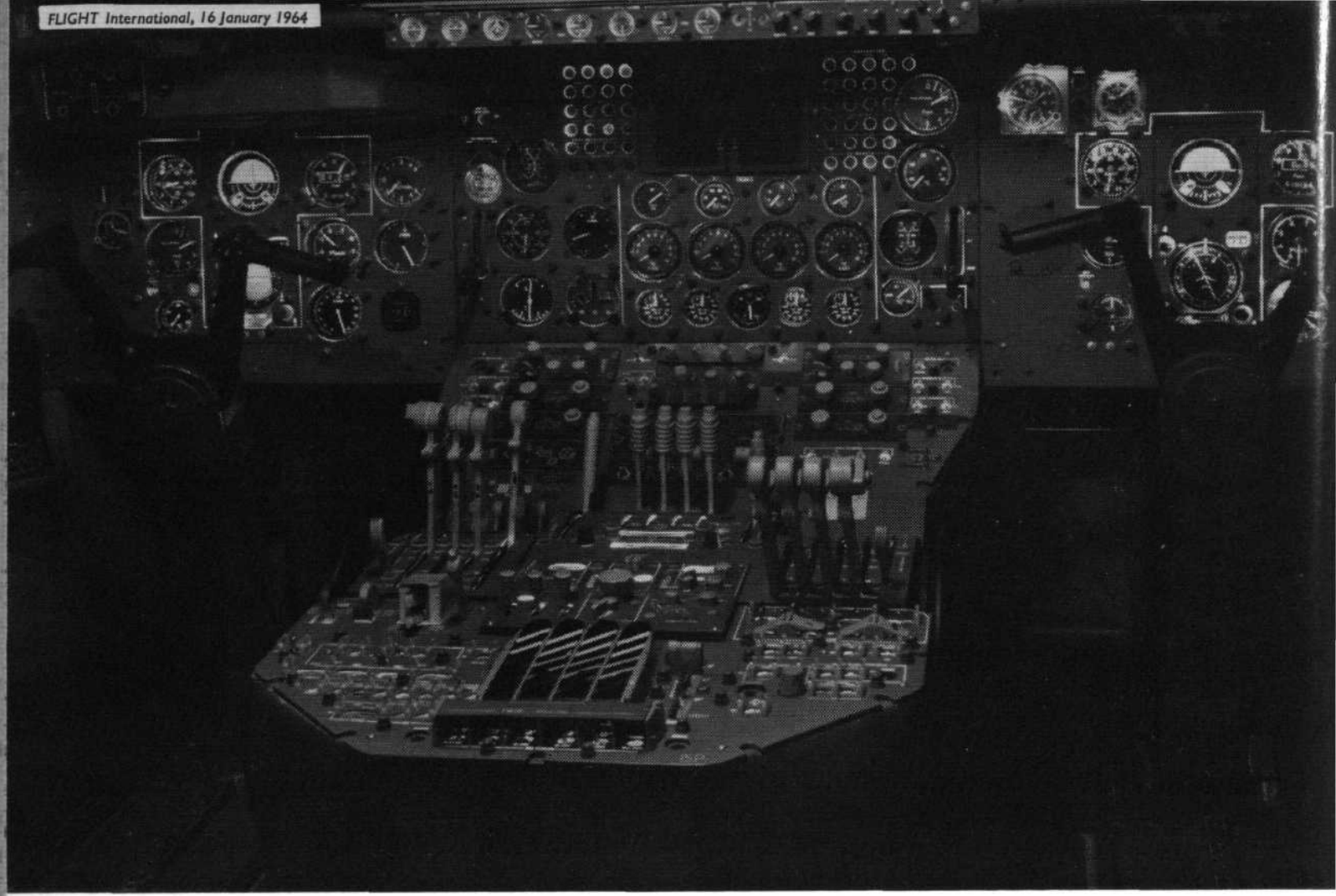
16 JANUARY 1964 ONE SHILLING & SIXPENCE

FLIGHT

International



SPERRY IN THE BELFAST

-the complete attitude system for the Short Belfast, comprising three Vertical Reference Units, two Attitude Directors and associated amplifiers, is manufactured by Sperry The Company also supply CL.11 Directional Gyros (a pair of which provides precision heading reference), Air Speed Indicators, Vertical Speed Indicators, Mach Meters and auto-pilot Rate Gyro Units.

SPERRY **AERONAUTICAL GROUP**

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Designers of Britain's newest strategic freighter the Belfast specified Royalite thermoplastic sheeting for the bulk of the interior lining and the flight deck canopy. There are seven reasons why. Royalite is lightweight, chemical resistant, non-magnetic, non-conductive. It has the elasticity of rubber with the rigidity of a plastic. It gives a fine finish and sharp, clean detail. Looks good. Is good. The Belfast (optimum cruising height 28,000 feet) will do a great job for Britain. Royalite does a great job for the Belfast.

Royalite

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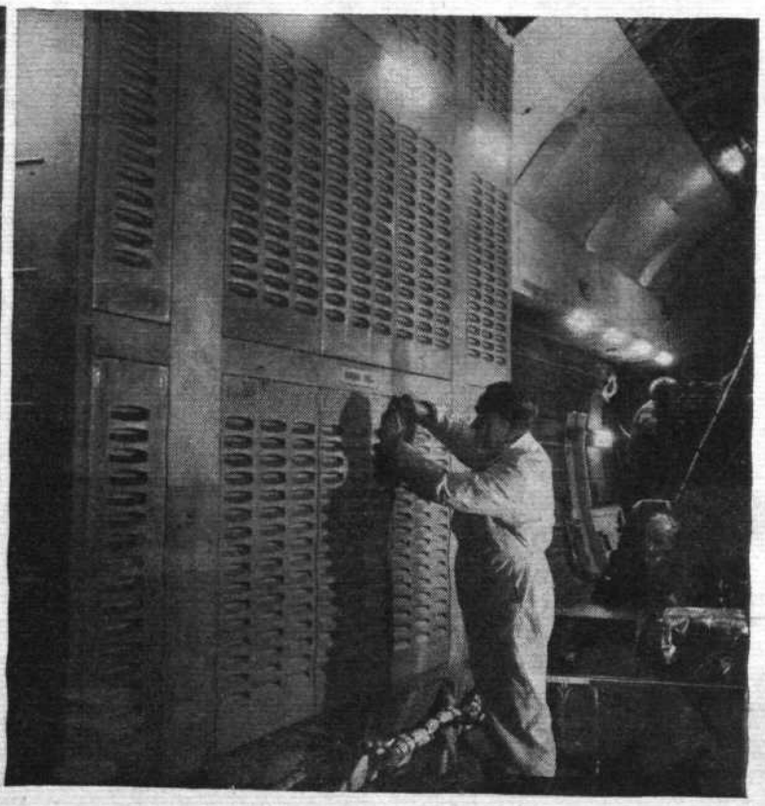

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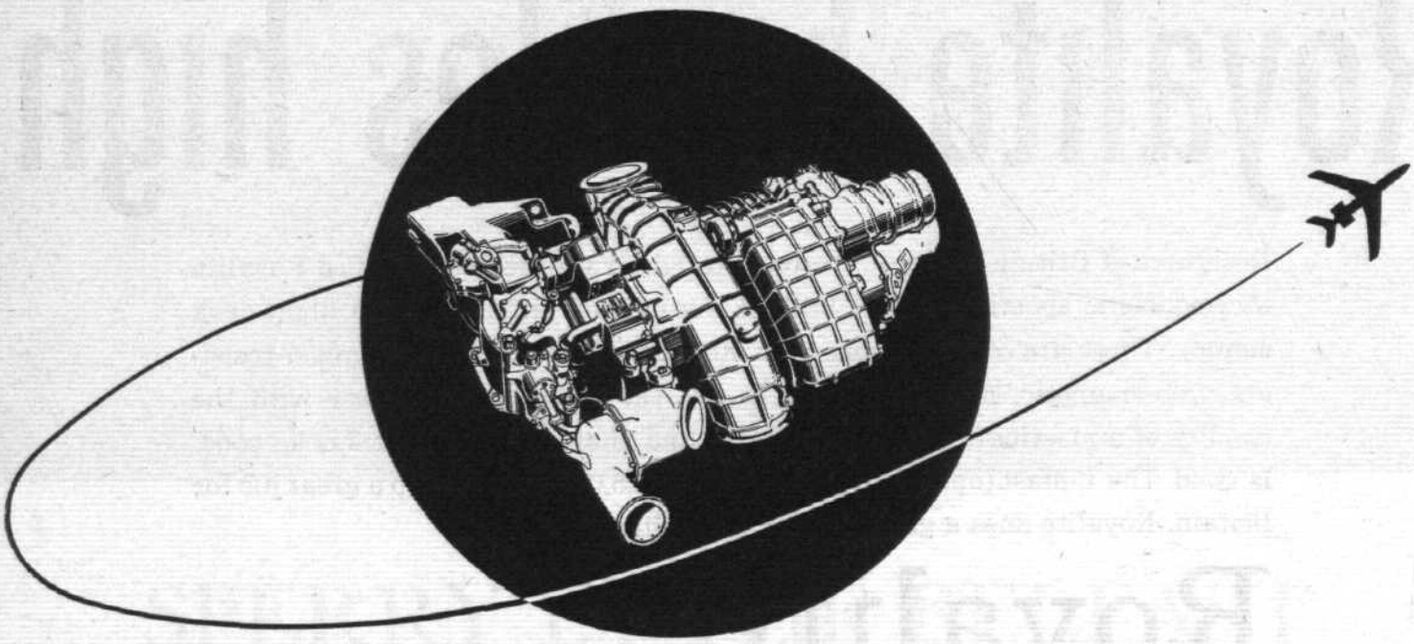

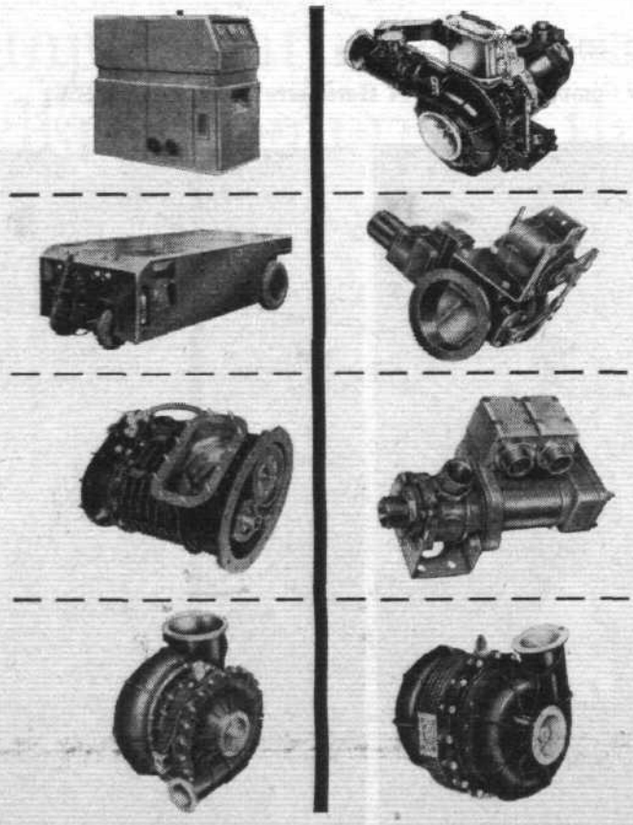

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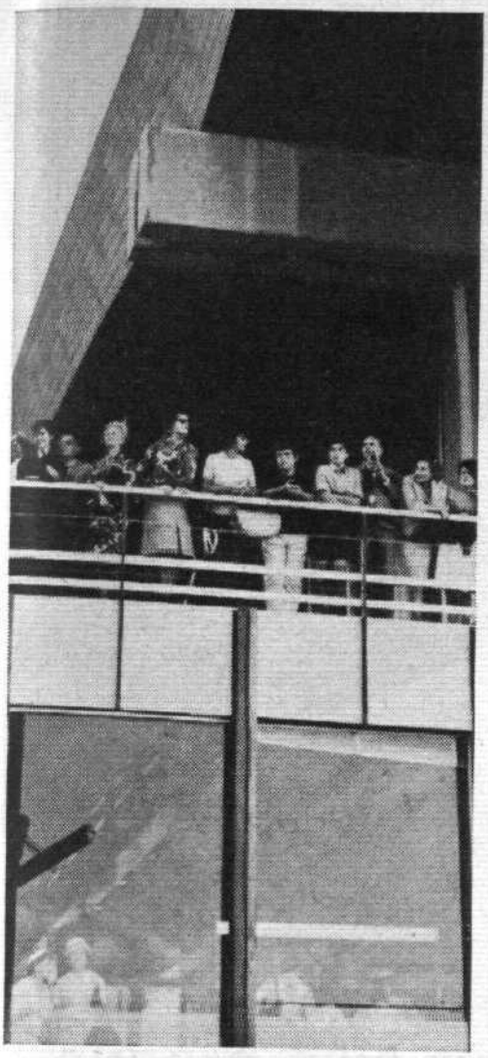

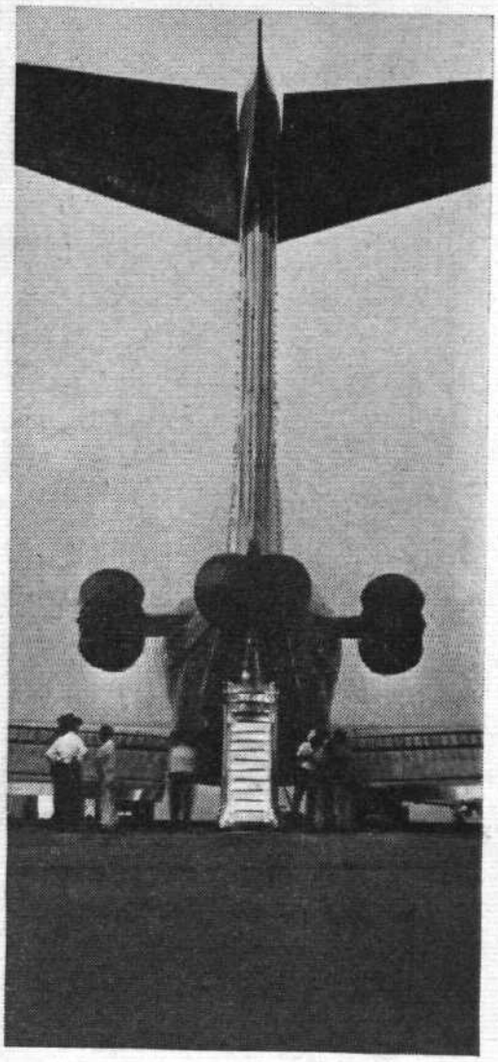

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We sent a bright new Boeing 727 to Khartoum, Tokyo, Sydney, Johannesburg and 42 other cities around the world. We wanted pilots, and airline and government officials, to see for themselves what this new jet can do.

The 727 was a hit at every stop. Pilots of 27 airlines found the 727, with its short, quick take-off and effortless control, an absolute delight to fly. Officials found the 727's unbelievably smooth and quiet ride equally delightful.

