tel: Hevingham 285. [1743]

£2,000 buys you a go-anywhere plane, fitted with VHF 1 and 2, VOR/ADF. For further details of Cessna 175, ARMIN ring Seales 3125 or Lowestoft 61809. [1738]

**BEAGLE AIREDALE O-ASWF.** £2,725 o.n.o. C of A 1971. VHF/VOR/ADF. 470hr. Maintained regardless of cost. Owner has twin. Apply E. A. Pritchard, 41 Queen Street, London EC4. [1758]

**CESSNA 310.** 1956. A/F 1,550hr. Check 2 recently completed. 1,300hr to run to next Check 4. Engines and props have 800hr to run. 2 VHF, 2 VOR, 2 ILS, 2 G/S, 2 ADF and 2 AX18 A/F. Spares include zero time engine. £9,500. Tel: 0102 43010. Telex 96343. [0250]

**STAMPE SV4C.** 1949. Low hours, fully modified, radio, starter, immaculate condition. Price £1,200. **JODEL D-115.** 1959. Total time 900hr. VHF, new permit. Price £1,250. Air Navigation & Trading Co Ltd, Blackpool Airport, Blackpool. Tel No. 0253 45398. [1746]

**NEW AIRCRAFT** at £2,300? Beagle Terrier just completed by Aircat Ltd, Coventry. 165 hours, full panel, dual control. All electric. Must be marvellous value. Contact Mr Hancock, Coventry 301802. [1794]



## SHACKLETON AVIATION LTD. ESTABLISHED 1930

International DEALERS. THE LARGEST AND BEST KNOWN AIRCRAFT DEALERS IN THE WORLD

Full Financial Valuations

SHACKLETON'S COVER THE WHOLE AIRCRAFT MARKET, SELLING PRIVATE AIRCRAFT FROM £500 TO TRANSPORT AIRCRAFT OF SEVERAL MILLION DOLLARS

FINANCE AVAILABLE ON ALL EXECUTIVE AND LIGHT AIRCRAFT

Fly above the weather swiftly and economically

Pressurized Prop-Jet Executive Aircraft immediately available. Only 700 hours since new, 7 passenger seats. Radar and full airways equipment. Full finance available on direct purchase or lease purchase. As new condition.

Brantley 305 Helicopter, 5 seats. Only 304 hours flown on airframe. New C of A. VHF/VOR/ILS ADF. In very good order. £13,000.

Beagle 206. Executive configuration. Public Transport C of A. Full de-icing system. Dual instrumentation. Sperry Autopilot. RMI. Full Arc Radio Station, VHF/VOR/ILS, ADF Markers, Elliot intercom. Engine TSO's 326, and 129 hours. Owned by a leading manufacturing company in England and is in very good order. £25,000.

Piper Twin Comanche, 4 seats. Private or Public C of A. Exterior pale blue and navy. Engine time since overhaul 490 hours only. Dual controls. Airways equipment. 3 axis auto-pilot. Really good Twin Comanche in excellent order throughout. £10,950.

OUR NEW SHOWROOM IS NOW AT COVENTRY AIRPORT.

### WE PROVIDE FINANCE ON TRANSPORT AIRCRAFT REGARDLESS OF WHERE THEY ARE PURCHASED

Our specialists will produce individual schemes to suit your particular airline. Transport aircraft immediately available:

DC 8-33 1 Passenger aircraft plus two spare engines. \$1,000,000 U.S.

Boeing 707-320 C. 1 Pass/Cargo aircraft. \$6,750,000 U.S.

B707-321 Passenger aircraft. \$2,453,000 U.S.

B707-321 F. Pass/Cargo Aircraft. \$3,163,000 U.S. each.

B720 Passenger aircraft. Price subject to configuration.

B720 B. Passenger aircraft. Price subject to configuration.

B727-21 Passenger aircraft. \$2,300,000 U.S. each.

BAC-1-11 400 Series Passenger aircraft. \$2,300,000 U.S. each.

Britannia. Three 300 Series Passenger aircraft. Two 100 Passenger aircraft. One 312F. Series.

Pass/Cargo aircraft.

### SPARES

available on BAC 1-11, Britannia & Boeing 707

### WANTED

### TWO H.S. 748 AIRCRAFT

Specifications and price should be sent to Head Office.

### REASONABLY PRICED AIRCRAFT AT PRESENT IN OUR SHOWROOMS. FOR CLUBS OR PRIVATE USE

Jodel D.9. Built 1970. One seat. Cream and blue. Current Permit to Fly. As new. £1,650.

Falco FBL. Red. 2 seats plus child's. Private C of A until June 1971. Retractable undercarriage. Fully aerobatic. VHF Becker 380-Channel 50 km. ADF. In very good order throughout. £3,950.

Nipper Mk. III. One seat only. 75 hours flown total. Current Permit to Fly. Immaculate. £1,375.

Cessna 150. 1 hour 50 minutes flown only. Individual buffet seats. Omni-flashing beacon. Corrosion proofed. £5,600.

Meta Sokol. 4 seats. White and blue. Supercharged engine—TSO 300 hours. Current C of A. Retractable undercarriage. VHF Murphy MR 80. A sportsman's aircraft. £2,750.

Piper Colt. 2 seats. White and blue. Engine TSO 493 hours. Dual controls. Blind flying panel. VHF. In very good condition. £1,975.

Cessna 172M. Only 185 hours since new. Private C of A until 1971. Retracting beacon. VHF/VOR/ILS Cessna 300. VHF/VOR 2 Arc RT 540A. Cessna ADF. Markers. This aircraft is as new. £7,950.

Auster J.50. Large model—carries four people. Engine TSO 285 hours. VHF. Glider towing hook. In good order. Only £950.

Also in Stocks—Beagle Terrier, Nord, Austers, Ercoupe, 2 Embruders, Mooney Mk. 20A, Bolkow Junior, Cessna 172G, Taylor Monoplane, 2 Cessna 150s, Hello Courier, Jodel DR 1051, Chipmunk, Fournier RF40, Jodel 140B, Tiger Moth.

Part Exchange Scheme

Head office 170-3 PICCADILLY, LONDON W.1. Tel 01-493 2448 Telex 263975



# FOR SALE



## BARON B55

A 1964 model just traded in against a Duke. Only 75 hours since new. Full airways radio with dual ILS Receivers, full dual controls including brakes, six seats, three-blade de-iced propellers, 3-axis auto-pilot, long range tanks. New Private C of A. **£16,500**

## BARON B55

A 1964 model shortly to be traded in against a new Baron 58. Company owned and maintained to Transport Category standards. Airways radio, full de-icing, six seats, long range tanks, full dual controls including brakes. H-14 autopilot with ILS coupler. One zero time engine. **£19,950**

## MUSKETEER CUSTOM III

Only 200 hours since new in 1968. Powered by the 165 hp. fuel injected engine. 360 ch. VHF, VOR, ADF. Two cabin doors and a host of other extras. C of A expires May 1972. Outstanding condition. **£8,500**

SOLE DISTRIBUTORS



SALES AND SERVICE



ROLLS-ROYCE  
CONTINENTAL  
SERVICE CENTRE  
PARTS - SERVICE - SALES

**EAGLE  
AIRCRAFT  
SERVICES**

Contact: A. Paston-Williams,  
Eagle Aircraft Services Ltd.,  
Leavesden Aerodrome,  
Watford, WD2 7BY.  
Tel: Garston 75233



## QUEEN AIR B80

Built 1968. One corporate owner since new and just traded in against a King B90. Based in the West Indies and maintained to ARB standards. Comprehensively equipped including Collins avionics with dual ILS, dual ADF, AVG-55 radar, Sunair SSB HF, Oxygen etc. Executive interior with couch and individual seats, toilet and bar. Immediate delivery. **£125,000**

## RILEY DOVE

Built 1960 and now with the Riley conversion. The 400 hp. Lycoming engines have run only 200 hours ssn. Three-blade propellers. Full airways radio plus space for Decca. De-icing with nylon piping. Executive interior with six seats, toilet and wash basin. The cabin features double paned windows and Southwind cabin heater. New Private C of A. **£14,500**

## VICTA AIRTOURER 115

The strongest and most proven aircraft in its class. Fully aerobatic +9-4 G. Powered by the larger 115 hp. engine for even more exciting performance. Nearly 1400 hours remaining on the engine. C of A expires March 1972. Fully equipped including 360 ch. VHF, VOR. Privately owned and flown. **£4,250**

## UNIQUE EXECUTIVE JET

D.C.9 Series 10 executive equipped with  
24 luxury armchairs and couches.

Only 850 hours total time since new.

Full non-stop transatlantic range.

Offered for lease at **£25,000** per month or outright sale



## TEMPLEWOOD AVIATION LTD.

AIRCRAFT LEASING AND SELLING SPECIALISTS

3 HIGH STREET, WINDSOR, BERKSHIRE, ENGLAND.

Telephone: WINDSOR 66811/66812 Telex: 84518 Cables: Tempair, Windsor.

**Rogers  
Sales and  
Service**

## Aircraft of the week PIPER TWIN COMANCHE

1964 Model; 1770 hours Total Time; Engines 950 hours left; Props 450 hours left; Two King 360 channel VHF; One King VOR/ILS with Glideslope; Bendix T12-B ADF; KR-20 3-light Marker; Full Panel; Night Flying Equipment; Dual Controls; Autocontrol II Autopilot.

**£10,950**

Call Mary Pike at Bedford 62441 for full specification.



ROLLS-ROYCE  
CONTINENTAL  
SERVICE  
CENTRE



ROGERS AVIATION LIMITED

Great Barford, Bedford. Tel: Bedford 62441. Telex: 82217



## AIRCRAFT FOR SALE

QUARTER SHARES available in Mooney 20A. Four-seat, retractable, well equipped. £1,000 per share. Call Terry Stewart at 01-953 6171. [1837]

## WEBSTER AVIATION LTD OFFER

ARTEC C 1907 TT 600 hr. Full IFR with DME and Transponder. Airframe/prop deicing. Heated windshield. Altimatic III with couplers. Oxygen. Stereo tape installation. New C of A. £26,500.

TURBO TWIN COMANCHE B 1966 TT 700hr. Full IFR with DME. Additional ADF.3 Axis A/P with couplers. Tip tanks. Oxygen. £21,500.

CEMINI Carus 2 engines. Murphy VHF. Dual controls. New C of A. Wings off '69. £1975. TEL. LEAMINGTON SPA (0926) 28359. [1831]

CESSNA 180E, 1964. Over 1,000hr left on engine. King KY95 3600Hz radio, gyro, lights, corrosion proofing, etc. Transponder C of A. £3,350. Westair Flying Services Ltd., Blackpool, Airport. Tel. Blackpool 45660. [1832]

## AIRCRAFT FOR SALE

## PETER CLIFFORD AVIATION LTD OFFER

PIPER COMANCHE 250. Autotilt TT engine 150hr. Tip tanks. 2 VHF/VOR/ADF. £8,900.

BEAGLE AIRDALE TT 520hr. C of A 1972. 2 VHF. 2 VOR. ADF and markers. £3,500.

CESSNA 172H TT 500hr. current C of A. IFR radio and Navromatic 300 auto-pilot. £7,850.

DEMONSTRATIONS, PART-EXCHANGE & FINANCE.

Send for our latest list.

Always required: Good Used Aircraft.

OXFORD AIRPORT-KIDLINGTON.

Tel: Kidlington 4202.

Cashiers: Clidair Oxford.

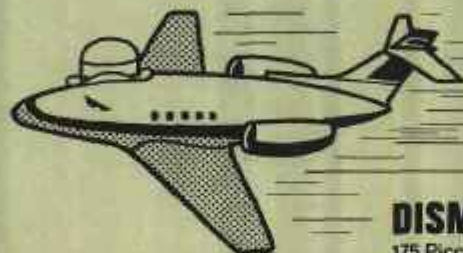
also at

WHITE WALTHAM AIRFIELD, MAIDENHEAD. [0053]

Tel: Littlewick Green 3241.

CESSNA 310J, 1965. Airline equipped, low hours, air fair to New York paid to view. £22,500 with UK C of A. Single-engine taken in part-exchange. Contact: Terry Stewart, 01-953 6171. [1838]

business jet travel  
saves time and money



if you are buying or  
leasing your  
business jet aircraft  
consult

**DISMORE AVIATION LTD**

175 Piccadilly London W1 tel. 01 629 6966

## GLOS · AIRTOURERS



+9G

-4G

THE SAFEST · THE STRONGEST

LOW RUNNING COSTS

PROVEN  
and  
IMMEDIATE

Spares Service

STAVERTON  
AIRPORT



CHELTENHAM

Telephone:  
CHURCHDOWN 3385

## AIRCRAFT FOR SALE

TIGER MOH. New 3-year C of A, new spray, 800hrs to go on engine. Immaculate. £1,295. Phone 01-205 2940. [1779]

BEECH 88 QUEEN AIR, pressurized cabin. Model 1966, fully IFR, de-icing, heated windshields, Collins PN 101, transponder, DME radar altimeter, weather radar, full air conditioned and pressurized cabin, executive interior with many extras. 500 hrs since new, engines Lycoming 1380/540 A 1, 2 x 360 hp. TT: left 50 hrs, right 315 hrs, long range tanks, lease or sale, extremely favourable conditions.

UNIVERSAL AIR LEASING

GmbH KG, 7000 STUTTGART.

CHARLOTTENPLATZ 6-DEUTSCHLAND

Tel. No. 33 43 29, Telex No. 07-22014. [1823]

## DO-6B FOR SALE

BARGAIN—excellent exchange offer, our Douglas DO-6B, U.S. registration, 70% life, presently 68 seats, possibility to increase to high density interior, full airlines avionics, ex North East; aircraft is moth-balled and in mint-condition.

TRADE—against 2 AERO-COMMANDER 680, super-charged engines.

SUBSTANTIAL PRICE REDUCTIONS ARE

POSSIBLE IF CASH DEAL.

We are ready to move. Write, call or wire to:

UNIVERSAL AIR LEASING GmbH KG

D-7000 STUTTGART, GERMANY

CHARLOTTENPLATZ 6

Tel.: 33 43 29, Telex: 07-22014. [1818]

CESSNA 172E. Blue and white, fitted 380-channel transceiver with VOR indicator, Bendix ADF with RFO. Many other extras. TT 130hr on engine and airframe from new by private owner. Would sell for £8,300 or a half share at £3,350. Based LBA. Credit available or take car/cars in part-exchange—Ring Mirfield 5343. [1836]

## BEECH MUSKETEER 1964

Two VHF Class 1 VOR/LOC, ADF. Full panel and two Altimeters. Only 400hr and C of A to August 1971, four seats, 135 m.p.h., 900-mile range, 160 h.p. Lycoming. Useful load standard 1,000lb. Distinctive paintwork: excellent condition. £5,300 for quick sale. Tel. Office: 061-336 5582. Home: Wilmslow 28377 or write: David Bainton, Jaans Farrow, Morley Green, Nr Wilmslow, Cheshire. [1840]

**Cessna**  
**FOR CESSNA BUYING**  
**BRYMON AVIATION LTD**  
CESSNA DEALERS  
TEL: CHOBHAM 7475  
FAIROAKS AIRPORT, CHOBHAM, WOKING, SURREY.  
NEW & USED AIRCRAFT AVAILABLE FOR IMMEDIATE DELIVERY

**SPORTAIR AVIATION LTD**  
**FOURNIER RF4 AND RF5**  
The most exciting light aeroplanes available  
Touring ★ Training ★ Gliding ★ Aerobatics  
Unrivalled economy and performance  
C of A. Quick Delivery. Spares in U.K.  
★ Free training to PPL for RF5 purchasers  
★ Free conversion training for RF4 purchasers already holding PPL  
Biggin Hill Airfield, Kent. Tel: 3110 & 4717  
(for demonstrations training and spares)  
Luton Airport, Beds Tel: 29684

**YORKSHIRE LIGHT AIRCRAFT LTD**  
**ROLLS-ROYCE CONTINENTAL SERVICE CENTRE**  
PARTS · SERVICE · SALES  
**NARCO RADIO DEALER**  
LEEDS/BRADFORD AIRPORT.  
YEADON, LEEDS. Tel: Rowdon 3133-4



# CESSNA SKYLANE-FOR SPEED & RANGE



## LET US DEMONSTRATE IT TO YOU

- Continental 230 hp engine ● 1969 model ● 400 series 360 VHF/VOR ● 400 series ADF ● Constant speed propeller ● Top speed 170 mph ● Cruising speed 160 mph ● Long range fuel tanks ● Range up to 1,200 miles ● Rate of climb 980 ft per minute ● Accommodation for four people plus 120 lbs baggage ● Cash price £11,000 or lease for 60 months at £181 per month.



'PHONE DAVID GRAYSON  
DENHAM 2417

## AIR GREGORY LTD.

DENHAM AERODROME . DENHAM . UXBRIDGE . MIDDX.

**Cessna** DEALER

**HUGHES**  
HELICOPTERS

SOLE U.K. CONCESSIONAIRES

Cessna & Hughes  
parts in stock.  
Maintenance &  
C of A.  
Air Taxi & Charter

## Clarkair INTERNATIONAL (SERVICES) LIMITED

### BOEING 727 SERIES 100

For immediate delivery we can offer two of this type of aircraft for sale or lease, wet or dry, together with complete ground crew, air crew and engineering support.

FULL SPECIFICATIONS AND PRICE BREAK-DOWN  
AVAILABLE ON REQUEST.

CLARKAIR HOUSE, 85 TOOLEY STREET, LONDON, S.E.1.