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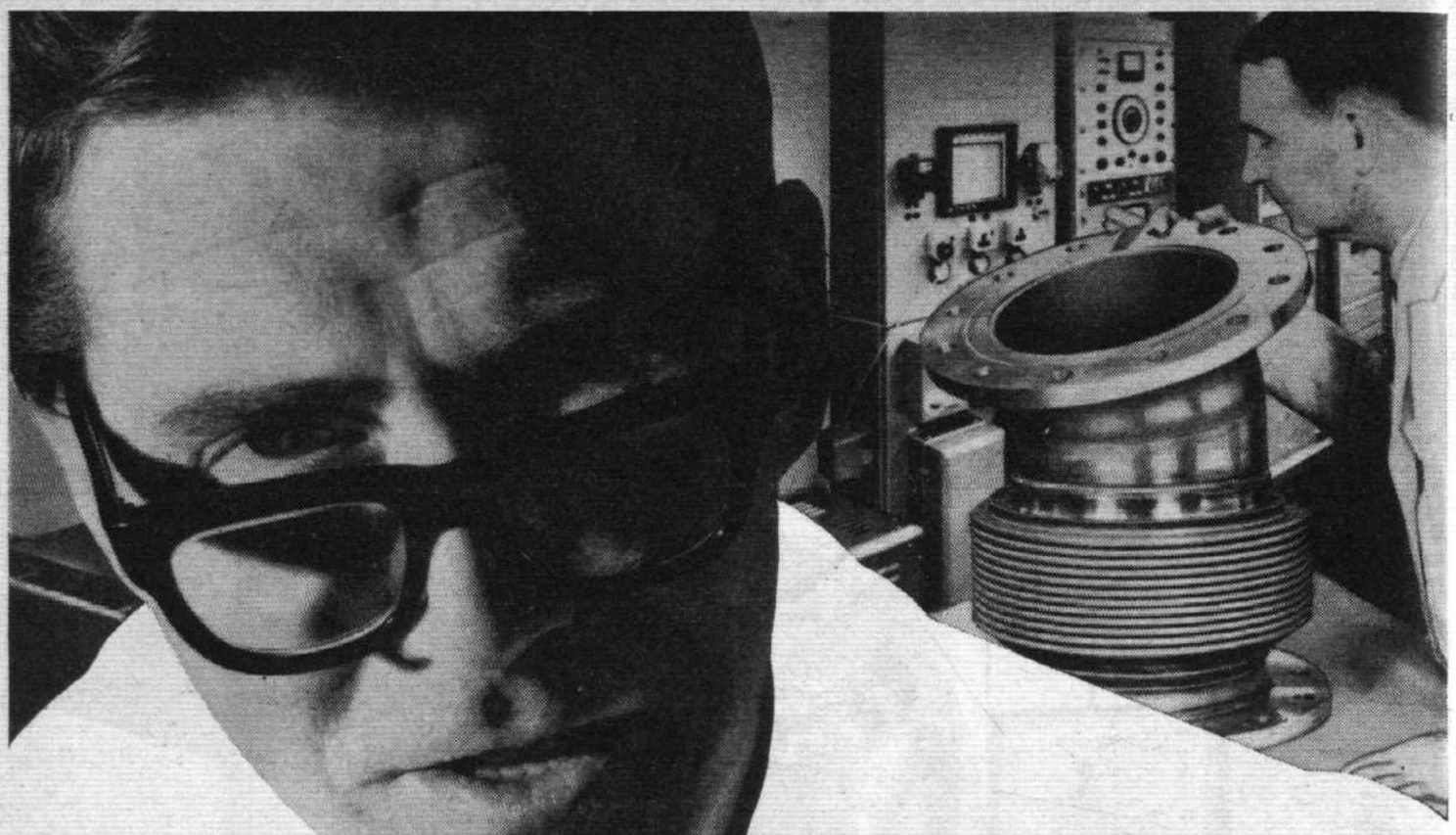
The 727, America's first short-range jetliner, has been ordered by American, Ansett-ANA, BWIA, Eastern, Lufthansa, National, TAA (Australia), TWA and United airlines. It goes into service within weeks. Watch for airline announcements!

BOEING 727



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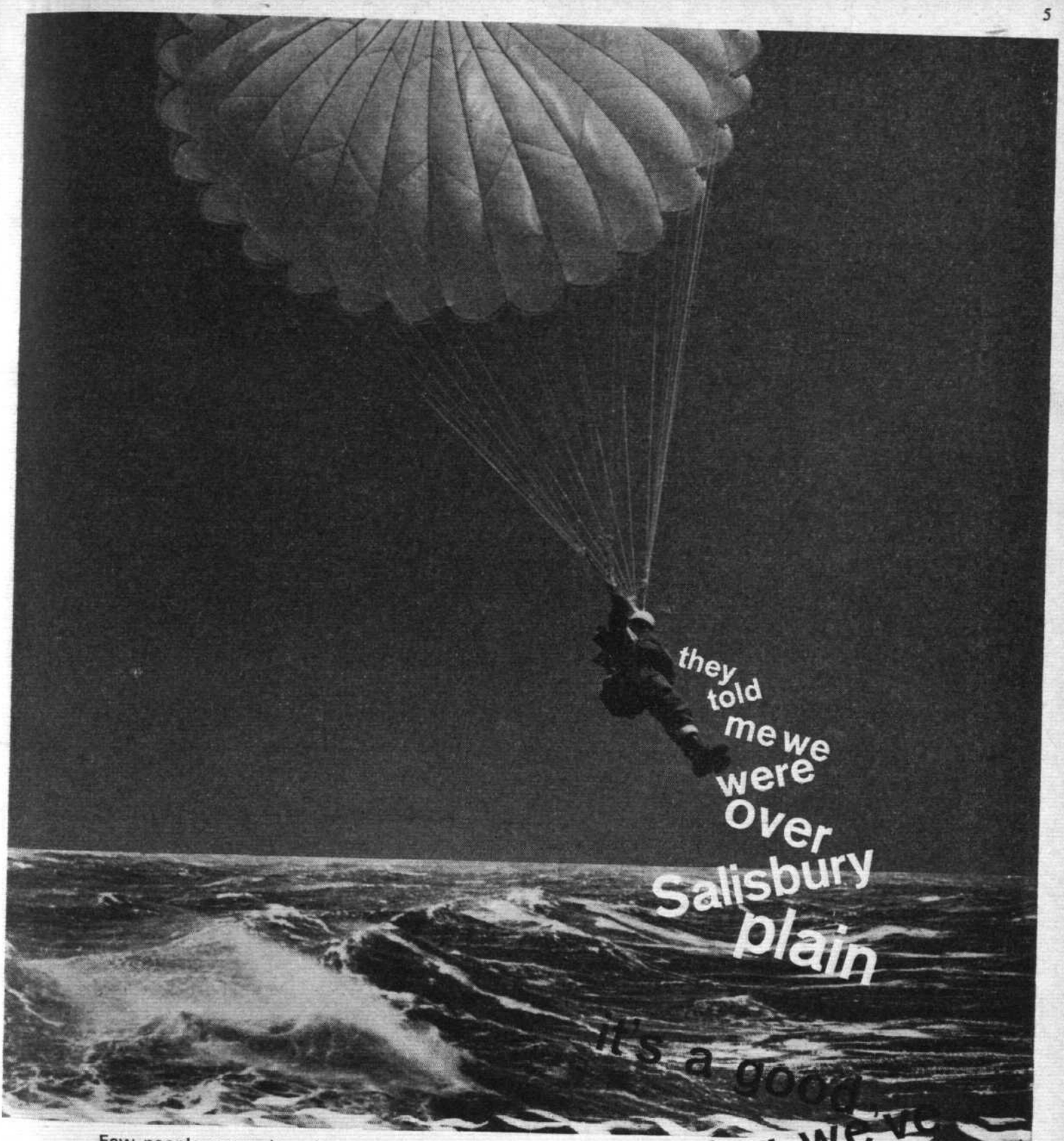

Few people remember that the earliest G.Q. parachutes were manufactured in the original R.F.D. factory at Guildford—or that R. F. Dagnall was a founder director of G.Q. as well as a pioneer of inflatable life rafts. That was thirty years ago. Both Companies developed independently and are acknowledged leaders in their fields. The spirit of close cooperation remains to this day. This is a logical merger—it brings with it a new deal in PACKAGED SAFETY.

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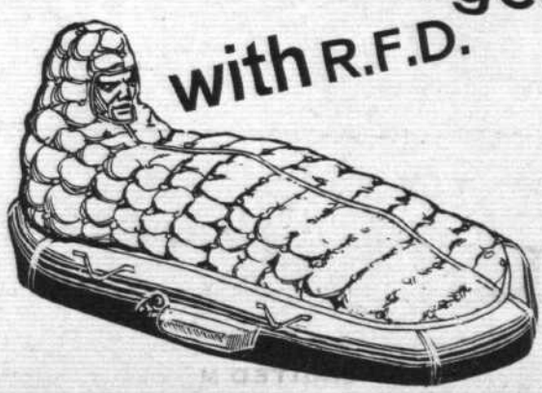

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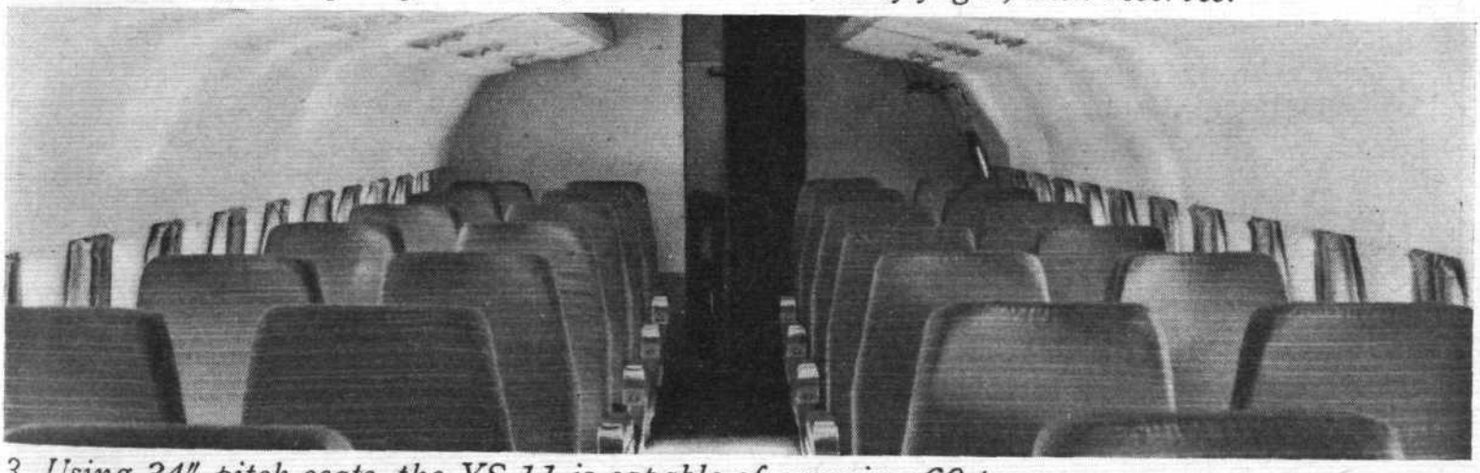
1. Runway length requirements are only 3,790 feet . . . in any climate.

2. Maximum fuel capacity allows 1,290 nautical miles of flight, with reserves.



3. Using 34" pitch seats, the YS-11 is capable of carrying 60 passengers.

VERSATILITY . . . to meet the demands of short-range services

This is the YS-11, a new turboprop airliner, which has been designed to meet the needs of even the most demanding short-range airline operations.

Static load tests have already been completed, with total success. Flight testing with two models and fatigue testing with one are proceeding very well. By the middle of 1964 production models will be ready to take to the air for commercial carriers on Japanese domestic routes. Twenty-eight YS-11s have already been ordered.

Write for further information about the YS-11 to:

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The V-sign

THIS week we are beginning, in the CCJ column, a series of articles on the speeds used by airline pilots in day-to-day operations, with particular reference to the new generation of speeds (Vr, Vmn, Vref, etc) which have been introduced over the last ten years primarily to cater for the different ideas applied to the jet. The main object of the articles is to arrive at "popular" definitions for these speeds.

We believe that the series will prove very useful to practising pilots and will fill a conspicuous gap in the field of current aviation literature—at least the gap in any textbook literature available for training the jet pilot. Indeed, we ourselves have not succeeded in tracking down any publication which deals with these speeds authoritatively and comprehensively and which at the same time could be described as a textbook suitable for introducing the jet pilot to the performance concepts which lie behind the techniques recommended to him.

For this reason, namely the lack of ready sources, we are conscious that in some of the explanatory material, and possibly in some of the definitions, the optimum form of expression may not have been achieved. With this in mind, therefore, the definitions appearing in the body of the series should be treated for the time being as provisional. If there are errors, we have little doubt that these will be picked up by our vigilant readers and we will be happy to adjust the definitions accordingly.

It is intended that the final (adjusted) definitions will be reproduced at the end of the series "on a single sheet of paper" and it is hoped that, in this summarized form, they will be found valuable to airline pilots for some years to come.

Simply to manufacture definitions, with no background information and no explanation of the numerical corrections between the parameters, would hardly have fulfilled the above purposes. The definitions have, therefore, been introduced in the setting of actual operations, with a certain amount of historical data thrown in. By this means not only should they be applicable to today's operations but they may well form a useful basis for discussing the new performance requirements expected of the SST.

The Whale and the Sprat

THE first flight of the Short Belfast has rightly been greeted as the first major event of the British aeronautical year; but in welcoming the leviathan we must not forget a diminutive yet impressive freighter prototype which made its first flight at Belfast a year ago tomorrow. It is the Short Skyvan, conceived in 1958, announced in 1959, and later run at low priority to free design resources for the Belfast. Among airlines which are known to have beaten a path to Shorts' door to assess the Skyvan are some with such demanding requirements as TAA (with its Papuan routes), Wien Alaska, and its neighbour Northern Consolidated.

But operators' enthusiasm for the aircraft will not last indefinitely if no firm production commitments can be made. In this matter Shorts await an MoA decision. A verdict is thought to be imminent, but Ministerial indecision has lasted far too long. When the decision comes it is to be hoped that, in chasing the Belfast whale, Shorts will not be compelled to sail straight over a lucrative haul of sprats.

WORLD NEWS

Balzac Misfortune

The Dassault Balzac, development prototype for the Mirage III-V VTOL strike aircraft, crashed at about 5 p.m. on January 10 at the Centre d'Essais en Vol, Melun-Villaroche, killing the CEV civilian test pilot, Jacques Pinier. The loss of this much discussed aircraft (which had virtually completed its flight test programme and transitions) is not, however, likely to hinder substantially the Mirage III-V programme; the prototype of the definitive tactical aircraft is expected to fly in about three months time.