Overseas Offices: AMSTERDAM, NEW YORK, MONTREAL, MIAMI, SYDNEY, RIO DE JANEIRO, HONG KONG, BANGKOK, BEIRUT, BOGOTA

### SOME MORE JETS FROM OUR COMPREHENSIVE LIST:

- BAC 1-11 Series 400 for lease
- BOEING 727 Series 100C for lease
- CONVAIR 880-22M for sale
- DOUGLAS DC8 Series 33 for sale or lease
- CONVAIR 990A for lease
- DOUGLAS DC8-55F lease or sale
- and many more

Please send for complementary copy of our listing

Tel: 01-407 8417/8 Telex 884855

**LULSGATE  
AIR  
SERVICES  
LTD**

## advanced Cessna dealers

TEL: LULSGATE 714 or 444 . BRISTOL 24401 or 32406 FREQUENCY 127.75

Aviation Consultants. Service department offers quick and efficient service and quality C of A's. Contact Jack Evans for service and Mike Price for sales enquiries.

### All new Cessna singles available immediately

1969 Cessna 150, 360 VOR	from £5,950
1968 Cessna 150, 360	£5,200
1967 Cessna 150, 360	£2,650
1967 Cessna 172, Airways	£7,500
1968 Cessna 172, 360 VOR/ADF	£8,750
1961 Cessna 175, 360 VOR/ADF	£4,475
1969 Cessna 172, VOR/ADF	£3,500
1964 Cessna 336 Airways, Public Transport	£12,500
1964 Beech Baron, Airways	£19,500
1968 Cherokee 140, Airways	£8,450
1967 2 Cherokee 180's, 2/360 VOR	from £9,950

1965 Piper Artec, Airways ONE	£21,500
1957 Piper Apache Airways	£7,000
1965 Twin Comanche, Airways	£10,000
1968 Piper Arrow, Airways	£10,500
1969 Cherokee 180D, 360 VOR/ADF	£7,950
1959 Piper Apache, 2 VHF/VOR/ADF	£7,750
1967 Rallye club 360, VOR	£3,200
1964 Beech Travelair, Airways, de-icing	£17,000
1961 Jodel 1050, 80 channel full panel	£2,800
1948 Miles Gemini, immaculate	£950
1959 Auster Mark 5, Plessey radio, full panel	£1,150
Aerobatic Stampe, excellent condition	£1,350

FINANCE . LEASING . HIRING . BRISTOL AIRPORT • TWIN AIR TAXIS AVAILABLE . MEMBERS OF A.T.O.A.

**Rogers  
for used  
Aircraft**

### USED AIRCRAFT FOR SALE

CESSNA 150J	1969 VHF/VOR
CESSNA F172E	1964 VHF
CESSNA F172G	1966 VHF
TRI PACER 160	1961 VHF
JODEL D140	1960 VHF/VOR
PUP 100	1968 VHF/VOR
PUP 150	1969 VHF/VOR
TWIN COMANCHE A	1964 AIRWAYS

Complete specifications available from Mary Pike Telephone Bedford 62441. All these aircraft are in excellent flying condition with current Certificates of Airworthiness. Demonstration flights quickly arranged at your nearest airfield. Part exchange deals for aircraft or cars welcomed. Finance or lease subject to negotiation.



**ROGERS AVIATION LIMITED**

Great Barford, Bedford. Tel. Bedford 62441. Telex. 82217





## AIRCRAFT FILAMENT BULBS

- Midget panel, Instrument, Navigation, Sealed beam, Anti-collision, Neon, and Strobe.
- Landing Filament Bulbs.
- American & British origin and manufacture ARB Certified, quality controlled.

### FLUORESCENT TUBES, etc.

- "On Airport" and "Service Flights" facilities available for export orders.
- Quantity rate prices for call off orders.
- Purchase tax exemption for registered holders and all export orders.
- Immediate delivery from any of our two hundred and thirty three lines.

## AVIATION SUPPLIES Co., Ltd.

302 Bath Road, Hounslow, Middx.

TELEPHONES: 01-570 4776 and 3569

CABLES: AVISUPPLY HOUNSLOW



## SOLVE YOUR HANDLING PROBLEMS WITH THE LIGHTWEIGHT AND HEAVY CARRYING CAPACITY OF THE AMFOCAS CARGO SKATE

Full details from sole distributor

**SKYTRADE (INTERNATIONAL) LTD**  
AIRPORT HOUSE, CROYDON  
SURREY, ENGLAND

Telephone: 01-888 9433

Telegram: SKYTRADE CROYDON

Overseas enquiries welcomed

## AIRCRAFT FOR SALE

**GLOB AIRTOURER 100**, C of A to 1973. Long Eaton 86313. Derby R10016. [1858]

**MILES MESSENGER**, C of A April 1971. King 90-channel VHF, 150hr engine. £650. Phone 01-855 0401. [1851]

**RALLYE CLUB**, C of A to 1973. Perfect condition. £2,950. Brantley 3483. [1852]



## AIRLINE AIR SPARES

One of Britain's oldest established spares dealers offer a large range of off the shelf delivery for CL 44, VISCOUNT, and DC 7C spares.

Contact:

**BILL MANN STANSTED 2691**

## AIRCRAFT FOR SALE

**TURBULENT 1966**, Ardern 30hp, brakes, airframe, 100hrs, engine 154hrs, permit June 1971, £725. **BAYSIDE BE390** £190. Tel: 01-393 8894. [1853]

### CSE AVIATION LTD

Cherokee Bix 200B, 1949, 110hr. Public Transport C of A August, IFR radio, cargo door, auto-control ILS, electric trim, £15,500.

Zlin Tracemaster Z 32A, 400hr. KY 95-VHF. Price £8,000.

Twiss Comanche II, Turbo 500hr. Automatic III with coupler, Collins PM161, King Gold Crown radio plus DME and transponder, £21,000.

Piper Cherokee Arrow, 1968, Sportman group, Auto-pilot, two VHF, two VOR/ILS, markers, ADF, main extra, £10,700.

New PIPER Aircraft in stock.

Demonstration Aircraft for sale.

Prices available on request.

**CSE AVIATION LIMITED**

OXFORD AIRPORT,

KIDLINGTON,

OXFORD

Tel: 086-754321 [047]

**TIGER MOTH**, no C of A, engine 600hr, SMCH £750. Would sell engine or airframe separately. Northampton 37722. [1846]

**RALLYE COMMODORE 150**, 1970 range, VHF, VOR ADF, 300hr; new condition. Tel: Wotton-u-Edge 3150 [1847]

**RANGE OF FOUR CHEROKEE** aircraft in good condition, VHF, VOR, four-seat, £4,900-£5,000.

One Twiss Comanche fully IFR, £10,000.

Cherokee 186D, new, £9,400.

Single Comanche 350, new engine, repayed and fully equipped, £3,000.

**RAMMER AVIATION,**

THE AERODROME, KILSTREE

TEL: 01-893 4411 [1844]

**THE ONLY VINTAGE LUTON MINOR**, rebuilt with new permit. Offers: Otterhaw 2150 (evenings). [1857]

**TAYLORCRAFT**, 2 seats, Engine 430hr run. New C of A. Excellent condition. Price £700. Vendor, Biggin Hill Airport, Kent. Tel: BN9 2251. [1854]

## THE BELL JET RANGER HELICOPTER



U.K. Distributors:

## AUTAIR LTD

75 Wigmore Street, London, W.1  
01-635 1151

**DOVES & C47** (Passenger & Freight) for CHARTER or LEASE UNDER B.O.T., A.O.C  
**FAIRFLIGHT (Charters) Ltd**  
BIGGIN HILL AIRPORT, KENT  
Telephone: Biggin Hill 3247/8 (24 hours)  
Telex: 95456 Airtaxi Biggin/Fairflight

### WORLDWIDE AIRCRAFT FERRYING

- EXPERIENCED CREWS
- COMPLETE SERVICE
- LOWEST INSURANCE RATES

Terravia Ltd.

Prince Consort Drive, Ascot, Berkshire.

Tel: Ascot 21678 (24 hours) Cab: Worldwide, Ascot.

Operational Base, Blackbushe Airport, Yateley 3121

Our Company frequency is 130.05 Mhz.

Call us, we are at your service.

### EXPRESS AVIATION SERVICES LTD

Biggin Hill Airport, Kent.

Telephone: BN9/2233/4

### The CHIMP GO ANYWHERE BIKE

£67 10s. in quick assembly form. The two-seater run-about which can be carried in a light aircraft. 100 m.p.g. Automatic transmission. Trade enquiries welcome.

ALEYWOOD LTD, 25 CHURCH LANE,

WHITLESFORD, CAMBRIDGE

Telephone: SAWSTON 2356

Maintenance and overhaul for all Piper aircraft and Lycoming engines and their ancillaries. Air frames. Engines. Radio. Electrical components. Propellers. Instruments.