Last Friday's crash occurred from a height of about 325ft, when the Balzac was hovering. The aircraft was making its 125th flight and M Pinier was checking lateral stability in the hover. The aircraft descended rapidly and, shortly before striking the ground, rolled to almost 90° bank, hitting with one wing-tip and, under the effect of the lift engines, flopping on to its back. Fire broke out but was rapidly extinguished; and the airframe, though extensively damaged, is said to be just possibly repairable.

The pilot had said nothing over the r/t during the descent and is believed to have been unaware that he was in danger. He had apparently made no attempt to use his ejection seat. Although the cause of the accident had not been determined when these words were written, both airframe and engines were reported to have been absolved from blame.

During its test programme the Balzac had been proved able to survive the failure of any one or two of its battery of eight Rolls-Royce RB.108 lift engines. Recently it had been fitted with lift-jet deflector doors, for ground running and short, forward-running take-offs. These had been made at a lift-off speed of 60kt.

Turboprop Beaver Flies

The 1,525th de Havilland Canada Beaver off the 17-year-old Downsview, Ont, production line, the prototype Turbo-Beaver, made its first flight on December 30. An all-Canadian product, with the Canadian Pratt & Whitney PT-6A 578 s.h.p. turbine engine in place of the US P & W R985 radial, the Turbo-Beaver has its cabin extended by 30in—permitting two extra seats—and an enlarged fin. Standard cruising speed is increased from 130 m.p.h. to 146 m.p.h. Typical take-off distance to 50ft, at gross weight, is reduced from 1,015ft to 900ft.

The manufacturers claim that increased work capacity and lower running costs will give a 35 per cent improvement in efficiency and economy. The modification, first extensive change to the basic Beaver since production began in 1947, can be applied retrospectively to existing Beavers.

Hughes 300 in Europe

A European demonstration tour of the Hughes 300 three-seat helicopter was scheduled to begin at London Gatwick last Monday, January 13, after a TWA cargo flight from Los Angeles to London Heathrow the previous day. Powered by a 205 h.p. Lycoming derated to 180 h.p., with fuel injection, the Model 300 is developed from the Hughes 269A. According to the Aircraft Division of Hughes Tool Co, the machine has a retail price ($29,875) which is 30-40 per cent below that of competitive three-seat helicopters. Other data include: cruising speed, 80 m.p.h.; maximum speed, 86 m.p.h.; sea-level rate of climb, 1,450ft/min; hover ceiling, more than 7,100ft; service ceiling, 14,000ft.

Belfast First-flight Data

As a postscript to our Belfast first-flight feature (pages 94-97) we are able to publish data—received as we go to press—from chief test pilot Denis Tayler's debriefing report.

Rotation speed on take-off was 110kt and the climb with 15° take-off flap setting and undercarriage down was made at 150kt. Undercarriage retraction, at 5,500ft and 155kt, took 19sec, extension 19.5sec and retraction again 19sec. The flaps were then inched up in 2° stages and the aircraft trimmed at each stage.

A speed check was made against the Queen Air chase plane at 165kt. The undercarriage was again extended at this speed, in 19sec, reducing speed by 5kt but demanding no trim-change. Following a climb to 9,600ft the Belfast was trimmed to 155kt and then 15° flap was selected. At 135kt 25° was selected, with very little trim-change, and then 40°. Speed was reduced to 112kt—well below estimated normal runway threshold speed.

Following a practice overshoot at altitude and a descent to Aldergrove, the threshold was crossed at 117kt and the aircraft touched down at 100kt. (All the speeds quoted here are i.a.s., from the captain's instrument.) The air conditioning and pressurization systems were working throughout the flight, and de-icing of the propellers and the Rolls-Royce Tyne engines was operational for most of the time.

USN Adopts the Jindivik

Jindivik target drones to the value of over £750,000 have been ordered by the US Navy from the Australian Government Aircraft Factory at Fisherman's Bend, it was announced last week. The present production Jindivik Mk 3 has an operational ceiling in excess of 60,000ft and is powered by a Bristol Siddeley Viper 11 engine of 2,500lb thrust.

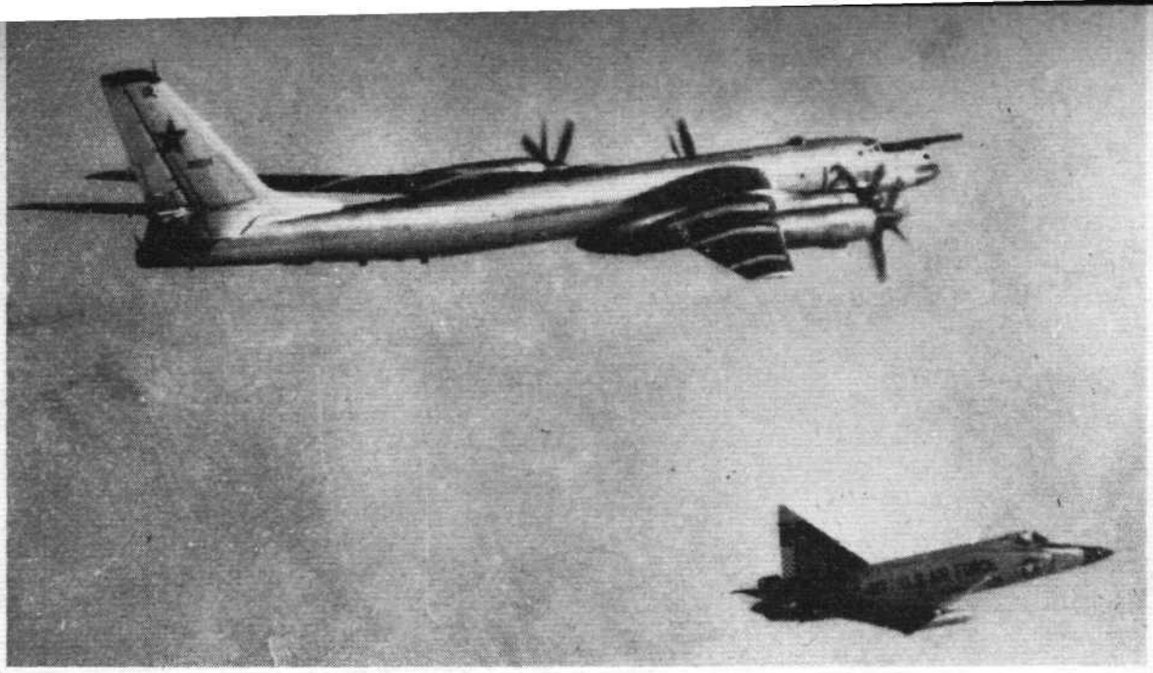
The USN's purchase is the second export order which GAF have booked for the drone, the previous one having been from Sweden.

Materials Expert Retires

Major P. L. Teed, OBE, BL, ARSM, MIMM, FRSA, FIM, FRAES, FInstMets, deputy chief of aeronautical research and development of Vickers-Armstrongs (Aircraft) Ltd, since 1945, retired at the turn of the year.

Maj Teed, who was born in 1889 and

New Whine ... *In 17 years over 1,500 radial-engined DHC Beavers have been built: now comes a turboprop conversion which made its first flight on December 30 (news item on this page)*



From Russia with Love
This unusal formation was photographed on January 9 over Greenland. This icy island, which belongs to Denmark, houses an American base (Thule) whence Convair F-102 intercepters were scrambled to intercept the big Tu-20 "Bear B" reconnaissance bomber, with large nose radar and refuelling probe

educated at Dulwich College and the Royal School of Mines, joined the Vickers Group in 1924. An acknowledged expert on aircraft materials and the fatigue of metals, he has lectured and written widely on these subjects. In 1953 he was awarded the Royal

Maj P. L. Teed

Aeronautical Society's Simms Gold Medal for a paper on *Fatigue of Aircraft Materials with Special Reference to Microstructure*. That he is a man of many parts is apparent from the list of fellowships and memberships that follows his name.

From 1914 to 1922 Maj Teed served with the RNAS and RAF. In the Second World War he served as Deputy Director of Material Production in the Ministry of Aircraft Production and later as Metallurgical Adviser to the Minister of Production and to the British Commonwealth Scientific Office in Washington. More recently—in 1953—he led a team which went to the United States to study titanium production and use.

Atlantic Progress

Following the logging of about 832hr in 392 test flights with two prototypes since the first flight on October 21, 1961 (a third prototype was lost early in the flight test programme), a Breguet 1150 Atlantic anti-submarine aircraft is due to arrive at the Centre d'Essais en Vol, at Bretigny, during the course of this week for a joint CEV/NATO evaluation programme of about 90hr. The first prototype, grounded since November last for modifications and adjustments to its flight controls, servo controls, speed brakes, automatic pilot and de-icing systems, will be ready for flight again next month.

The first of the evaluation batch of the twin-Tyne-powered maritime patroller is now being assembled at Breguet's Toulouse-Colombiers factory, from assemblies made elsewhere in France and in collaborating Dutch, Belgian and German factories. It is expected to fly in October.

HS.125 for Krupp

Probably the first business concern in the world to pass on to a second type of jet executive aircraft is the major West German shipbuilding and engineering group, Fried Krupp. They are replacing the Lockheed JetStar they have operated for about two years with a Hawker Siddeley 125, ordered last week for delivery in August. An option has been taken on a second aircraft.

Krupp directors and executives will use the HS.125 for high-speed travel between the group's factories in the Ruhr and other parts of Germany and its markets throughout Europe, the Middle East and North Africa.

Shackleton Pilot's Skill

The crew of ten escaped with only minor bruises when an RAF Shackleton of 120 Sqn, Coastal Command, crash-landed in flames six miles east of Inverness on the night of January 10. The aircraft had taken off from Kinloss about 30min before.

Fire broke out in the air and an engine dropped away, but the captain, Flt Lt J. "Pop" Gladstone, landed the aircraft on rough ground near Culloden. All the crew escaped through hatches before the fire reached the 4,000 gallons of fuel and the explosive stores aboard. The aircraft was completely destroyed.

As we closed for press the RAF Kinloss mountain rescue team, assisted by RN helicopters, police and civilians, were searching for the missing engine in the Beauly Firth area, west of Inverness. Finding it may indicate the cause of the fire.

COMFORT AND DECOR

NEXT WEEK'S ISSUE of *Flight International*, dated January 23, will contain special features concerned with the furnishing and finishing of aircraft interiors.

Germany Plans Ahead

The German Government, Defence Ministry and industry now have an overall plan to utilize the production, design and development capacity of the aircraft industry. In the civil field, the Ministries of Transport and Economics are to provide 60 per cent of the pre-production costs for the following types:—

Hamburger HFB.320 Hansa executive jet, for which about 40 per cent of the cost is accounted for by sub-contractors; Dornier P.350, a transport based on the Do28, but powered by two Wankel rotary engines; Dornier Do32Z (Zweisitzer), two-seat version of the Do32E (Einsitzer) prototype, which is already flying; Bölkow Bo105, a four-seat rigid-rotor helicopter powered by BMW 6022 turbines; and Siebel SIAT 223, a two-seat club aircraft, winner of the WGL design competition and powered by a 150 h.p. Lycoming. Government contributions will total DM17.8m in 1963, DM31m in 1964, DM37m in 1965 and DM43m in 1966. It is probable that a Viscount replacement for Lufthansa will be either a version of the HFB 314 or a joint German, Fiat, Fokker and French design.

Work for the 5,800 people now engaged on F-104G and G.91 production will run down in 1965 and Defence Ministry and industry are working out a ten-year plan to keep at least 4,800 people employed. For

High Season for Heavy Haulers *Another heavy logistic transport to make its maiden flight in recent weeks (that of the RAF's Belfast is illustrated on pages 94-97) was the Lockheed C-141 StarLifter for the USAF, which flew from Marietta, Ga, on December 17. Like the Belfast it spent 55min aloft. First aircraft to be designed and developed under USAF-FAA co-ordination, the StarLifter will carry a maximum payload of over 70,000lb. That of the L-300 commercial development will be 96,000lb. Four P & W TF-33-P-7 turbofans deliver over 84,000lb thrust. The StarLifter will span any ocean non-stop and carry 154 troops or 123 parachutists and their equipment*

WORLD NEWS . . .

the more immediate future, a batch of 32 TF-104Gs and a third of the G.91Ts needed are to be made in Germany. Work on a five to six year programme to make 110 Transalls is starting this month, with the type entering service in 1966-67. A subsonic V/STOL close-support fighter in even greater numbers than the G.91 will become operational in 1968-69. The type will be chosen, in accordance with the German/Italian agreement, between derivatives of the Fiat G.95/4 and Focke Wulf FW 1262. These and other projects to the same specification are known under the general designation VAK 191. The F-104Gs will remain in service until after 1970, but Germany is co-operating with France to produce a VTOL successor which will be bought in small numbers. Finally, there is a requirement for 300 medium helicopters. The choice seems to have fallen on the Sikorsky S-61R, but the possible need to accommodate the Pershing missile favours the Boeing-Vertol Chinook.

With a view to developing aircraft for common NATO use the Defence Ministry is financing development of the EWR VJ-101C VTOL research prototype, in X-1 subsonic and X-2 supersonic versions; the VJ-101D with longer-range reconnaissance capability and with Rolls-Royce RB.162 and RB.153 powerplant; the Dornier Do31 light VTOL transport in two versions; the Bölkow Bo46 Derschmidt rotor prototype (with Boeing-Vertol co-operation); and the Weserflug-Sikorsky WFS-64 crane helicopter.

Private-venture industry projects include the Bölkow P.310 twin-Derschmidt, twin-turbine airline helicopter; Focke-Wulf FW 260 and FW 300 VTOL transports; army reconnaissance aircraft such as the tilting propeller Heinkel He 212, VTOL Weser P.16 and P.23 and STOL Dornier Do28C; and Weserflug-Sikorsky twin-turbine airline helicopter.

LOH (and High) Flyer *Hiller's OH-5A turbine-powered light observation helicopter was the first delivered to the US Army last month for a 15-aircraft, three-manufacturer competitive evaluation for the next battlefield equipment, as reported in this journal on December 26. "LOH" hardly signifies lack of altitude capabilities: an OH-5A has been flown to 22,400ft during flight tests. The four-seat aircraft has reached 140 m.p.h. Its competitors are being fielded by Bell and Hughes*

RAAF Seeks a Jet Trainer

The Royal Australian Air Force is now working toward specifications for the all-through jet training equipment it intends to introduce in about four years' time. The Australian aircraft industry needs a new project if its design teams are to remain in existence—the Commonwealth Aircraft Corporation at present has no project to follow its current production of the Dassault Mirage IIIC fighter.

The Department of Supply is known to be considering several design-studies and to be evaluating engines in the 2,500lb to 5,000lb-thrust range. But the RAAF is reported to be undecided between having a two-trainer curriculum or aiming for one jet trainer to meet the entire requirement. Adoption of a two-aircraft curriculum would call for a locally designed and produced primary trainer to replace the CAC Winjeel, for which the BS Viper engine, already used in several types of jet trainer and familiar to the Australian industry in the Jindivik target drone, must stand a good chance.