CSE AIRCRAFT SERVICES LIMITED OXFORD AIRPORT  
KIDLINGTON OXFORD TELEPHONE: 086-75 4321

### C. of A. AND REPAIRS—ALL TYPES RADIO INSTALLATIONS AND OVERHAULS

Brooklands Aviation Limited,  
Civil Repair Service,  
Sywell Aerodrome,  
Northampton. Tel: 0604-0113



# AIRCRAFT FOR SALE

**CEA DE 221 DAUPHIN.** A really immaculate specimen. New 1967. Only 175hr TP. Narco Mark 12 with VOR, Britain Turn Co-ordinator, Magnesyn, 2 Afts. Today's new price £7,200+. Our price £4,999. DRG Aviation Services Ltd, Fyfeon Hill, Watlington, Oxford. Tel: Watlington 499 or 343. [1955]

# AIRCRAFT WANTED

**LULSGATE AIR SERVICES LTD.** Genuine Dealers, urgently require second-hand light singles or twins in good condition; all types of transactions considered. Cars, etc., in part-exchange. Tel: Bristol 34401/2/3, or Lulsgate 714. [0694]

**CESSNA 172** wanted for hire or possibly purchase. Tel: Watlington 3434, Box 1780/5. [1747]

**ENTRIES FOR AIRCRAFT AND ACCESSORIES AUCTION SALE.** Compton Abbas, September 20. Entry forms, details and catalogue, Dorset Aviation Centre, Compton Abbas Airfield, Shaftesbury, Dorset. [1947]

**PRIVATE PURCHASER** requires four-seater aeroplane. Box 1849/9. [1850]

**WANTED—PIPER ARROW.** Cessna 172 or similar four-seater aircraft, small hours, in part-exchange for 25ft twin diesel yacht, built 1965, Lloyd's 100 A1, speed 18 knots, value £12,000 approx.; sensible exchange offers please. Box 1851/5. [1855]

# AIRCRAFT ACCESSORIES & ENGINES

**AIRCRAFT SPARES.** Engines and Instruments, Vantage, Biggin Hill. Tel: 2252. [0229]

**CONTINENTAL A65** for sale. 540 hours since major overhaul. £100. Wolverhampton. Tel: Wolverhampton 783008. [1824]

# AIRCRAFT ACCESSORIES & ENGINES

**WANTED—Addison-Leard Calculator.** Appleyard Calculator, Bygrave Slide Rule, RAE Mk V and other Bubble Sextants—Box 1843/5. [1935]

# AIRCRAFT FOR CHARTER

**EUROPA CHARTERS** Aster and other Single and Twin Engines Aircraft available for Charter, Cargo, Aerial Photography, and Self Fly Hire. 24 Hours Service. Telephone: 01-229-0613. 01-229-8405. [0766]

**AZTEC.** 4 passenger seats, available for charter with or without pilot. David Bodworth Limited, Harwich. Tel: 3116/7. [0349]

**£5 PER HOUR**, including insurance. Monthly dry-hull charter of Piper Cherokee. Spencer Aviation, 01-829 3894. [1785]

# AIRCRAFT FILAMENT LAMPS AND FUSES

**AIRCRAFT FILAMENT BULBS & LANDING LAMP BULBS.** Thorne panel lighting, navigation lamps, American Strobo. [0665]

**FLUORESCENT TUBES,** ballast units, stabilisers, fittings, neon lamps, fuses, fuse links, cartridge fuses. Continuous stocks for British and American-made aircraft. ARB released quality controlled. [0611]

**AVIATION SUPPLIES CO LTD.** 302 Bath Road, Hounslow, Middlesex. Tel: 01-870 4776 and 01-870 3569. [0611]

# AIRCRAFT SERVICING

**C OF A SERVICING, REPAIRS.** Approved to 5,000lb a.u.w. Enquiries welcomed. West London Aero Services, White Waltham. [0665]

**AIRCRAFT SERVICING.** C of A all aircraft to 5,500lb. Air 10 Ltd, Halfpenny Green Airfield, Huddersfield, nr. Stourbridge, Worcestershire. Tel: Bolton 215. [1714]

# AIR CHARTER

**SOUTHERN AIR CHARTER.** Business air taxis, freight-twin Astors and larger aircraft 34hr service. Biggin Hill 4488 or 01-930 3033 (day); 01-884 1966 or 01-927 2789 (night); Telex 95485. [8258]

# AIR PHOTOGRAPHY

**AERIAL CAMERAS.** All types at most economic prices—Apply for details to: Direct Photographic Supplies Ltd., 234 Edgware Road, London, W.3. 01-363 4427/8. [0492]

# AIR PHOTOGRAPHY

**K24, F24, K12B, K12E** and most types of aircraft cameras in stock. Accessories, controls also available. Developing equipment. Morse printers, test units available from stock. [0814]

**HARRINGAY PHOTOGRAPHIC SUPPLIES LTD.** 432 Green Lane, London N6. 01-346 5341-5. [0814]

# ANTI-COLLISION BEACONS

**WHELEN STROBE** and Rotating Models (Inter-changeable) always in stock. New or exchange. Air Stores, Maitland Road, London E15. [0293]

# AVIATION COMPUTERS

**KAYS OF EALING LTD.** stockists of Aristo, Jappson, Swallow, RAK Mk. 4 Computers, kneeboards, scale rules, protractors, map cases, books, etc. Quotation mail orders by return. Write for latest illustrated catalogue, Dept. P 8-10, Bond Street, Ealing, London W5. 01-967 2813. [0254]

# BUSINESS AND PROPERTY

**ESTABLISHED Flying Club,** no opposition, good membership, low rent, ingoing £2,000. Suit instructor with capital. South of England, Box 1831/5. [1812]

**GRASS AIRFIELD** with hangar for sale. Freehold and no tenants or lease if desired. No time wasted, please. Principals only. £25,000. Box 1823/5. [1813]

# CLUBS

**PRIVATE PILOTS.** Fly a Jodel Car. £4 per hour. 01-834 6324, Ext. 845. [1946]

# FERRYING

**AIRCRAFT DELIVERIES.** Twenty years world-wide experience ferrying all types piston and turbine. Peler Rock, West London Air Charter Ltd., Ferry House, Copthorne, Sussex. Phone Copthorne 2315. [0543]

# GROUP FLYING

**CHEROKEE 180C.** Join our group and fly this beautiful VHP/VOR/ADF equipped aircraft at £3.10a per hour. Share price £255. Apply Mrs Lahner, 01-383 3832, or Marlow (06384) 4615 Bucks. [0458]

**PPL HOLDER** wishes to join group near London. Share £300 or under—Apply Box 1842/5. [1834]

# Aircraft Finance

## LOMBANK

AIR FINANCE DIVISION

Lombank House, Purley Way, Croydon CR9 3BL. Tel: 01-684 6911.

# SANDPIPER

An extremely sensitive receiver which we consider to be above average performance utilizing the latest noise free transistors. An absolute must for the serious listener. Specification: Standard Broadcast: 200-500 metres; Long Wave: 1000-5000 metres; VHF: 108-140 MC's. Comes complete with batteries and earphone. Excellent performance with high quality reproduction.



# £18.95



# AIRBORNE CASSETTE TAPE RECORDER—COMPLETE WITH VHF RADIO CASSETTE

A really compact unit which enables reception and recording of all aircraft and broadcast signals to be monitored and automatically recorded. Built-in recording level meter. Unit will operate from either internal batteries or mains supply. Supplied complete with microphone and all ancillaries. Frequency response: 50-1000 cps. A beautiful unit which will operate extremely well, and is useful for recording signals when airborne.

# 'AUTOTAPE' RECORDER—LONG DURATION RECORDER

The autotape has been designed for the continuous monitoring of any type audio signal, and is particularly suitable for recording aircraft radio transmission. Long duration recording facility is achieved by the inclusion of an electronic audio switch which operates the recorder on receipt of signal and switches off automatically when signal ceases. Recording times of up to eight hours are possible on a single track. Ideal for the busy airport. Can be used as conventional tape recorder with four track facility.



Send for the Volstatic "Pilots Catalogue"

**VOLSTATIC AVIATION LTD. 57-67 STIRLING ROAD, LONDON W3. 992 6931**

All equipment sold on 10 day money back guarantee. Credit facility also available

# ALDERNEY FLYING CLUB

**CHANNEL ISLANDS** are holding an Air Rally on SATURDAY 19th SEPTEMBER.

Incoming aircraft arrivals 9.30-1.00 p.m. Competitions start at 2.00 p.m. All clubs and members cordially invited.

**ALDERNEY TOWER FREQUENCY 123.6** For information ring ALDERNEY 2711

# CONSULTANTS TO THE AVIATION INDUSTRY



Financial Analysis and Route Feasibility Studies  
Maintenance Planning and Procedure  
Equipment Selection and Utilization Studies  
Demand and Marketing Studies  
Airline Operation Planning and Management  
Airport Facility Planning  
Air Freight Operations and Marketing  
CAB Case Preparation and Presentation

# SYSTEMS ANALYSIS and RESEARCH CORPORATION

1100 Connecticut Ave., N.W., Washington, D.C. 20036

Write for Brochure

Cambridge • Los Angeles • New York • San Diego • Washington



# No routine flying for Martinair crews!

Why, because Martinair, Holland's largest charter airline company, is specialised in diversified transports to all destinations. Not only do we fly hundreds of thousands to their holiday resorts and emigrants' parents to their children overseas, but we also convey ready-for-transport freights to all corners of the earth to mention some of our activities.

Our company's dynamic development creates vacancies. Right now we need:

## Co-pilots

for our Douglas DC-9 and Fokker F-28 Fellowship aircraft

Minimum requirements:

A valid commercial licence and first-class instrument rating. An ATR will be an additional asset. A first class medical. No need to apply without a DC-9 or Fokker F-28 endorsement.

## Flight engineers

Required: Experienced flight engineers, holders of valid licences for Douglas DC-8 aircraft.

## Navigators

We have a number of vacancies for experienced first-class navigators for our long-range DC-8 operations. Applicants must have recent experience in long-range transatlantic and polar navigation.

Letters of application to:  
Vice-president operations  
Martin's Air Charter  
Schiphol Airport  
Amsterdam (Holland).



# MARTINAIR HOLLAND

# ENGINEERS

With experience of aircraft production

required to fill 2 posts with the Ministry of Technology in London. The main task is to assess the feasibility of production programmes and to estimate production costs for both civil and military aircraft. Although primarily costing jobs, considerable professional ability is required and the work is both challenging and rewarding for the right people.

Candidates (men or women) should be Chartered Engineers (or holders of honours degrees). They must have a broad aircraft production engineering background and preferably be experienced in the application of modern aircraft management and cost estimating techniques. Ability to present oral and written cases is essential and some knowledge of aircraft equipment would be an advantage.

Starting salary in the band £2,484-£3,226. Non-contributory pension.

WRITE to Civil Service Commission, Alencon Link, Basingstoke, Hants, for fuller details and application form, quoting S/7538/70. Closing date 5 October 1970.

## GROUND EQUIPMENT WANTED

WANTED. CRYSTAL Charging Equipment for light aircraft system. Box 1835/5. [1835]

## HELICOPTERS FOR CHARTER

BELL JETRANGER available for charter. Four passengers at 140 m.p.h. Spencer Aviation, 15 King Street, St. James's, SW1. Tel: 01-838 2884. [0489]

## HELICOPTERS FOR SALE

£1,300! MILLER 12C, 3 seats, Ex. condition. VHF VOR/Intercom, long-range tank, dual controls. Good blade/engine life. C of A September '71. Tel: Haslemere 3373 (office). [0039]

## INSURANCE

BUDGET FLYING? Insurance on credit up to 12 months without charge! Traffords, 151 Hatfield Road, St. Albans, Herts. [0032]

## RADIO AND RADAR

NABCO Nav. Com. coupled VOR, as new. £99 o.n.o. Box 1846/5. [1846]

## SITUATIONS VACANT

LONDON AVIATION LTD. Now a Rimmer Aviation Company is expanding its fleet of Piper Charter and Executive Aircraft. We therefore require additional full and part time professional Pilots for Public Transport Flights in UK and Western Europe. Apply in confidence to Captain W. O. Beaton, Chief Pilot, The Aerodrome, Elstree, Herts. 01-953 4411. [1795]

"A" and "C" LICENSED ENGINEERS, Cessna/Cherokee, required in the Hertfordshire area. Box 1799/5. [1799]

SKILLED FITTERS required for Pratt & Whitney and Dart engine overhauls. Air Engine Services, Bindley Heath, Lingfield, 2040. [1797]

FULL TIME Assistant Instructor wanted for expanding club. One hour west of London. Box 1828/2. [1828]

FULL INSTRUCTOR required. For particulars write secretary Arusha Aero Club, P.O. Box 505, Arusha, Tanzania. [1829]

## DAN-AIR ENGINEERING LTD

LASHAM, HAMPSHIRE.

REQUIRE

INSTRUMENT ELECTRICAL LICENSED TECHNICIANS

for Inspector supervisory duties. Monthly staff positions.

INSTRUMENT ELECTRICAL MECHANICS for maintenance and workshop duties. Weekly positions.

(1) SENIOR LICENSED TECHNICIAN For supervisory inspection duties. Licensed in Category 10.1.4.

(2) AIRCRAFT ELECTRICIANS

(3) INSTRUMENT MECHANIC For newly completed workshop.

(4) ENGINE/AIRFRAME MECHANICS

(5) AIRCRAFT RADIO MECHANIC

(6) DETAIL SHEET METAL WORKERS

Apply: PERSONNEL OFFICER, Herford 283 [1840]

## AIRCRAFT APPOINTMENTS

Applications are invited for the appointment of an officer in charge of operations in a small air force. The successful applicant will have:

1. Held the rank of Major, or equivalent, in a national air force.

2. Completed at least 2,000 hours of flying of which not less than 1,000 hours will have been in fighter aircraft.

3. Flown not less than 200 hours in Hunter aircraft and have had operational experience of this type within the last two years.

4. Qualified as an instructor in pilot attack techniques.

5. Acquired fluency in the English language.

It would be an advantage to have:

1. Qualified as a flying instructor.

2. Experience of helicopter operations.

3. Completed a course of instruction in weapons employment.

Replies please to Box 1826/1. [1810]

## TRANSVAAL HOLLAND NV

REQUIRE

SEASONAL CARAVELLE CAPTAINS AND FIRST OFFICERS

BEGINNING APRIL 1971

Applicants must have current ICAO Licence with Caravelle (210) endorsement (Group 1).

Apply in writing giving full details of past experience to:

LICHTVAARTMAATSCHAPPIJ

TRANSVAAL HOLLAND NV

SCHIPHOL AIRPORT, AMSTERDAM [0499]





# Government of Kenya

## Police Air Wing

require a

# HELICOPTER PILOT

On contract for one tour of 24 months in the first instance.

Candidates, preferably under 45 years, must hold a valid U.K. (or Commonwealth) Commercial Pilot's Licence (Helicopter) and have a minimum of 1000 hours' experience on helicopters. Fixed wing experience on light and medium twin engine aircraft will also be an advantage.

Duties include training and operational flying on Bell 47G3B1 helicopter for which an instructors' rating

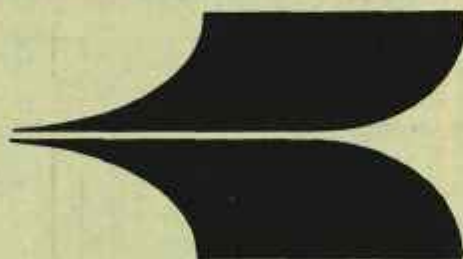
will be required. In addition, there may be a limited amount of flying on light fixed wing aircraft.

Commencing salary according to qualifications and experience in the basic scale Kenya Shillings 26980 - 33420 (£Stg. 1515 - 1949) a year. In addition, Inducement Allowance normally tax free of £Stg. 848 - 956 a year will be paid by the British Government direct to an officer's U.K. bank account. Temporary flying pay allowance of £Stg. 260 a year. Gratuity 25% of total

salary drawn or 45% without terminal leave. Free passages. Liberal leave on full salary. Generous education allowances.

Car advance of up to £300 may be payable.

Apply to CROWN AGENTS, 'M' Division, 4 Millbank, London, S.W.1, for application form and further particulars stating name, age, brief details of qualifications and experience and quoting reference number M3T/700803/ FE



# PANINTERNATIONAL

THE GERMAN INTERNATIONAL AIRLINE

PANINTERNATIONAL will have a limited number of immediate vacancies for

**BOEING 707 - 123B** CAPTAINS  
FLIGHT ENGINEERS  
FLIGHT NAVIGATORS  
FIRST OFFICERS

**BAC ONE ELEVEN** CAPTAINS  
515 FIRST OFFICERS

**OPERATIONS** DISPATCHERS

Preference given to pilots experienced on 707 and One Eleven - Types, but conversion training possible. Successful applicants will be based at Düsseldorf or Munich. Applications to PANINTERNATIONAL Head-Office, 8 München 2, Theatinerstr. 33-34, Germany



## SITUATIONS VACANT

**EXPERIENCED ENGINEER** required, with full licence coverage ("A" and "C" minimum) on light aircraft. Must be capable of controlling all aspects of maintenance, including staff. Senior position in well established company. Salary subject to negotiation. Box 1771/5. [1736]

## SITUATIONS VACANT

**SOUTHEAST AERO CLUB** has two vacancies immediately for Assistant Instructors. These are permanent appointments. Full details should be sent to the CFI Southeast Municipal Airport or Tel: 0703 41968. [1839]

## SITUATIONS VACANT

**REQUIRED FOR STANSTED AIRPORT:** TRAFFIC MANAGER; STATION DUTY OFFICERS; SENIOR TRAFFIC RECEPTIONISTS AND TRAFFIC RECEPTIONISTS. The Traffic Manager and Duty Officers must have previous experience. Box 1834/5. [1821]



# Government of Kenya Police Air Wing require an **AIR PILOT**

On contract for one tour of 24 months in the first instance.