Hanover Show Reminder

The International Hanover Air Show will be held next year between April 24 and May 3 at Langenhagen Airport, Hanover. Organized by the Bundesverband der Deutschen Luft- und Raumfahrtindustrie, it will run concurrently with the general industrial Hanover Fair. British agents of both the Air Show and Fair organizers are Schenkers Ltd, Royal London House, Finsbury Square, London, EC2 (METropolitan 9711).

AIR COMMERCE

BOEING 727s FOR JAPAN

BOTH Japan Air Lines and All Nippon Airways have decided, like TAA and Ansett in Australia, to choose Boeing 727s for domestic operations. This decision concludes one of the most intensive commercial sales battles of recent years, and it must obviously be regarded as a severe blow for the Trident.

It was announced by Japan Air Lines in Tokyo on January 13 that they have ordered four Boeing 727s, with an option on two. All Nippon have ordered three 727s at a cost which they give as $4.7m each plus spares and equipment for the fleet valued at $4.9m.

DECISION FOR THE FERRYMEN

AUTAIR'S applications to operate vehicle ferry services from the north London airport of Luton to the Continent have been refused by the ATLB. At the same time BUAF's applications for new Carvair services from Coventry, with which the Autair applications were directly competing, have with minor qualifications been granted. Air Ferry's applications to operate vehicle ferry services from Manston to Calais, Dijon and Toulouse are dismissed, but this operator's requests to ferry cars to Le Touquet and Ostend from Manston, and also between Le Touquet and Belfast, are granted.

The hearings were reviewed in our issue of November 14, 1963, page 786 (" Three Ferrymen ").

TO PUT IT ACROSS

LORD NORMANBROOK, 61, former Head of the Civil Service and a former Cabinet Secretary, has been appointed by the Minister to be a member of the BOAC Board. Welcoming the appointment Sir Giles Guthrie, BOAC's chairman, says: "I shall especially value the advice Lord Normanbrook is uniquely qualified to give on the manner in which my proposals for the future of BOAC should be presented to the Government . . . At one time it seemed that he would be available only in an advisory capacity: as a Board member he will be able to help even more effectively."

Footnote Mr R. M. Forrest, BOAC's solicitor, succeeds Mr Kenneth Staple as secretary of the corporation. Mr Staple made it known in 1961 that he intended to retire at the present time.

ROTTERDAM'S FATAL DYKE

THE BUAF Carvair accident at Rotterdam at 1100hr on December 28, 1962, is the subject of a Dutch report issued on October 30 and published* by the MoA on January 10.

The Dutch investigators find that the commander, Capt J. B. Tootill, who was killed, made the final approach (his 120th to this runway since April 1961) below the glide path and with insufficient power. The aircraft hit a dyke 240m before the threshold and turned over. The co-pilot was badly injured but the 14 passengers were unhurt

There was considerable snow-covering, and the red and white obstruction markers on the dyke had not, says the report, been cleared of snow. A special inquiry, involving a number of DC-3 test approaches, found that the dyke did not stand out against the surrounding terrain; that the approach lights could not be distinguished; and that the threshold lights were not clearly visible. However, in the opinion of the Dutch investigators, the aircraft would still have hit the ground a considerable distance short of the threshold even if there had been no dyke, " although possibly with less fatal consequences."

* *Report of the Netherlands Air Accident Board, Carvair G-ARSF, published as MoA document CAP 201, HM Stationery Office, London, 1s 3d.*

EROS APPEAL LOST

THE onus is on an operator to convince the ATLB of its financial fitness, and it is not the Board's duty to stipulate minimum requirements or to approve or disapprove financial plans. This controversial finding is handed down by Sir Ralph Hone, the commissioner who heard the Eros Airline appeal against the ATLB's refusal—on grounds of financial unfitness—of two Gatwick - Perpignan charter licences. The Minister upholds this finding, published on January 9.

Eros complained to Sir Ralph that the Board had not given them an opportunity to discuss their plans and had not given a measure to the required finance. Sir Ralph concluded that the Board had " given the closest attention to the financial position of the company over a considerable period," and had " properly exercised the discretion vested in them."

The appeal hearing brought out financial facts and figures which are not normally made public. In their first year of operation Eros lost £23,000 (which they said was fully anticipated) and a small profit would probably be made in the second year. Eros considered that £30,000, the purchase price of their three Vikings, was a fair valuation, and £6,000 had been set aside in the June 1963 balance sheet for " checks, replacements, renewals and depreciation." Eros told the commissioner that " all commitments have been honoured and there are no major creditors," adding that they were in a position to increase their capital. Sir Ralph Hone's report takes note of Eros's contention that the Board were satisfied with the company's operational competence.

CHANGES AT THE TOP

THERE has never been a year bringing so many changes in the leadership and in the equipment of British air transport. The year will see making their debut into public service three completely new types of rear-engined British second-generation turbine aircraft: the BAC VC10 with BOAC, the DH Trident with BEA, and the BAC One-Eleven with British United. There are to be, or have already been, major changes in the leadership of BOAC and BEA, and less publicized but important reorganizations in both British United and British Eagle, the two leading independents.

But even less publicized have been the major changes in the Ministry of Aviation's civil aviation staff. Two of the most senior people who have long been the grey eminences behind succeeding

Mr R. Burns, new Deputy Secretary (B), Ministry of Aviation (see "Changes at the Top")

This BEA S-61N is not off course between Land's End and the Scillies, but over New York's East River on pre-delivery trials from NYA's Manhattan heliports. The pilot is Capt J. A. Cameron, general manager of BEA Helicopters Ltd, which will be introducing two S-61s into service between Land's End and the Scillies in May. Summer weekend day return fare is £4 6s, or 6s more than the Rapide fare

AIR COMMERCE...

Ministers—Mr Michael Custance and Mrs Alison Munro—have both left, taking with them all the expertise and continuity that they brought to the administration. Both Michael Custance and Alison Munro were, in a quiet way, responsible for much of the creative thinking and initiative on their side of the Ministry.

Succeeding Mr Custance as Deputy Secretary B, and warmly welcomed by the industry, is Mr R. Burns, CB, CMG. Mr Burns, who has already been in action discussing the Anglo-Scandinavian bilateral air agreement (see below), was born in 1912 and educated at Hamilton Academy and Glasgow University. He has had a very varied career in the Civil Service, which he entered in 1936. He served first in the Dominions Office (now Commonwealth Relations Office) and the Colonial Office. During the war he was first in the Ministry of Supply, where for a time he was Lord Beaverbrook's private secretary, and then in the Ministry of Production before moving to the Board of Trade in 1945.

Apart from three years when he was Counsellor in the Embassy in Washington, he served as an Assistant Secretary in the Board of Trade until 1953, gaining a wide experience of international trade, particularly in relation to Europe and the Commonwealth. He then became an Under Secretary at the Ministry of Supply and later at the Ministry of Aviation handling in succession the financial and policy aspects of the Royal Ordnance Factories and of the guided weapons and electronics programmes. Before his present appointment he was the Principal Establishment Officer.

Mr Burns is married and lives in Highgate where his family of four children has kept him from premature solemnity. He finds time to play badminton in the winter. He sees less of Scotland than he would like but finds Exmoor a good substitute and travels abroad as often as he can.

SAS AND GLASGOW

NEGOTIATIONS on the Anglo-Scandinavian bilateral air agreement moved from Glasgow to Stockholm on January 6. Mr Robert Burns, successor to Mr Michael Custance at the Ministry of Aviation, led the British delegation. The Scandinavian delegation included Mr Henrik Winburg of Sweden, Mr Hans Jensen of the Danish Civil Aviation Board, and Mr Alf Heum of the Norwegian Civil Airways Board. The talks ended, apparently inconclusively, on January 9.

Differences have been mainly concerned with landing rights for SAS at Prestwick. Officially the bilateral is up for its five-year review but recently BOAC have been exerting pressure on the Ministry to end SAS's fifth freedom rights at Prestwick on the Scandinavia-North America transatlantic service. BOAC are said to have pointed to the note in the recent White Paper which mentioned that it may soon be necessary to make adjustments to the traffic rights enjoyed by foreign airlines whose countries do not or cannot provide comparable benefits for British airlines.

But powerful Scottish bodies view the BOAC move as a serious threat to Prestwick and indirectly to Scandinavian-Scottish interests —interests which Mr Burns, a Scot, has no doubt considered.

STARWAYS SUMMONSES

A NUMBER of summonses served on Starways for alleged infringements of the Air Navigation Order, and which were due to be heard on February 4, have been withdrawn by the Director of Public Prosecutions. Since the summonses were served the company has been taken over by British Eagle.

A spokesman for the office of the Director of Public Prosecutions was last week unable to give any details of the nature of the summonses.

AMERICAN SST EVALUATION BEGUN

MORE than 200 technical personnel from four civilian agencies and two military services comprising the Federal Aviation Agency's Supersonic Transport Evaluation Group, met in Washington on January 6 to begin the process of selecting designs for the United States SST. Final date for manufacturers to submit design studies was January 15.

Mr Gordon M. Bain, FAA deputy administrator for SST development and chairman of the group, said in announcing this stage of the SST programme: "The evaluation group has before it a demanding task, one that is worthy of the notable past experience of its broad membership. This task will be to conduct an objective, skilled, painstaking evaluation of competitive proposals to determine which, if any, can result in a safe and economically sound United States supersonic transport.

"On the basis of the multiple analyses to be performed by these evaluators, we will be able to select manufacturers to go forward with construction of the SST. Or, on the other hand, it may be that we will find wisdom directs us to modify the programme to a significant extent. Our purpose is to be certain, whatever the decision is, that it is the right one, based upon the most comprehen-

sive evaluation in the history of commercial air transport. We owe this to the nation, to the taxpayer, to the competing manufacturers, and to the future of aviation."

Three airframe and three engine manufacturers are taking part in the competition for SST development contracts, which will carry a Government subsidy. The airframe manufacturers are Boeing, Lockheed and North American, and the engine builders are General Electric, Curtiss-Wright and Pratt & Whitney.

The FAA evaluating group will analyse and evaluate the designs for development potential from the technical, operational, management and economic points of view according to a scoring system notified to manufacturers when the design proposals were requested. The evaluation should be completed by early March. At the same time, ten airlines will independently study the proposals. The airlines are: American Airlines, Braniff, Continental, Delta, Eastern, National, Northwest, Pan American, TWA and United, and their findings will be submitted to the FAA by March 18. Government and airline evaluations will be formally reviewed in joint Government-airline discussions scheduled for March 25 and 26 in Washington.

On May 1 the FAA administrator, Mr Najeeb Halaby, will announce selection of airframe and engine contractors to proceed with a year-long detailed design competition. If no proposals meet the requisite technical and economic design criteria (*Flight International*, December 19, 1963, page 990), the programme may be redirected.

RECOMMENDATIONS ON LIGHTNING AND JP.4

BOTH the Civil Aeronautics Board and the Federal Aviation Agency have issued recommendations to reduce the hazard of lightning strikes.

According to reports, the CAB are convinced that a lightning strike caused the PAA 707 accident near Elkton, Maryland on December 8. In a letter to the FAA, the Board recommends that an investigation should be held into the possibility of redesigning the flame arresters designed to protect fuel tank vents from static electrical discharges and lightning. Of even greater significance is the Board's view that kerosine should be used in turbine aircraft in preference to the more volatile JP-4.

Although there is some argument on the usefulness of static dischargers in protecting aircraft from lightning, the FAA have recommended airline operators to equip them to all their jet aircraft. No deadline is suggested by the Agency, but a prompt response has already been indicated by the operators who are participating with government agencies in the intensive work now going forward on the lightning problem.

The Agency's recommendation was based on the fact that the wicks can improve airborne communications by draining static electricity from the aircraft and could conceivably offer some slight protection from lightning, though there is no agreement among those working on the problem that this is the whole solution.

AMERICAN AIRLINES' FAMILY PLAN

THE Civil Aeronautics Board have approved American Airlines' proposal to allow fare discounts of up to 25 per cent to families travelling together. Under the new rate structure, which came into effect yesterday, January 15, family discounts of 25 per cent apply on all the airline's coach and first-class services from noon on Mondays to 1800hr on Fridays. In addition there are reductions ranging from 5 to 15 per cent in all first-class fares on flights of more than 700 miles.

Marion Sadler, American's vice-president and general manager, says that he expects the lower fares to increase sharply the already noticeable trend among businessmen to travel first class instead of coach. Mr Sadler also says: "Since American proposed these new fares, we are naturally delighted that the CAB has approved them. We believe they will greatly benefit not only travellers but the airline industry as well."

SUPER HERON?

ACCORDING to the US National Association of Third Level Airlines, a stretched de Havilland Heron may be the answer to the short-haul needs of local service and third level carriers in the USA. In a letter to the chairman of the CAB, Mr Alan Boyd (as reported in *Aviation Daily*) NATLA notes that the Heron has an empty weight of 8,500lb, gross of 13,500lb and is powered by four 250 h.p. engines weighing 530lb each. "These engines can be replaced with the new 250 h.p. turbo engines (125lb each) with a total weight saving of 1,600lb," it says. "As the weight is replaced by the smaller engines, the fuselage can be lengthened forward of the spar so as to maintain centre of gravity. This would allow an estimated four to six more passengers, giving the plane a potential 21 seats." With lighter engines, understood to be Continentals, and allowing a 500lb increase for extending the fuselage, empty weight would be 7,400lb and gross 13,500lb, making possible carriage of 21 passengers and baggage and 800lb to 900lb of freight. Use of a 13,500lb aeroplane would require a change in the air taxi exemption which limits operators to 12,500lb gross.

"Further consideration should be given also to the installation of a higher horsepower turbo engine which we understand is now available and suitable for the Heron," NATLA says. "This would result in an increase in the carrying capacity with but slight increase in gross weight. Also, the installation of two 500-600 h.p. turbo or piston engines in lieu of the four engines should prove a satisfactory plane for the short-haul operations we are conducting. The Heron has been manufactured for a number of years and the production tools and engineering we assume are written off. It thus appears this plane can be produced at a much lower price than a new design and can be delivered much sooner." The letter to Mr Boyd, signed by Merrill Armour, NATLA executive secretary, made the request asked that "this matter be investigated promptly" by the CAB.

His Holiness Pope Paul VI flew by Alitalia DC-8 to the Holy Land for his recent historic visit. The crew of 11 included six stewards and, from third left, Capt G. M. Zuccarini, Capt Sergio Mosetti, 1st Off Alessandro Ragionieri and Engineer Aldo Stagliano. The DC-8, a newly delivered aircraft, had made two proving flights between Rome and Amman

Boeing's first export 727, one of 12 aircraft for Lufthansa, will be handed over to the airline for crew training at the end of next month and will be delivered in mid-May. By July six will be in service on Lufthansa's European and Near East networks

AIR COMMERCE . . .

Douglas v BAC

BETWEEN aircraft as similar as the BAC One-Eleven and the Douglas DC-9 a tough sales battle is inevitable, and sounds of knocking have been reaching the pages of the public print. It began on November 27 when the *Aviation Daily* reported that IATA's technical committee, which attended a DC-9 briefing recently, were told among other things that the DC-9 had 150 fewer systems components than the BAC One-Eleven. Douglas supported the statement with the following:—

Systems	BAC One-Eleven	DC-9
Air	104	83
Hydraulic	192	130
Fuel	66	61
Electrical power	26	25
Flap support and actuating systems	94	24
Total	482	323

BAC subsequently issued their version of the Douglas comparison of the two jets. The sensitive competitive areas are well highlighted in the BAC point-by-point answer:—

Zero fuel weight The One-Eleven Series 400 has a z.f.w. of 64,000lb, not 61,500lb as credited to it by Douglas.

Weight limited payload BAC One-Eleven is 17,930lb, not 15,430lb. BAC also revises DC-9 operating weight upwards from 45,970lb to 47,300lb to account for 1,000lb of expected weight growth to adjust for the a.p.u. in the One-Eleven which the DC-9 does not have. BAC One-Eleven comparable operating weight is 46,070lb.

Payload/range performance BAC curve shows its -300 version with slightly higher payload than DC-9 out to about 620 miles at which point the DC-9 begins to trade payload for fuel while the One-Eleven holds maximum payload to 800 miles. BAC gives the One-Eleven a 2,000lb payload advantage over the DC-9 at this range.

Operating cost BAC pegs the One-Eleven 400 series at about 12 cents per aircraft mile less than the DC-9 for ranges from 200 to 1,000 miles due to (1) lower first cost, (2) better fuel economy and (3) a smaller, therefore lighter, aircraft. BAC notes that the 10ft longer DC-9 fuselage results in a cabin only 2ft longer.

Take-off distances BAC adjusts the DC-9 upward from 4,950ft to account for expected added operating weight and to correct for a.p.u. and ventral stair which the DC-9 does not have. It also adjusts One-Eleven downward from 5,500ft to account for added thrust of Spey 511 giving both aircraft a take-off distance of 5,400ft. BAC lists both aircraft with a 122kt approach speed but gives the edge in cruise to the One-Eleven at 354kt at sea level versus 350kt for the DC-9.

System components BAC footnotes the Douglas comparison of system complexity with a caution on non-comparability of many systems. For example, the numbers cited by Douglas for the One-Eleven include an a.p.u., three generators instead of two and two sets of powered stairs, none of which is on the DC-9. On the flap system comparison, for example, BAC points out that 30 of the 54 maintenance points credited to the BAC One-Eleven by Douglas require no maintenance and therefore the respective figures for the BAC One-Eleven and DC-9 should be 24 versus 12.

Warning lights BAC says the One-Eleven has 35 cockpit warning lights of which 26 require action. On the DC-9 the numbers are 46 and 35.

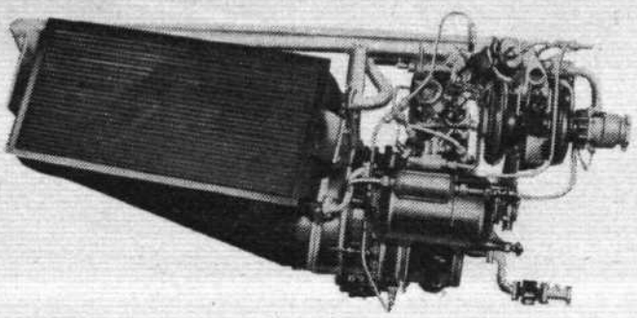
Window maintenance The BAC One-Eleven has only four, not six, fewer windows than the DC-9, say BAC. It also features four quick-release clips which permit a window replacement in 30min and this compares with 24 bolts on each DC-9 window which will require an unknown number of hours to change a window.

Fuel consumption BAC places the fuel consumption of the JT8D at 7 per cent above that of the Spey, with 0.8 per cent in lower s.f.c., 4.1 per cent from greater drag of the JT8D pod, 1 per cent from higher engine weight and 1.1 per cent from weight of additional block fuel, residual fuel and structural weight. In operation, BAC estimates the JT8D as 8 per cent higher in fuel consumption during high speed cruise, 7 per cent in average cruise, 8.3 per cent in long-range cruise, 11.4 per cent in holding at low altitide and 14 per cent at ground idle. BAC pegs the weight of the bare JT8D engine at 3,021lb and the Spey -25 at 2,315lb. For cruise s.f.c. its figures are 0.8222lb/hr for the Spey and 0.8286 for the JT8D, a difference of 0.0064.

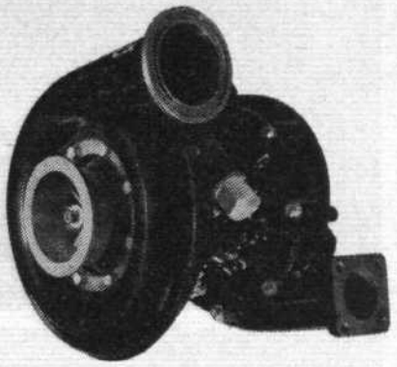
Of the 23 "advantages" cited by Douglas for the DC-9 over the BAC One-Eleven, British Aircraft Corporation deducts 15 leaving only eight. However, its own list of BAC One-Eleven advantages over the DC-9, which now includes an item "100 per cent financial programme responsibility," totals 24.

It will be recalled that an anonymous brochure on the DH Trident published last year was answered by a signed DH comparison of the Trident and the Boeing 727.

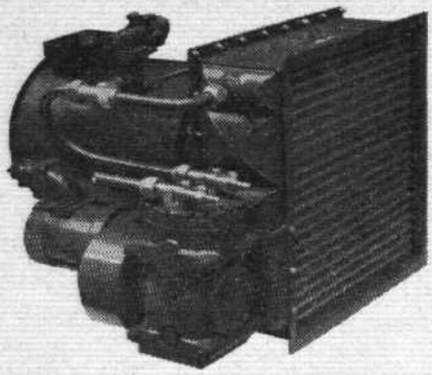
Footnote In a letter to Sir George Edwards of BAC Mr C. R. Smith, president of American Airlines, has written: "Don't worry about our confidence in the One-Eleven. Accidents in aviation are always regrettable and the accident to the One-Eleven especially so because you lost some fine and valued associates. But the problems that brought about the accident can and will be removed and the airplane will be a welcome addition to our fleet as soon as you can make it available. It is encouraging to learn that delays in deliveries to American may be quite modest."



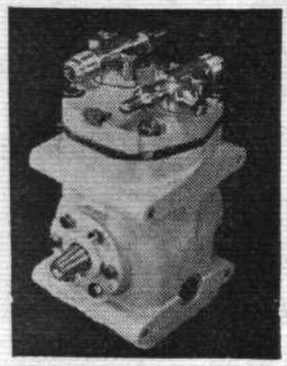
Vapour cycle pack for passenger compartment cooling in large civil aircraft.



Centrifugal compressor—
max. refrigeration capacity 15 tons.
(Overall size approx. 12" x 11" x 10")



Transportable cooling pack suitable for a wide variety of airborne and ground applications.



Reciprocating compressor—
max. refrigeration capacity 3 tons.
(Overall size approx: 9" x 6½" x 5")

vapour cycle VERSATILITY

Normalair vapour cycle cooling systems can be supplied to meet a wide range of applications and in a variety of design configurations to meet specific operational requirements.

Systems are available or can be developed to suit all types of airborne or ground cooling applications, the basic component in all cases being a high performance refrigerant compressor which may be either a reciprocating or a centrifugal type depending upon the required duty.

Typical examples of current applications of Normalair fixed or portable vapour cooling systems are:

AIRBORNE Aircraft passenger and crew compartments ☐ Aircraft radar and other electronic equipment ☐ Aircraft freight holds ☐ Aircraft galleys and compartments Guided missiles ☐ Air cushion vehicle cabins ☐ GROUND Pre-flight cooling of aircraft cabins and equipment ☐ Radar and other electronic equipment ☐ Guided missiles — pre-launch cooling ☐ Medical research chambers ☐ Control compartments — fixed or transportable ☐ Road vehicles ☐ Oil cooling

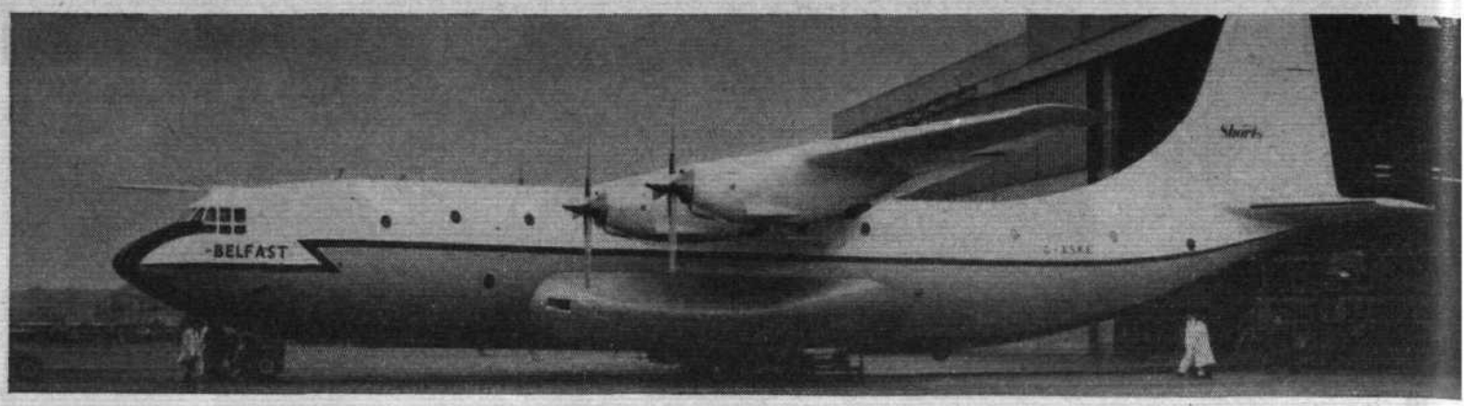
Normalair vapour cycle cooling systems are in all cases designed to occupy a minimum of space and are in current production to meet any refrigeration load requirement within a range of 1-18 tons.

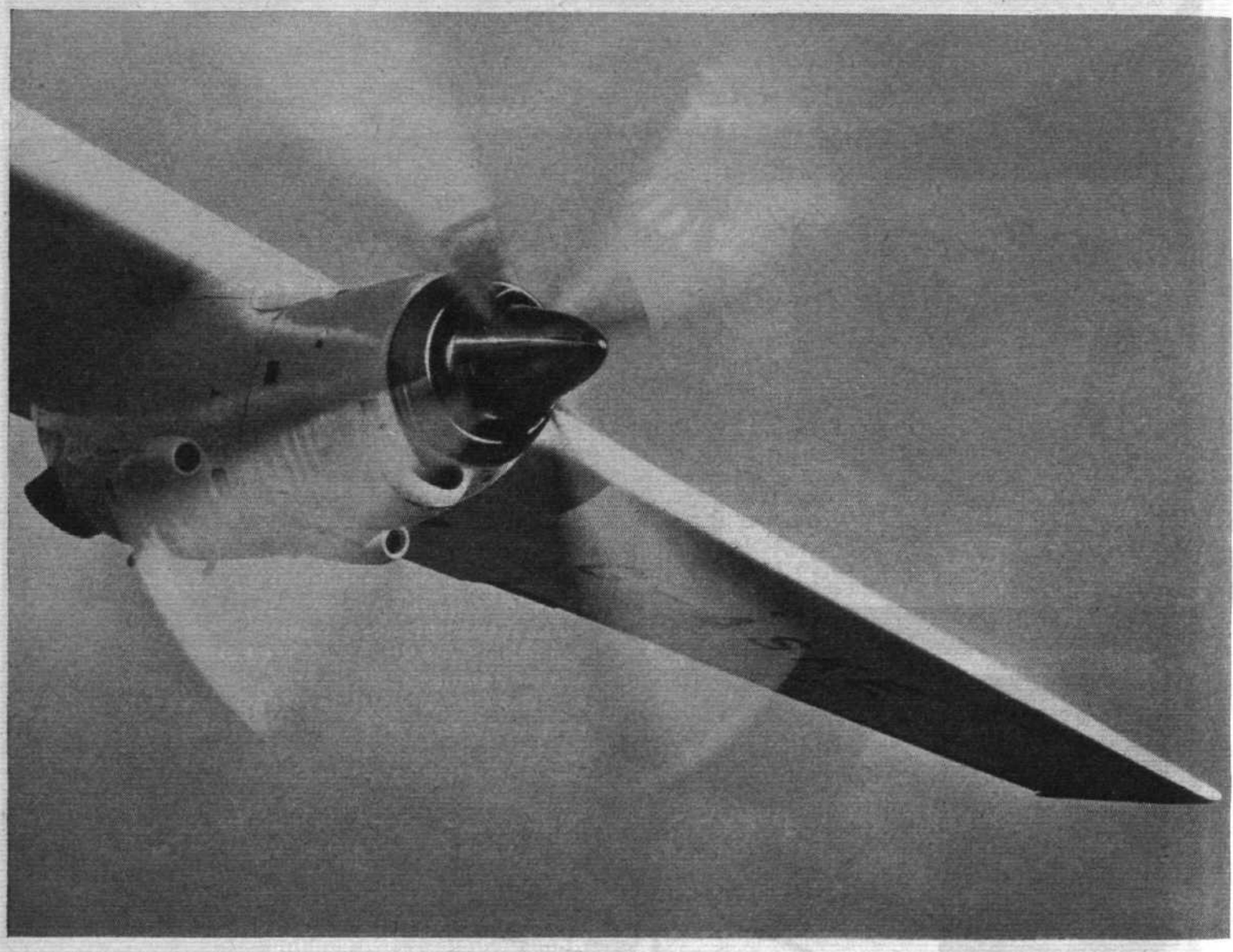
NORMALAIR YEOVIL SOMERSET ENGLAND

A member of the Westland Group of Companies

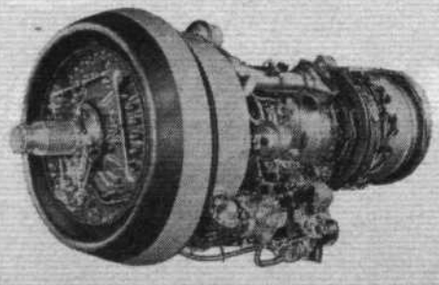
Europe's largest and most experienced producers of aircraft cabin air conditioning systems and components

Normalair (Canada) Ltd., Toronto Normalair (Australia) Pty. Ltd., Essendon, Victoria





THE Short Belfast strategic freighter is powered by four Rolls-Royce Tyne propjets of 5,715 t.e.h.p. each. The Tyne is a high-efficiency engine designed to provide low cost operation for transport aircraft. It powers the Canadian Forty-Four and Yukon, the Vickers Vanguard, the Transall C-160 and the Breguet Atlantic. The Tyne is in service or on order for six armed forces and six international airlines.