Commencing salary according to qualifications and experience in the basic scale Kenya Shillings 25980 - 33420 (£Stg. 1515 - 1949) a year. In addition, Inducement Allowance normally tax free of £Stg. 848 - 956 a year will be paid by the British Government direct to an officer's bank account in the United Kingdom. Temporary flying pay allowance of £Stg. 260 a year. Gratuity

25% of total salary drawn or 45% but without terminal leave. Free passages. Liberal leave on full salary. Generous education allowances. Car advance up to £300 may be payable.

Candidates, preferably under 45 years, must hold a valid U.K. (or Commonwealth) Commercial Pilot's Licence and Instrument Rating and have a minimum of 1500 hours in command of multi-engine aircraft. The duties of the Police Air Wing consist of flying on

general police work and government communications and include flying Cessna 185, Piper Aztec, Cessna 402, Grand Commander and D.C.3 aircraft.

Apply to **CROWN AGENTS**, 'M' Division, 4 Millbank, London, S.W.1., for application form and further particulars stating name, age, brief details of qualifications and experience and quoting reference number M3T/700802/ FE



## COURT LINE

### Safety & Survival Instructor

Applications are invited for the above position from experienced Safety & Survival Instructors. The successful applicant would be based at Luton Airport, and would be responsible to our Operations Manager.

Duties would include safety and survival training and checks; the preparation of survival data and supervision of survival equipment.

He will work in close liaison with the Ground Training School staff and be responsible for the provision of training equipment, films and visual aids as required.



Applications giving details of qualifications, experience and career to date should be forward to:

**A. F. Dale Esq., Personnel Officer, COURT LINE Aviation Ltd, Luton Airport, Luton, Beds. LU2 9NB**

## TRADEWINDS AIRWAYS LIMITED

The Gatwick-based cargo specialist airline requires experienced

### ENGINEERS

in all categories, for their fleet of Canadair CL44 aircraft, engaged in world-wide charter operations. Previous experience on CL44 or Britannia and/or Tyne engines an advantage. Salary commensurate with experience and qualifications.

Applications in writing, please, to:

**Chief Engineer,**

**Tradewinds Airways Limited,  
Gatwick Airport,  
Horley,  
Surrey**



# "If you'd like to find out what career-opportunities we have to offer, meet us at the Farnborough Air Show..."



...at the British Aircraft Corporation Guided Weapons Pavilion"

If you're a Technologist, Scientist, Designer or Engineer looking for a more interesting, more challenging career in the field of advanced electronics, precision instrumentation or defensive guided weapons, make a point of visiting our Guided Weapons Pavilion adjoining the Static Aircraft Park at Farnborough. We think that our exhibits will show you that at Stevenage, we have one of the biggest, busiest programmes in Europe.

On Friday, Saturday and Sunday (September 11, 12, 13), Personnel Representatives will be on hand to tell you something about the vacancies at Stevenage arising from our large expansion programme and what this can mean to you in terms of a new future.

If you aren't going to Farnborough or if you cannot see us there on the open days, why not write, quoting area of interest and Ref. 9700, to:—

**Dick Parkes, Personnel Services Manager,**  
9700 Personnel Department, British Aircraft Corporation,  
Guided Weapons Division, Stevenage, Herts.



**BRITISH AIRCRAFT CORPORATION**  
the most powerful aerospace company in Europe



## SITUATIONS VACANT

## AIRCRAFT APPOINTMENTS

Applications are invited for the appointment of an officer in charge of administration in a small air force. The successful applicant will have held the rank of major, or equivalent, in the armed forces, and will have had experience of all aspects of administration at unit level. Experience of accounting would be an advantage. (Fluency in the English language is essential.)

Replies please to Box 1827/5.

[1817]

## CHIEF SUPPLIES OFFICER

British Island Airways invite applications from experienced airline personnel for the above post.

Experience in the various aspects of aircraft and commercial material procurement, stock control procedures, and general stores administration would be an advantage.

Salary in accordance with qualifications and experience. Please apply to:

PERSONNEL OFFICER,  
BRITISH ISLAND AIRWAYS LTD.  
CONGREVE HOUSE,  
36 STATION ROAD,  
REDHILL, SURREY

[1823]

## DAN-AIR SERVICES LTD

## REQUIRE

## TECHNICAL

## TRAINING MANAGER

Duties: Co-ordinate all ground technical training within the Group. To represent the company with the various organisations associated with training. To administer the Technical Instructors and set up training units, training documentation and methods of co-ordinating regular air and ground crew technical checks.

Salary will be subject to negotiation.

Applications to Personnel Manager, Dan-Air Services Ltd., Gatwick Airport, Horley, Surrey, Crawley 28922 Extension 6036.

[1829]

CHIEF INSPECTOR familiar with experimental prototype work required at Redhill Aerodrome for Bellicopter development. Write to Servotec Ltd., South Block, Redhill Aerodrome, Surrey.

[1822]

CHIEF  
FLYING  
INSTRUCTOR

is required by a thriving club situated 6 miles south of Belfast at Newtownards.

The Club has over 350 members, is a B.O.T. approved school, and flies Aircoques, Victas, Cherokees and a Rallye Club.

The man we're looking for must have a Commercial Licence and be full of enthusiasm to see the club go from strength to strength.

Apply, in writing, giving details of licences held, hours flown and previous employment, etc., to:-

THE SECRETARY,

ULSTER FLYING CLUB (1961) LTD  
PORTAFERRY ROAD, NEWTOWNARDS,  
CO. DOWN.

## SITUATIONS WANTED

AIRLINE CAPTAIN, age 45. ATR DC-8.53/63, fluent Spanish, English, French, will relocate temporary freelance, prefer offer with future. Ground studies available October 1st.—Box 1836/3.

[1827]

DC-8/63 CAPTAIN is interested in free-landing for ca. 2 months starting November. Previously flown equipment includes DC-9, G1-44, DC-7c.—Box 1837/5.

[1828]

BELGIAN PILOT, FAA commercial, instrument and multi-engine ratings, agricultural flying instructor, 2,000hr on 35 airplane type, seeks position. Write Box 1843/5.

[1841]

FLYING INSTRUCTOR, 1,300hr; twin, night and IMC ratings, requires position anywhere. Tel: Pormby, Lancs. 73011 (after 6 p.m.).

[1842]

## SPONSORS REQUIRED

AMBITIOUS YOUNG MAN, aged 20, with "O" Levels, seeks sponsorship for CPL/IR. Any terms considered. Box 1796/5.

[1774]

YOUNG MAN, 23, desperately require sponsor, CPL/IR. Very keen, 50hr experience. You name the terms. Box 1800/5.

[1791]

## TUITION

ARE CERTIFICATES. Expert Postal Courses for the Basic Aeronautical Engineering Examinations on "Satisfaction or Refund of Fees" terms. Officially approved and recognized. For Details of Exams and 999 Courses in Aeronautical, Mechanical Eng., Electronics, Radio, etc. write for 124-page Handbook FREE. British Institute of Engineering Technology (Dept. 181K), Aldermaston Court, Aldermaston, Berks.

[0077]

AVIGATION, 30 Central Chambers, Raffle Broadway, London W1 (Tel: 01-567 8948). Full-time or part-time tuition for the written examinations for Board of Trade Pilot/Navigator Licences. Courses arranged to suit individual requirements. Board of Trade recognition for the Instrument Rating, Service pilots and navigators may obtain our courses through the Forces Correspondence Course Scheme. Details on application.

[0246]

LEARN TO FLY. Trial flight £3. Condors, Aircoques, Cessna 180's from £5 14s per hour. West Essex Flying Club, Biggin Hill 4132 or 01-892 4217.

[0070]

STAPLEFORD FLYING CLUB. Modern aircraft. Excellent clubhouse facilities. IMC and RT Ratings. Phone Stapleford 380 for full details or trial lesson.

[0243]

## WEST LONDON AERO CLUB

Approved 12hr PPL, Instructor's and Advanced Training course: 12 aircraft, four instructors; D4 Link; RT training examination. Residential accommodation available. Restaurants bar. Social members welcome. London 30 miles (M4).

## WHITE WALTHAM AIRFIELD

Tel: Littlewick Green 233/1/4.

[0054]

## MACK AIRWAYS TRAINING

## FLIGHT TRAINING CENTRE

## GATWICK AIRPORT

- \* INSTRUMENT RATINGS
- \* IMC RATINGS
- \* TWIN RATINGS
- \* LINK TRAINERS WITH AUTOMATIC RADIO AIDE.

Tel: Crawley 2822, ext. 6515.

Crawley 31693.

[0515]

SIR JOHN CASS COLLEGE SCHOOL OF NAVIGATION. New address: 100 The Minories, Tower Hill, London EC3. Tel: 01-480 8043 ext. 63. Courses of lectures for ALTP and CPL, also individual tuition for all BoT licences if preferred. Fees: CLP £8 15s. ALTP £16 5s. P/Nav. £20 5s.