ROLLS RR ROYCE

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C.C.J's COLUMN

V_1, V_2 AND ALL THAT

SOME time ago the Editor confided to me that he had always been somewhat vague in his understanding of V_1 and V_2 but that now V_r, V_{ref}, V_{mc}, M_{no}, etc, were coming into daily operational use, he was completely confused; no glossary contained the lot and, even if one tracked down an official definition here and there, it did not necessarily supply an answer in terms which the layman, or even the average pilot for that matter, could readily understand. Could I not write out a few definitions in popular form, in the hope that they would catch on and last for at least the next decade or so?

I have jibbed at the job for a month or two: I recognize the desirability of some catchy definitions but how can one make an attractive article from V_1, V_{mcg}, V_{no}? Another deterrent is the sheer proliferation and complexity of the terms. I find that over a score are in common use and that many of these have variants according to country or manufacturer; some of the variants are exact equivalents but some contain small though significant differences. Thus the speed between the point where the aircraft leaves the ground and the point of initial power reduction will be referred to, with very nearly unanimity, as take-off safety speed, initial climb-out speed, or as V_2, V_{2min}, V_{ref}. The slight nuances between these terms tend to vary according to the individual national code or to the date of the publication in question—the different connotations of each emerging only as new specifications evolve to match the new concepts of the designer. No wonder the Editor gets confused. I am.

However, with the tacit (though as yet unratified) acceptance of the ICAO PAMC (Provisional Acceptable Means of Compliance) on performance, the industry as a whole seems to be settling for the standard terms of the ICAO Airworthiness Committee. Only when these definitions seem too drastic (as in the definition of the stall*) does a manufacturer tend to introduce his own version and attempts to talk a certificating authority into accepting it. With this encouraging trend and with an obvious and growing need for a *practical* set of definitions, I propose, in the next few articles to have a go at the job.

However, before one can even make a start it is necessary, in the interests of arriving at fairly brief definitions, to lay down quite a string of ground rules.

First of all, I propose wherever possible to take the ICAO PAMC concepts and definitions as the norm and to treat the others as variants. Secondly I propose, with one or two exceptions (e.g., where it is desirable to keep related speeds close together), to start at the lowest speed and work up. On this basis I will first comment a little on each speed as we go along, then try to reduce it to a practical definition.

No Room For Feelings

I say "try to" reduce it because I am not sure that one can, in the true academic sense, reduce most of these definitions; many of them have been born out of fifteen years of controversy and in the course of this have acquired numerous subtle but important touches. For example, the minimum unstick speed (V_{mu}) used to be such that lift-off (V_{lof}) occurred at 1.12 V_{mu} or above. Another exception (5 per cent less margin) was made for aircraft which were difficult to stall on the ground because the tail bumper touched, and a modified definition was therefore introduced by which "geometry limited" aeroplanes need demonstrate only that V_{lof} is 1.07 times V_{mu}; finally this proved rather too much of a concession and aircraft taking advantage of this criterion had to conform to another, namely to demonstrate, just after lift-off at V_{mu}, a minimum horizontal acceleration of $\left(1.1\ \frac{V_{mn}}{V_{lof}}\right)^2$. By now someone will probably be trying to introduce a further qualification to that! These are subtle but important touches which cannot be ignored in certification. This is how the aerodynamicists and the certification authorities work. Good luck to them, but they do not have to fly the aeroplanes and, at the expense of hurting their feelings, they have to be told that one cannot arrive at a "practical definition" for use by pilots and operators on the basis of all these exceptions and qualifications. For our present purposes therefore, I propose to ignore all but a few of the exceptional cases. It does mean, however, that a true academic definition is out as far as I am concerned, and if anybody wants all the refinements, he must go to the official manuals.

Not that they will always help him; for example, if he goes to our appointed bible, the ICAO PAMC on Performance, and looks for the definition of V_r, he will find that it is "The rotation speed (see 6.2.5)"; and if he goes to 6.2.5, he finds, among other requirements, that V_r must produce a climb-out speed at 35ft of not less than V_{2min}; and if he goes to V_{2min}, he finds, among other things, that it has to be at least 1.10 V_{mc}; and, if he goes to V_{mc}, he finds, among other things. . . . In fact, I am not sure that anyone has yet got all the rounds and there seems to me to be more than a chance that the studious researcher who tries to do so could find himself with a 3d Underground ticket, going round the Inner Circle indefinitely: everything is fine so long as he does not want to get anywhere. However, let it not be said that we have no thought for the studious researcher, and for this reason we will supply him with the 3d ticket to start him off—in the form of leading references.

A Definition of Style

As a means of reducing the verbiage, I propose to apply what I call a "commonsense" set of conditions in all the definitions. For example, for all speeds applicable to the take-off and accelerate-stop, the power, flap setting, gear position, ground effect, etc, will be those normally associated with the take-off run—it would hardly be commonsense in the take-off case to assume a landing flap setting or a gear up configuration and I don't propose to spell out the obvious. But I mean a little more than simple commonsense: I mean also that all weightings will be *reasonably* on the adverse side. For example, the CG will always be adverse, the engine failure will apply to the most critical engine and the trim will not be moved during a critical manœuvre; on the other hand, automatic feathering and anti-skid braking may be assumed where they are fitted and proven and, additionally, no actual abuse of settings or controls will be assumed. As certification definitions are on critical values, the concept of "the expected configuration but the moderately adverse (though within range) setting" is, I believe, a "commonsense" line to take and it will simplify the definitions a great deal if throughout we can take this as read. Where, however, the assumption might lead to serious error, we will include the "conditions" in more detail.

Again, to keep the wording down, I will relate all definitions to the case of a four-engine aircraft; general principles, however, should not be different for threes and twos.

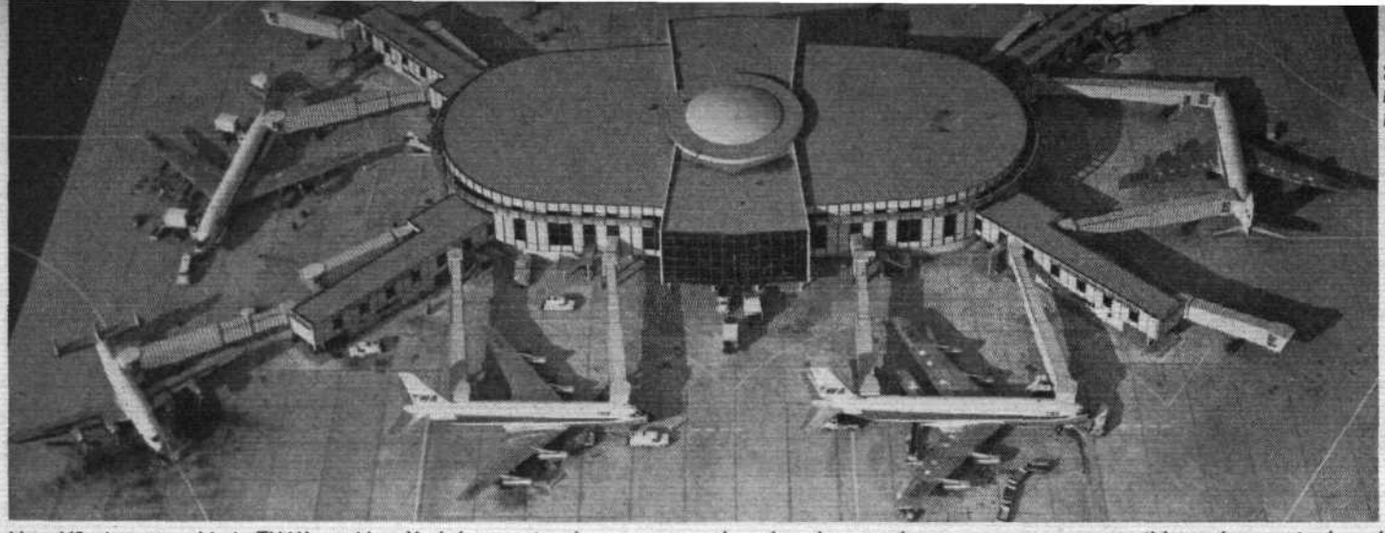
A useful convention in BCARs is that all the speeds which the certifying authority normally requires to be displayed in the cockpit (i.e., the "placarded" speeds) are annotated by an asterisk; I propose to keep to this and also, for added clarity, to mark the speeds which are used in design and in certification, but which are rarely needed for operations, with the symbol †.

One further editorial convention: I will use only small type for the suffixes; thus V_{no}, not V_{NO}. In a few cases this may look unusual. For example, I have never seen the lift-off speed written V_{lof}; it is always V_{LOF}; but there seems no special reason for these peculiarities and it would seem sensible to go in for uniformity while we are about it.

Finally, all speeds are, unless otherwise stated, in Calibrated Airspeed, that is the airspeed shown by the pilot's ASI, corrected for known position error but not for density or compressibility error.

With this clearing of the decks for a cut-and-thrust action the definitions of the principal operating speeds, I propose next week (?) to get down to business. At the end of the series, I will try to satisfy Roger Bacon and give all the recommended definitions, shorn of frills, explanations or qualifications, "on one sheet of paper."

* *See "Flight International," March 7, April 4, April 18, June 13.*



New US airports—this is TWA's at New York International—are arranged so that the aeroplanes are as near as possible to the terminal, and passengers can do as much for themselves as possible. Comments on the attention to cost-saving detail in the American airline industry is the subject of the article beginning on this page

AIR COMMERCE . . .

PROFITABILITY THROUGH PRODUCTIVITY

FLORENCE NIGHTINGALE directed the Indian sanitary commission from a bedroom in Mayfair, and from statistical data alone she reached vital conclusions about the health hazards facing the Army in India. Nevertheless, anyone who has not visited the airline industry's Mecca, the United States, must have some residual doubts about the validity of comparisons between that country and Britain.

While travelling on a tight programme unconnected with aeronautical matters, the opportunities for studying the industry are limited to personal experiences and to observations as a passenger. Yet this gives an opportunity to see the answer to a vital question: Why are British station staff costs so much higher than American, when the individuals are paid so much more in the United States?

The answer is "High staff productivity arising from a high level of managerial attention to detail." It is due to a myriad small simple improvements over the standard here, which must be described as managerially amateur and consequently wasteful of labour by comparison. In an industry where an unusually high proportion of expenditure, up to 40 per cent, is on pay and allowances, this is highly significant. A few examples illustrate the approach:—

(1) Book-in positions arranged so that baggage deposited by the passengers rolls across the scales. A girl clerk does the whole job: no beefy porters are needed.
(2) Flight documentation is done at the gate, usually within yards of the aircraft, eliminating document conveyors, squadrons of motorized supervisors, and tons of paper. At some major airports, a stewardess deplaned during transit-stops carries out the gate documentation.
(3) Tickets are collected in flight by cabin staff (this is on normal services, not air shuttle; a passenger list is checked at the gate).
(4) "Do it yourself" booking in by telephone at the check-in desk during slack periods.
(5) Passengers are encouraged to carry baggage up to 21in × 13in × 8in into the cabin, and larger pieces on aircraft equipped with special racks, such as American's Electras and Convairs.
(6) The use of glass-fibre baggage bins, holding 15 to 20 pieces, to minimize handling at the aircraft.

There are always a hundred and one reasons why "none of these ideas applies here." The vital principle, however, applies everywhere: it pays off to apply high grade managerial effort to the little problems. This seems to be routine throughout most United States industry; but many British managers, unfamiliar with the techniques involved, perceive only the technical differences when they visit the country, and overlook the organizational aspect.

Nearly all the conceivable economies in station staffing are achieved on the Air Shuttle services. On Sunday December 1, following the Thanksgiving holiday, it was planned that aircraft would leave La Guardia about every 20 minutes. The fleet of 39 aircraft allocated to the routes had to be increased to 46: over 20,000 passengers were carried. Yet there was only one traffic clerk, with occasional help from a supervisor, on duty at each of the two gates (for Boston and Washington). As each passenger was checked through, he deposited his baggage on a trolley which two loaders subsequently pushed a few yards to the aircraft. Ticketing was carried out in flight: the passengers themselves wrote their name and address on a boarding pass which was handed in at the gate. No reservations and few sales staff were needed, and thus the two largest items of indirect operating expense (traffic and sales) were cut to the very minimum.

It is for this reason that the Shuttle is almost undoubtedly profitable in an economic sense, though an orthodox accounting approach would have it stopped because revenues do not exceed the airlines' 86 per cent "average" overhead.

The lessons for airport designers are that priority should be given to Function rather than to Fine Art—though this need not entail eyesores. The poor functional design of the three terminals at Heathrow is a major cause of low staff productivity. Though nominally the responsibility of the Ministers of Aviation and Works, etc, it might be constructive for the airlines to say to themselves "Whatever has happened is our own fault. We failed to define our needs closely enough, and we failed to put them across to the Ministry planners with sufficient force."

A first principle is that the finger and gate layout does not achieve much until there are lounges, or at least waiting areas, at each gate, and the passengers are responsible for getting themselves there. When the nose of the aircraft is almost in the lounge, as it is in the American Airlines terminals at Idlewild and Los Angeles, for example, no shepherding whatever is needed. A door into the aircraft is opened and passengers board in three or four batches, divided up by pre-allocated seat numbers. Even where the passengers have to go into the open air briefly *en route* to the aircraft, no shepherds (or shepherdesses) were seen at any airport.

At Heathrow one of the biggest causes of aircraft lateness is that passengers get lost in the vast, overcrowded lounges, having ceased to listen to the myriad broadcasts that beat upon their ears. The language problem evaporates too.

The two-level layout, separating arriving and departing passengers and their vehicles, is a straightforward way of doubling the vehicle access and processing areas, which is widely exploited. It also automatically prevents the head-on clash of two armies of people moving, by definition, in opposite directions. Most of those arriving want to get away from the airport as quickly as possible: many of the departing passengers will have some time to wait.

Another design principle noted at New York and elsewhere is that of spreading the terminals out into a "linear perimeter" configuration, so that each company's aircraft are near the road network which feeds the passengers to them. Thus each airline's staff is concentrated into the minimum area, eliminating the huge distances that engineers and other staff travel at Heathrow, for example. An airport is a big place; aeroplanes are reasonably mobile; cars and buses can drive to any given spot; so why concentrate everything into a tight little island like Heathrow Central? Perhaps London airport (North) should be resurrected and extended around the whole perimeter, which is the only place where there

is any hope of accommodating the car parks now dominating the layout of all airports.

In most US cities, the airport buses are not allocated to specific flights. Frequently they start from the airport with a load of incoming passengers, drive round the downtown area, stopping at say four strategic points, and then return directly to the airport. Departing passengers are picked up at any of the stops, and the service runs every 10 or 15 minutes. Apart from passenger convenience, this improves the productivity of the buses and drivers over our "hangabout" system. From the airline viewpoint it makes the passenger responsible for getting himself to the gate on time, and it eliminates the cost of a town terminal.

Though a town terminal survives in New York, its future as anything more than a bus depot seems uncertain. Taxi fares from the airports are modest, by American standards, and the numbers using the buses seem to be small—a dozen were the most observed in six journeys.

Amongst all these symptoms of high staff productivity it is ironic that the aircraft themselves should be provided with so few seats by comparison with our "sardine style" layouts. In a recent flight by BEA Comet, the seat pitch was measured to be 30in, though whether this was standard or due to a mistake in the engineering department was not established. In North America, two aircraft only, a TCA Vanguard and a Continental 707 in economy class, had a seat pitch of 34in, and the Canadian aircraft had three-by-two seating in contrast to BEA's three-by-three. Otherwise coach-class passengers had 36in or 38in. A local service DC-3 provided a luxurious 40in, with seat rows of two-by-one.

Perhaps in Britain it is that competition has not been enough to force the airlines to concentrate sufficiently on cost analysis and

The Eastern Air Lines terminal at New York International, one of a dozen airline terminals at that airport, is as big as the Gatwick terminal
"Flight International" photograph

cost reduction. Some of the figures produced by BEA in particular bear the marks of an academic, traditional accounting approach in which the emphasis is on allocating every penny of overhead rather than on the "marginal" approach more appropriate to airline operation.

Perhaps there is again something to be learned from the past. At a recent administrative inspection of the Royal Army Medical Corps, the outside experts congratulated the Corps on the simplicity and functional excellence of their costing system, and asked who designed it. The answer was "Florence Nightingale." A. B. C. BODY

Under the Il-18's Cowlings

MORE has recently become known in Western Europe about the Ivchenko AI-20 4,000 h.p. turboprop engine which powers the Il-18 four-engined airliner, standard equipment with Aeroflot, LOT, CSA, Malev and other national airlines of the Communist *bloc*.

The Ivchenko AI-20 has a number of very unusual features, when compared with western turboprops, not least its reduction gearbox. With overall dimensions similar to the Dart gearbox, this transmits almost twice the shaft horsepower. Compactness is achieved by splitting the torque path along two routes, the two-stage epicyclic gear having a differential feature between the two gear trains, as shown in the accompanying diagram. The torque-meter system is similar to that of the Rolls-Royce Tyne engine, employing six piston and cylinder assemblies restraining one of the planet cages. The system is sufficiently accurate for test as well as flight purposes.

It seems a fair assumption that the same torque-splitting gear technique is used in the 15,000 h.p. Kuznetsov turboprops which power the leviathan Tu-114 now in Aeroflot service, with the likely difference that once the torque path has been split the individual drives go to individual components in the two-part propellers.

Propeller oil lines on the Ivchenko AI-20 are fed along cored passages through the reduction gear casing, over the gears to a large transfer sleeve around the propeller shaft. There is a third oil line to break-down propeller locks. Propeller blade actuation is similar to that on the Rotol Dart propellers, featuring a large piston with link pins to each blade root.

Main rotary components are a ten-stage axial compressor and a three-stage turbine running on a single shaft. The compressor end is of the balloon type, made up of separate rings, one for each stage. These rings are spigoted into each other with heavy intervening rings and are assembled hot, on a 25-ton press. The compressor blades are dovetailed into these rings and the lock tang for each blade features a small dowel which is an interference fit in drillings going through the spigot of each adjacent ring, so that each blade tang forms a dowelling feature between adjacent rings. It is not normal practice to dismantle the shaft at overhauls but if necessary it is possible to replace individual rings.

The turbine assembly is very similar to that of the Dart RDa.7, utilizing ten long bolts to hold the turbine wheels together and on to the shaft. Short dowels are fitted between adjacent rings and oversize dowels can be fitted, enabling any one disc to be replaced four times in one disc set. The turbine blades are set in the wheels with the normal fir tree roots and are unshrouded, but feature a small fin seal similar to that in the Napier Eland engine.

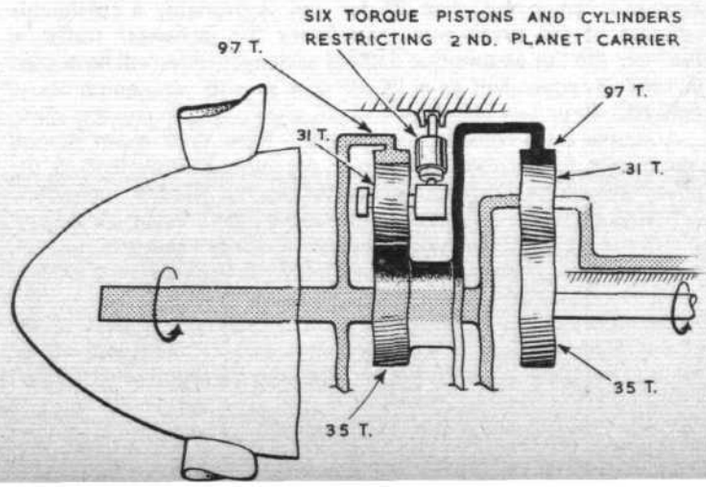
Ten cans in a common casing and duplex downstream burners comprise the combustion system. The fuel manifold is a rigid, small-bore steel-tube construction. The control system is completely automatic and there are no ground adjustments whatsoever to be made in service—a notable advantage for an operator over some much-used western turboprops.

But in overhaul life the Ivchenko AI-20 does not match such engines as the Dart, Tyne and Proteus. Recently, the overhaul life of the engines in the Polish airline LOT's Il-18 fleet was 750hr for a new engine and 600 for one already overhauled, though these figures may now have been increased, for Aeroflot is thought to be running its AI-20s through to 1,500hr.

Engine life development follows a similar practice to that adopted by British engine manufacturers—12 per cent of engines are trialled to 300hr more than the approved life. Aeroflot aims at an unscheduled removals rate of less than 0.3 per 1,000hr and this rate is being achieved. The most common failing is distress in the turbine resulting from temperature effects. Oil is changed every 400hr.

The engine is of handsome and "expensive" appearance; an engineer who recently saw some in Il-18s after lengthy operating lives said that they were immaculate, without a trace of an oil leak to be seen. All fuel lines, oil lines and so on are coloured according to their function—fuel lines and filters being bright red, oil lines and filters being brown.

Schematic diagram of the split torque-path technique which enables the Ivchenko AI-20 reduction gearbox, transmitting 4,000 s.h.p., to be no larger than a Dart gearbox transmitting about half as much. The figures indicate the number of teeth on each spur gear



TOO MANY BOAC AIRCRAFT?

WHEN Sir Giles Guthrie met the Press on his second day in office as BOAC's new chairman, he said that during the first six months his intention was "not to ask what people thought before but to have a new look." In the same spirit of enquiry this article is a probe into the fleet capacity inherited from previous managements.

Two years ago the Air Transport Editor estimated that BOAC would have a surplus of ten large jet aircraft by the mid-sixties. Since then important things have happened to create a new set of circumstances. The drag of the VC10 was higher than expected, some of the Super VC10s have been "change-ordered" with big freight doors, and IATA have devised an exciting new set of freight and passenger rates for the Atlantic routes. The calculation still shows that BOAC have an excess capacity problem, but in some ways the outlook is not quite as gloomy as it was two years ago. If the corporation can expand its passenger mileage by 13 per cent per annum without allowing its break-even load factor to rise, while at the same time developing a big freight business based on a capacity equivalent to about nine Super VC10s, then it should make a genuine profit. Whether the corporation can achieve growths of these orders will remain to be seen, but the prospect for the moment has not changed from the situation two years ago. BOAC have at least nine too many aircraft on order.

What is the basis of this conclusion? The table below contains an estimate of BOAC's generated capacity in 1967-68 when the all-jet fleet ought to be well established and the capital investment half way to being amortized.

Average Statistics of Each Fleet in 1967-68

Type	707	VC10	Super VC10	Mixed traffic Super VC10
Number in service	19	12	22	8
Block speed (m.p.h.)	445*	430†	440†	440†
Available capacity:‡				
Seats (Nc)	130	120	130	65
Freight (tons)§	8.5	3.5	9.0	16.7
Annual utilization† (hours)	3,100	3,600	3,000	3,000
Capacity produced:				
Seat-miles	3,400m	2,240m	3,790m	690m
Freight (ton-miles)	222m	66m	262m	176m

* 1962-63 achieved. † BOAC estimate (February 1962). ‡ For each type the total tons of available capacity is 80 per cent of the zero fuel weight payload; this is proportioned into seats (each occupant and baggage considered as 200lb) and freight-tons. In each case seats are made available first and the remaining tons allocated as freight (except in the mixed-traffic Super VC10, where the reverse is assumed). The number of seats used in each estimate is an average of the standard mixed-class layouts for that aircraft type. § Throughout the article, freight includes excess baggage, mail and diplomatic baggage as well as cargo.

The sum of the individual fleet outputs give total capacity-produced figures of 10,120 million seat-miles and 726 million freight ton-miles.

In 1962-63 BOAC's overall break-even load factor, after payment of interest, was 50.4 per cent. If it is assumed that during the next five years the reduction in operating cost will match the lower average revenue rate, then 50 per cent is probably a reasonable estimate of the break-even load factor for passenger traffic in 1967-68. On this assumption 5,060m passenger-miles will be needed in 1967-68, equivalent to a 13 per cent growth per annum above 1962-63.

A simple ratio between the London - New York mean general commodity freight-rate and a rate per pound equivalent to the off-peak economy class passenger fare is the basis for assuming here that 60 per cent is a likely break-even load factor for freight. This means that 435m ton-miles of freight will be needed in 1967-68, equivalent to a 35 per cent average growth per annum on the 1962-63 result.

When the estimated required growth rates are applied to the plot of BOAC's previous scheduled service traffic, the results can be seen as the dashed lines on Fig 1. Although the required passenger-mile line shows fair agreement with BOAC's estimate published in February 1962, both these lines seem optimistic compared with the trend of the previous five years, when sales derived impetus from the appeal of jet travel and low load factors. The all-time low fares which are about to come into force on the Atlantic will undoubtedly appeal to a bigger market and help to even out the summer traffic peaks, but load factors must rise for the airline to profit. Taking everything into account, the hoped-for growth may not be too optimistic for the corporation's Atlantic routes (some 58 per cent of BOAC's output) but Sir Giles may have to think of something fairly drastic for the eastern and southern routes, where traffic seems to be marking time.

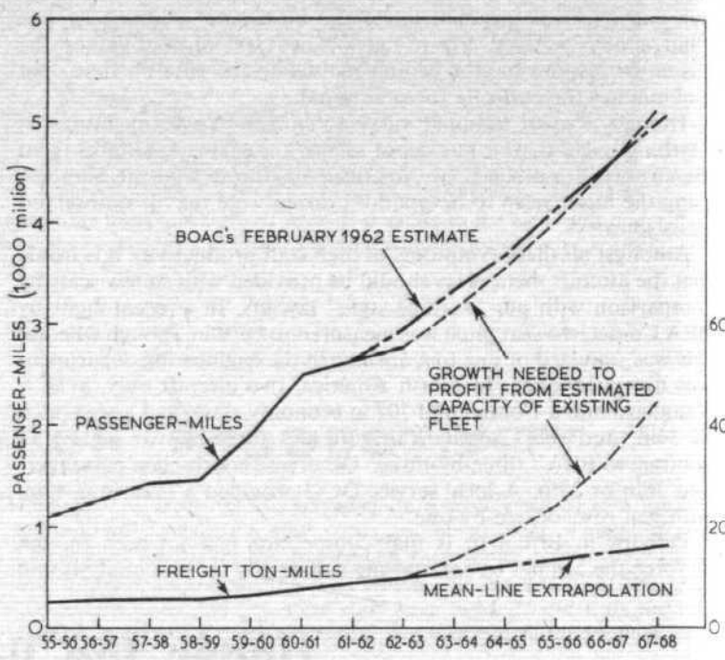


Fig 1. BOAC scheduled traffic in the past and estimates of the future

With the decision taken last September to order eight of the 30 Super VC10s for delivery with big side doors and strengthened floors, the corporation at last put itself in a position to enter the air freight business in a really big way. But as the graph shows the growth in this side of the corporation's business needs to be pretty phenomenal to mop up the remaining capacity.

A mean-line extrapolation of the freight traffic shows the need for almost a three-fold increase over what might reasonably be expected in five years of normal growth. In terms of all-freight Super VC10s the extra growth is equivalent to just over nine aircraft. If Sir Giles decides this is not possible, his one consolation will presumably be that it won't be quite so difficult to off load RAF Transport Command with mixed traffic VC10s as it might have been with purely passenger aircraft.

BOAC-CUNARD APPOINTMENT

SIR GILES GUTHRIE succeeds Sir Matthew Slattery as chairman of BOAC-Cunard, it is announced. At the same time Mr Ross Stainton, manager of BOAC's western routes, succeeds Sir Basil Smallpeice as managing director of this BOAC non-operating subsidiary.

According to Sir Giles Guthrie, "If BOAC-Cunard's results continue on target for the rest of this financial year a clear profit of around £1.5m can be expected."

It is also announced that Sir Giles Guthrie's appointment as chairman of BOAC is for a period of five years. Mr C. E. M. Hardie, Mr Anthony Milward and Mr Ron Smith are appointed part-time members for three years.

TMA DC-4 LOST ?

A TMA DC-4 missing on a flight from Beirut to Kabul via Kuwait on December 12 must now be presumed lost. The aircraft had a crew of three on board. If the aircraft crashed it will have been the ninth aircraft lost by this small Lebanese company since July 1959, with a total loss of 13 crew.

During the last year a TMA DC-4 was damaged by fire in the hangar at Beirut, injuring three people; a York was written off near Teheran with the loss of four crew in March; and a DC-4 was substantially damaged near Azaiba in January last year.

The TMA accident record was the subject of a note in *Flight International* for August 22, 1963, page 273.

Air Couriers' Adria Contract Air Couriers at London Gatwick are overhauling a DC-6B of the Yugoslav airline Adria.

Martins-Fairways Take-over Martins Air Charter have taken over the small Dutch company Fairways Rotterdam.

PAA's Dozen C-Jets Pan American have ordered a twelfth Boeing 707-320C, for delivery in 1965.

British Eagle Scottish Appointment Mr Ian Ritchie is appointed British Eagle's manager for Scotland and Northern Ireland. A Scot, he has represented TWA and also TCA in Scotland.

More DC-8-50s for Delta Delta have ordered two more Douglas DC-8-50s, for delivery before April 1965, to bring the DC-8 fleet up to 16 aircraft, of which ten have been delivered.

PAA-NYA Deal Reports of merger talks between PAA and NYA, the New York helicopter airline, are referred to in a recent *Interavia Air Letter*.

Jets and Turbulence The November/December issue of *Boeing Airliner* contained an article discussing the effect of turbulence on jets and recommending higher turbulence/penetration speeds.

£A15,000 for Lost Licence An Australian pilot, Capt J. W. Burgess of Qantas, has been awarded £A15,000 under a 1954 insurance policy with Lloyds of London.

JAL Short-range Jet Order According to an announcement by the Japanese airline last week, "JAL will decide early in 1964 on the type of short-range jet aircraft which it will purchase to go into service on the main Japanese trunk routes from 1966 onwards."