[0204]

These classified pages of

FLIGHT  
INTERNATIONAL

are studied by over  
200,000\* readers in over  
100 countries throughout  
the world.

If you have a new or  
used aircraft for  
sale, a service to  
offer or a personnel  
requirement phone

01-928 3333

for immediate attention.

WHY NOT LET US  
HELP YOU IN  
OUR NEXT ISSUE?

Dorset House  
Stamford Street  
London S.E.1  
Telex 25137

\*1969 ABC circulation 39,880 with  
6-8 Readers per copy



# COURT LINE

Require PILOTS for their BAC 1-11 Fleet 1971 operations.  
Minimum qualifications CPL/IR—1200 hours.



Applications should be submitted in writing to:

Chief Pilot, COURT LINE Aviation Limited, Luton  
Airport, Luton, LU2 9NB



# TUITION

## FLY FROM STANSTED REDUCTION FOR PAYMENT IN ADVANCE

- Night Ratings.
- 30hr Approved PPL Course.
- IMC Ratings.
- Twin Ratings.
- Type Ratings.
- Instrument Ratings and Renewals.
- R/T Ratings.
- Piper and Cessna Aircraft.

Phone: Bishop's Stortford 502340 (day). Bishop's Stortford 4234 (night), or write Skywork Ltd, Bldg 92, Stansted Airport, Essex. [0627]

## LONDON SCHOOL OF FLYING

30hr approved PPL course. Instructors' Twin Ratings and Advanced Training Courses. 16 Cherokees, 2 D4 links, RT Examinations. Pipers for self-fly hire and sale. Piper air taxi service and Piper aircraft maintenance. Restaurant, Cordon Bleu cooking.

SOLO RATE ON CHEROKEE 140s.

28 PER HOUR INCLUDING WEEKENDS.

KIMMER AVIATION LTD,

PIPER MAIN DEALERS,

THE AERODROME, ELSTREE, HERTS.

01-953 4411

[1643]

# BOOKS

**AERAD FLIGHT DOCUMENTATION**—World-wide coverage with weekly amendment service.

**IATA Publications** (Register of Containers and Pallets; Restricted Articles Regulations); **IAL—Air Mileage Handbook**; "Air Freight—Key to Greater Profit" by Greenewald & Helmeyer.

**APPLY INTERNATIONAL AERADIO LTD** Aerad Flight Documentation and Printing Division, Aeradio House, Hayes Road, Southall, Middlesex, England. [0696]

**MODERN AIRCRAFT SERIES** (Sports Car Press, USA). Finest series of illustrated practical manuals on the market! Established best-sellers: "Modern Aerobatics," "Cockpit Navigation," "Lightplane Construction and Repair," "Parachuting for Sport," "Air Traffic Control." Latest titles: "Multi-engine Flying," "Single-engine Beechcrafts," "All About Helicopters," 19c 4d each, post free. Full list available. Sole importer: Graham K. Scott, Bookseller, 2 The Broadway, Priern Barnet Road, London N11 3DU. [1838]



## LEARN TO FLY AT DENHAM

- B.O.T. Approved for Helicopter and Fixed Wing Aircraft Flying Tuition
- 35 Hour Approved Course for P.P.L.
- I.M.C. Rating • Night Rating • R/T Rating • Twin Conversion



FIRST LESSON £3—'PHONE JOHN HOLLIDGE—DENHAM 3621 or 2417

## GREGORY FLYING TRAINING SCHOOL

DENHAM AERODROME ■ DENHAM ■ UXBRIDGE ■ MIDDX.



## ROGERS AVIATION LIMITED

### FLIGHT SCHOOL

#### U.K. FLIGHT TRAINING COURSES

- |                   |               |
|-------------------|---------------|
| Private Licence   | I.M.C. Rating |
| Night Rating      | Multi Rating  |
| Instructor Rating | R/T Rating    |
| 1179 Ratings      |               |

FULL TIME PROFESSIONAL FLIGHT/GROUND INSTRUCTORS • LATEST EQUIPPED SIMULATOR

#### F.A.A. FLIGHT TRAINING COURSES

- |                   |                     |
|-------------------|---------------------|
| Private Licence   | Commercial Licence  |
| Instrument Rating | Multi Rating        |
| Airline Transport | Flight Engineer     |
| Flight Navigator  | Aircraft Dispatcher |

#### ROGERS AVIATION LIMITED

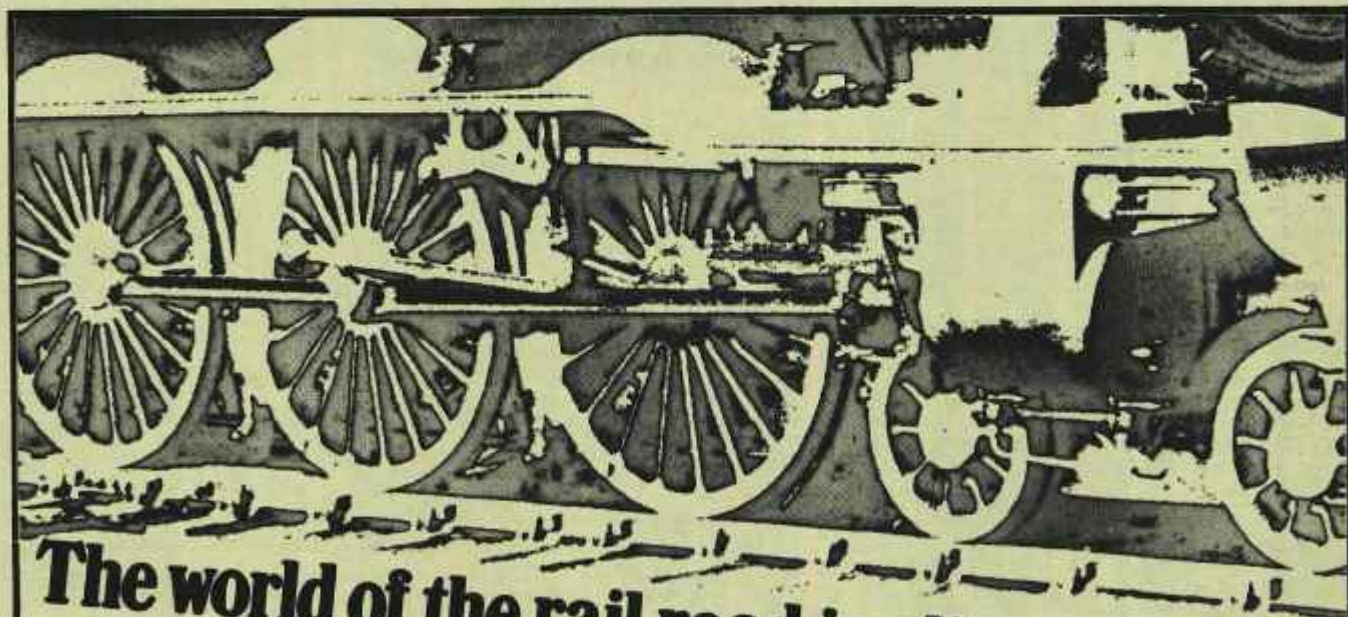
CRANFIELD AIRFIELD - BEDFORD - ENGLAND  
Telephone: Cranfield 661 Telex: 82220

## SURREY & KENT FLYING CLUB BIGGIN HILL AIRFIELD

35 hour Approved Course for PPL Night Ratings; IMC Ratings; Modern Aircraft for all Training; Airways Equipped Twins and Singles; Specialised Courses for Instrument Rating for Commercial and Private Pilot; D4 Link Training with Qualified Link Trainer Instructor.

Apply for brochure stating your requirements.

Telephone: BN9 2255



# The world of the rail road is alive and well...

and lives in Railway Magazine. Read about the nostalgic days of steam, the exciting developments in diesel locomotives. Travel through the glorious past, the progressive present, the fascinating future of railways at home and overseas. Fully described and illustrated every month with historical features, performance data, news from around the world. If you're interested in railways, catch Railway Magazine every month.

## Railway Magazine

4s monthly

Annual subscription 48s  
Post Free  
Half year 24s

Dorset House, Stamford Street,  
London SE1

Or from your local newsagent



# CLASSIFIED ADVERTISEMENTS

## Use this Form for your Sales and Wants

To "FLIGHT International" Classified Advertisement Dept., Dorset House, Stamford St., London, S.E.1

Telephone: 01-928 3333. Telegrams/Telex: Flight Hiffepres, 25137 London.

PLEASE INSERT THE ADVERTISEMENT INDICATED ON FORM BELOW

- **RATE:** 2/6 (12½p.) per word, minimum £1.10.0. (£1.50).
- **NAME AND ADDRESS TO BE INCLUDED IN CHARGE IF USED IN ADVERTISEMENT.**
- **BOX No.** if required, add 2 words plus 1/-.
- **Cheques, etc., payable to "FLIGHT International" and crossed "& Co."**
- **PRESS DAY: FIRST POST THURSDAY** for following week's issue.

NAME .....

ADDRESS .....


Please write in BLOCK LETTERS with ball pen or pencil.

NUMBER OF INSERTIONS REQUIRED.....

REMITTANCE VALUE..... ENCLOSED

## INDEX TO ADVERTISERS

PAGE	PAGE	PAGE
Aero Macchi ..... 16	Decca Navigator Co. Ltd. .... 7	Paninternational ..... 41
AFSA Ltd. .... 14	De-Havilland Aircraft of Canada ..... Cover 11	Plaggio, SpA Rinaldo ..... 11
Aircraft Materials Ltd. .... 12	Diamond Aviation Ltd. .... 26	Plasma Dynamics Co. Ltd. ....
Aircraft Supplies Ltd. .... 24	Donalco International Inc. .... 8	Between Edit. Pages 410 & 411
Air Engine Services Ltd. .... 10	Dowty Group, The ..... Facing Edit. Page 410	Plus Gas Co. Ltd. .... 33
Air Gregory Ltd. .... 37 & 48	Eagle Aircraft Services Ltd. .... 38	R.M.R. (Eng.) Ltd. .... 30
Airline Airports Ltd. .... 28	Eagle Flying Services Ltd. .... 30	Rogers Aviation Ltd. .... 35, 37 & 45
Aldermay Flying Club ..... 20	Egins Matrux ..... 38	Rolls-Royce Ltd. .... Cover 11
Alexwood Ltd. .... 38	Express Aviation Services Ltd. .... 38	Shackleton Aviation Ltd. .... 34A
Autair Ltd. .... 30	Fairlight (Charters) Ltd. .... 38	Short Bros & Harland Ltd. .... 2 & 3
Avdel Ltd. .... 6	Fairways Aviation Services Ltd. .... 20	Skirade (International) Ltd. .... 38
Aviation Supply Co. Ltd. .... 32	Perranti Ltd. .... 1 & 15	Speckair Ltd. .... 38
Aviation Traders (Eng.) Ltd. .... 32	Pox & Sons Ltd., C. J. .... 34	Sud Aviation ..... Facing Edit. Page 411
Black A & C ..... 30	Olson-Air Ltd. .... 38	Surry & Kent Flying Club ..... 45
B.M.B. (Sales) Ltd. .... 25	Hants & Sussex Aviation Ltd. .... 10	Systems Analysts & Research Corp. .... 39
British Aircraft Corporation ..... 43	Helicopter Sales (U.K.) Ltd. .... 31	Technical Plastics Ltd. .... 10
Brooklands Aviation Ltd. .... 28	Lambair Ltd. .... 8	Templewood Aviation Ltd. .... 35
Brymon Aviation Ltd. .... 30	Lombank Ltd. .... 28	Terravia Ltd. .... 38
Castlemain (Marine) Ltd. .... 26	Lusgate Air Services Ltd. .... 27	Titanium Metals & Alloys Ltd. .... 31
Castrol Ltd. .... 22	Martinair Holland ..... 40	Tradewinds Airways Ltd. .... 43
Cannon Electric (C.B.) Ltd. .... 27	Martin Baker Aircraft Co. Ltd. .... 13	Uster Flying Club ..... 44
Cemeralium (Muffette) Ltd. .... 12	M.L. Aviation Ltd. .... 23	United Aircraft International ..... 24 & 28
Cliffair International (Services) Ltd. .... 4 & 37	Nard Aviation ..... Cover 14	Vinten Ltd., W. .... 32
Civil Service Commission ..... 40		Volatase Ltd. .... 39
Court Line Aviation Ltd. .... 43 & 44		Wilson Ltd., W. .... 31
Cox & Son Ltd., John ..... 20		Yorkshire Light Aircraft Ltd. .... 36
Crown Agents ..... 41 & 42		
C.S.E. Aviation Ltd. .... 9 & 38		

Change of address—please note that four weeks' notice is required, together with the return of a wrapper bearing the old address. Registered at the General Post Office as a newspaper. Second Class Mail privileges authorised at New York, N.Y.  
 Branch Offices: Coventry, 8-10 Corporation Street; telephone 0203 25110. Birmingham, 401 Lynton House, Walsall Road, Birmingham 22b; telephone 021 356 4838.  
 Manchester, Statham House, Talbot Road, Salford, Manchester M3 0EP; telephone 061-872 4211. Glasgow, 2-3 Clairmont Gardens, Glasgow C3; telephone 041 332-3792 or 041 332-8806. Bristol, 11 Elmdale Road, Bristol 8; telephone 0272 21491/2/3.

ibpa

International Business Press Associates OVERSEAS ADVERTISEMENT SALES OFFICES. FRANCE: Division Internationale, Compagnie Française d'Éditions, S.A., 40 Rue du Colisée Paris 8e. GERMANY: Kontinental Anzeigen-Verwaltung, Grafenberger Allee 269, 4 Düsseldorf, W. Germany. HUNGARY: Hunexpo, Budapest XIV, Varosliget. ITALY: Bias-Kompass S.p.A. Via Montena 5, Milan, Italy. JAPAN: International Business Press, Asia Magazines Ltd., 8-16 Building, 7-16 4-chome, Atsuka, Minato-ku, Tokyo. SWITZERLAND: Agentur 12, 8301 Schaffhausen, Neustadt 67. NEW YORK: Hiff-NTP Incorporated, 305 East 42nd Street, New York, N.Y. 10017. CHICAGO: Hiff-NTP Incorporated, 1 South Wabash Avenue, Chicago, Illinois 60601. LOS ANGELES: Duncan Scott & Marshall Inc., 1830, W. 8th Street, Los Angeles, California 90037. SAN FRANCISCO: Duncan Scott & Marshall Inc., 85, Post Street, San Francisco, California 94104.

Printed in Great Britain for the Publishers, IPC TRANSPORT PRESS LTD, Dorset House, Stamford Street, London, SE1, by INDEX PRINTERS, Dunstable, Beds. Distributed by IPC Business Press (Sales & Distribution) Ltd., 40 Bowling Green Lane, London, EC1 (01-877 3636). "Flight International" can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd., Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency Ltd; Wm. Dawson & Sons (SA) Ltd. USA: Eastern News Distributors Inc, 150 West 15th Street, New York 10011, USA. CONDITIONS OF SALE AND SUPPLY: This periodical is sold subject to the following conditions, namely, that it shall not, without the written consent of the publishers first given, be lent, re-sold, hired out or otherwise disposed of by way of Trade at a price in excess of the recommended maximum price shown on the cover; and that it shall not be lent, re-sold, hired out or otherwise disposed of in a mutilated condition or in any unauthorized cover by way of Trade; or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.



## We've got the answer to a very serious problem.



The new generation wide-bodied jets are here—and with them, unprecedented headaches in passenger collection and dispersal. Taxis, limousines and buses aren't able to cope with this problem.

The proven technology of STOL aircraft in moving passengers quickly from major airports is the answer. The STOL Series 300 Twin Otter is such an aircraft. And it's here today in use, and ready for tomorrow. No matter what's on anyone's drawing board now, we have the proven air passenger solution to one sector of the wide-bodied jet crowd problem.

When flying as a STOL aircraft, the Twin Otter gets in and out faster than a taxi. Only, instead of carrying four passengers, it'll carry 20. Luggage? It takes 40 pieces.

Powered by PT6A-27 engines, the Series 300 Twin Otter can cruise at 200 m.p.h. A Twin Otter shuttle STOL service makes passenger handling a snap instead of a crawl. With new civil STOL regulations coming, the Twin Otter is ready. It already meets safety and operational requirements.

It's tomorrow's plane today. Get ready.



### **STOL** Twin Otter

The de Havilland Aircraft of Canada  
Limited, Downsview, Ontario  
World Leaders in STOL  
A Hawker Siddeley Company



## Europa II

**AEROSPATIALE (S.N.I.A.S.),** leading missile and satellite manufacturer in Europe, has a major share in programs of international scope such as the EUROPA II launcher and the more advanced EUROPA III project.

The Company's vast range of industrial resources, its long-standing experience and the pioneering spirit of its research teams, enable it to take a pre-eminent part in all the significant space developments of the future.

The SPACE AND BALLISTIC SYSTEMS DIVISION of AEROSPATIALE (S.N.I.A.S.):

has developed and manufactured the main part of the DIAMANT B launcher which successfully placed a German scientific satellite in orbit earlier this year and is planned to launch the D 2 satellite in 1971;

acts as integrating contractor for the spacecraft of D 2, a scientific mission satellite, and of EOLE, a meteorological satellite program, conducted jointly with NASA;

is also prime contractor for the C.I.F.A.S. Industrial Consortium SYMPHONIE project, a Franco-German telephone/television satellite;

supplies equipment for ESRO programs;

offers a wide range of probe rockets for vertical exploration of the upper atmosphere as well as the associated ground support equipment.



Symphonie



Coralie

**aerospatiale**

37 boulevard Montparnasse 75 016 PARIS FRANCE

Division SYSTEMES BALLISTIQUES et SPATIAUX  
6, Quai National 92/Puteaux