DC-7 Lease Schreiner Aero Contractors, the Dutch independent which recently ordered Friendships, has leased a DC-7 from Flying Enterprise, one of the three aircraft purchased in the USA. The aircraft will be used for tourist charter work.

Tu-114 Safety Record During his visit to the USSR Mr Najeeb Halaby, administrator of the FAA, was told by Soviet officials that the Tu-114 had had a perfect safety record during its three or four years of Aeroflot service.

TWA's Profit in the 12 months ending November 30 was £6.4m compared with a loss of £3.9m in the same period ending November 1962.

BALPA Tech Sec Leaves Mr D. J. Coxhead, AFC ARAeS, MIN, former test pilot and aeronautical engineer, recently left the British Air Line Pilots' Association, where he was technical secretary for two years, to return to industry. He has joined GEC.

Airport Congestion Study A study made for the FAA with the co-operation of the US Air Transport Association finds that airport congestion is the principal cause of airline delays. The study was made by R. Dixon Speas Associates, Manhasset, NY.

College of Air Training Appointment Dr Kenneth G. Bergin, BOAC's director, personnel and medical services, has been appointed deputy chairman of the Governors of the College of Air Training.

One-Elevens for Hawaiian The order being negotiated between BAC and Hawaiian Airways calls for three One-Elevens, two for delivery in 1965 and a third in 1966. CAB approval of the purchase, since Hawaiian is a subsidized carrier, is required.

Short-haul Airliner Market A $50,000 FAA contract to survey the potential US domestic and world markets for a new short-haul passenger-cargo aircraft (*Flight International*, October 24, 1963, page 684) has been awarded to Systems Analysis and Research Corporation of Washington. The final report is due by October 1.

Jet Freighters for Qantas Qantas have signed a contract with Boeing for the delivery of three Boeing 707-320C mixed passenger/cargo jets in 1965, two in April and one in September. These aircraft will supplement eleven 707-138Bs in service or on order. The C-Jets will provide the same passenger accommodation as the present Qantas 707s, plus cargo volume.

Autair Refused Valencia The Air Transport Licensing Board have refused an application by Autair for an "air villa service" to Valencia to be operated on behalf of Mediterranean Villas Ltd, who hire out accommodation in the area. The Board say that BUA, who carried the bulk of those hiring the accommodation in 1963, had already been licensed for the 1964 season on the strength of a repetition of the demand. Coupled with BEA's plan to increase capacity on the Valencia route substantially in 1964, the Board did not feel there was any need or demand for the extra service proposed by Autair.

Boeing-Beaver Near-miss Report The Dutch Aeronautical Board of Investigation has blamed a PAA pilot and a Royal Dutch Air Force pilot for the near collision between a Boeing 707 and a Beaver over eastern Holland in July 1962. Twenty-six of the 79 passengers in the Boeing were injured when the pilot, Capt James Magenis, 55, took evasive action. The report says that Capt Magenis had failed to arrange an adequate look-out system although there were deficiences in the company's rules and that Sgt Maj Aarts, pilot of the Beaver, was at fault in having wrongly changed course.

With more than twenty 727s now flying, the flight line at Renton is beginning to afford Boeing publicity photographers with opportunities for impressive pictures like this (Lufthansa's first 727: see page 82)

Straight and Level

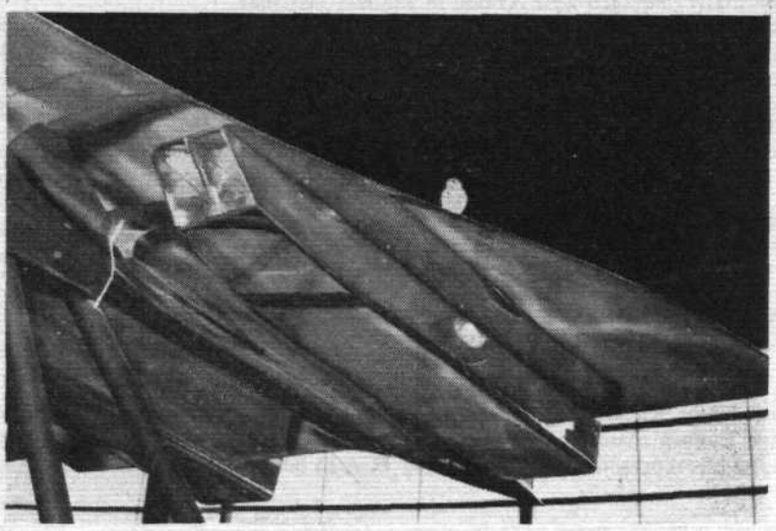
MY paragraph about brothers brings a letter from the Miles brothers beginning: "We were flattered to come across your mention until we were pulled up short by the word 'were.' Like Mark Twain, we can assure you that this dismissal is premature, although it may be that some of our present ideas are too far ahead of the times to be recognized as pace-setters and some were put forward too long ago to be remembered as the progenitors of 'modern' design.

"The M.52, designed *circa* 1943, and axed just before completion, incorporated biconvex thin wing sections, all-moving slab tailplane, power controls, afterburning, telemetering, variable area annular intake, etc. The jettisonable cabin which was another feature has taken a little longer to find acceptance. The design of the Aerovan, Merchantman and HDM.106 foreshadowed present advances in commercial aviation. . . . We put proposals forward in 1942 for transatlantic and short-range freighters of the then novel box-car configuration. Then, a year or so later, for the post-war development of the same aircraft meant to inaugurate a cross-Channel car ferry service. We demonstrated, abortively, net arrester gear before Sir Stafford Cripps in 1943 and this was not followed by the present runway and aircraft carrier net barriers until long after we had abandoned hope of arousing interest in this concept.

"Do you remember our 'Libellula' proposals of 1943, through to those for a transatlantic mail carrier and a supersonic airliner (1946)? Compare them with current American ideas of what a supersonic commercial aircraft should look like. Or perhaps the Jeff Hawke strip in the *Daily Express* would be better!"

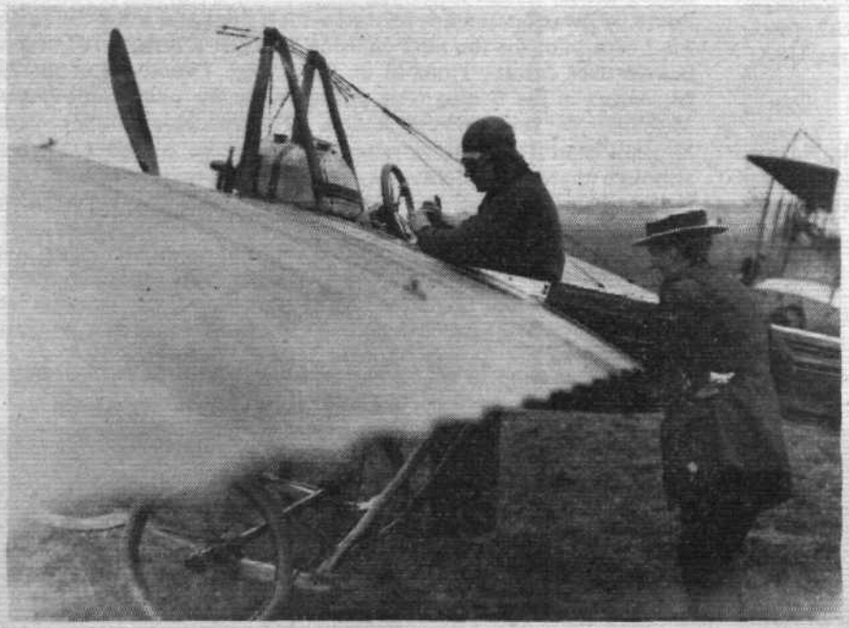
The letter is signed "Yours modestly, F. G. and H. G. Miles" and carries this P.S.: "I've got the next decade's landing system, too, if you want it. FGM."

My own P.S. is: The Miles brothers were, are, and will continue to be, pace-setters.



The owl and the pussy cat went to see
A supersonic airliner swift
You can read of the cat in column three
The owl just thought he'd add some lift

Straw hat: Won't it start, then?
Helmet: No.
Straw hat: Why are your legs sticking out underneath?
Helmet: I'm going to try walking it off the ground



● "An interesting booklet has been put out recently for the guidance of aeroplane pilots. The thing to do under bad flying conditions, it appears, is to put a cat in the cockpit. Cats always remain upright, so the pilot merely has to see which way the cat leans to determine if the wings are level. Prudent aviators select an elderly cat, one which has used up eight of its nine lives and so, with only one to go, has as much to lose as the man at the controls. Young cats, with seven or eight lives in hand, are not to be depended on.

"A further word of warning. The chosen cat must be clean and well groomed, as your grubby cat will want to spend all its time washing itself. Trying to follow a washing cat usually results in a tight snap-roll followed by an inverted spin and structural wing failure."—From the 1963 *Pick of Punch*.

BLAMERY BOOBS AGAIN!

By our Planes Ministry Correspondent

● Last month Mr J. (Neddie) Blamery, the famous Socialist Planes Minister, made history by appointing a chairman of BOAC before he was even a member of the board, thereby BREAKING THE LAW.

Yesterday, in a seething House, Neddie shyly admitted he had gone one better. He had, he said, appointed Lord Crathorne to be chairman of the North Eastern Advisory Committee on Civil Aviation before actually setting up the committee in the manner prescribed by Parliament.

"Typical Neddie," said Grizelda, the 7ft 3in wife of the Minister of Football, "he never lets red tape stand in the way of getting things done."

A Ministry spokesman denied rumours

(*Continued on page 89*)

BPL

PRC Sealants

on active service with the

Built by Short Brothers & Harland Ltd. and destined for service in Transport Command of the Royal Air Force, the Short Belfast Strategic Freighter is one more aircraft to be sealed by PRC Synthetic Rubber Sealants. These man-made rubbers are today chosen for many of the world's finest aircraft—are used to seal integral tanks, pressurised areas and vital joints on commercial and combat planes of every type.

SHORT BELFAST STRATEGIC FREIGHTER

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Also at Newcastle upon Tyne, Liverpool and all principal towns

Straight and Level

[good gracious, I seem to be going on a bit this week] as I was saying, a Ministry spokesman denied that Mr Blamery had caught a bad cold. "The Minister has merely taken leave of his senses," he said.

● **Mr A. Puzzled** (Chorleywood): Will the Minister state under what authority he has appointed Lord Crathorne to be chairman of the North Eastern Regional Advisory Committee for Civil Aviation?

Mr J. Blamery (Minister of Planes): No.

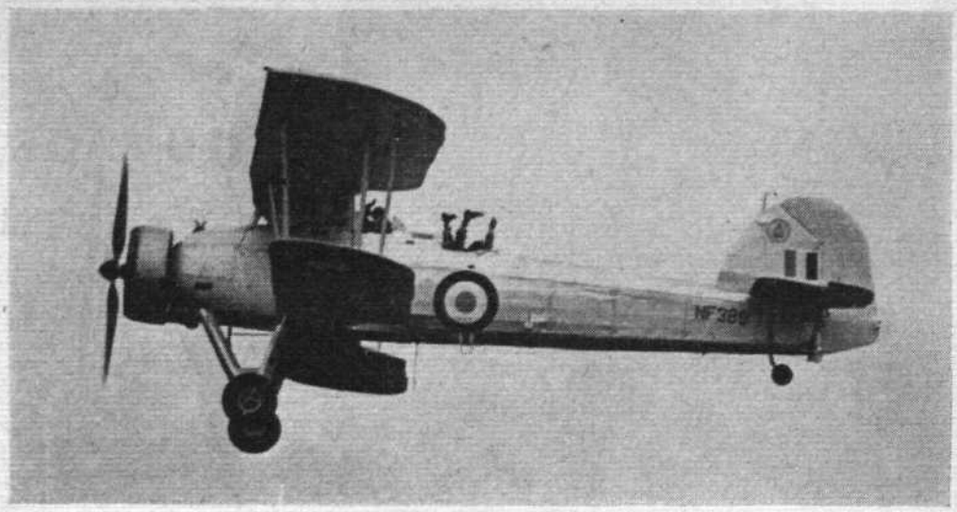
Puzzled, Chorleywood: Is the Minister aware that the power to set up regional advisory committees to assist the Air Transport Licensing Board can only be exercised by statutory instrument subject to annulment in pursuance of a resolution of either House of Parliament in accordance with Subsection 4 of Section 5 of the Civil Aviation (Licensing) Act 1960? Is he aware that at this point in time no such statutory instrument has been made authorizing a North Eastern regional advisory committee?

Mr Blamery: if the Hon Member cares to repeat his unfounded and totally irresponsible allegations outside this House I will be pleased to deal with him in accordance with the law. I can only assure hon Members that the answer to the Member's first question is categorically in the affirmative.

Puzzled, Chorleywood: Does the Minister of Planes agree that before appointing a chairman it would first be necessary for him to make a statutory instrument and lay it on the table of the library in accordance with the Standing Orders and then if it be not annulled within the appropriate time, he is then at liberty to appoint the committee from whom he must choose the chairman in accordance with Regulation 20 of the Civil Aviation (Licensing) Regulations 1960, eh?

Mr Blamery: The Hon Member is putting words into my mouth. I never said that.

Mr Speaker: Oh.



*Are you all right?—No 31**

** Fairey Swordfish, RAeS Garden Party 1957*

● Among the highlights of Japan Air Lines' 1963 year has been, I learn, "the signing of an interline agreement with the domestic carrier All Nippon Airways, and a joint agreement on reduced fares."

A refreshing variation on the joint agreements on *increased* fares that are becoming an annual event in this country.

● A young Englishwoman, a friend of a colleague, arrived at London Heathrow from the Continent just before Christmas. The wife of a Swiss, she was travelling with her three-month-old-son. Having a British passport, she queued up under BRITISH PASSPORTS. Having reached her turn she was told, perfectly nicely, that because her baby was Swiss she must now go through FOREIGN PASSPORTS. Thanks to a BEA official who used his discretion and took her to the front of the queue, she did not have to shuffle through the whole rigmarole again.

All over the world thousands of Government tourist officials are working as hard as they can to promote air travel, while thousands of their colleagues in Government immigration offices seem to be working as hard as they can not actually to obstruct it, but to make it as tiresome and irritating as possible.

● BOAC, who have an accumulated deficit of £80m, have just reduced fares on their No 1 route by 20-40 per cent.

BEA, who have been making record profits in their current year, have applied to increase domestic fares—for the second time in a year.

Which makes more sense: Cutting fares when you are losing money? Or increasing fares when you are making it?

Replies will be forwarded to the alleged authorities responsible for the alleged economic regulation of British domestic and international air transport.

● According to Peterborough in *The Daily Telegraph* Mr Harold Bamberg, chairman of British Eagle, has just made a shrewd deal with BOAC. The Boeing 707s he had before BOAC-Cunard was formed have been exchanged for 29 BOAC Britannias.

But this is not the cause of the corporation's £80m deficit. They were all scale models.

Bit of a front coming up, Fred

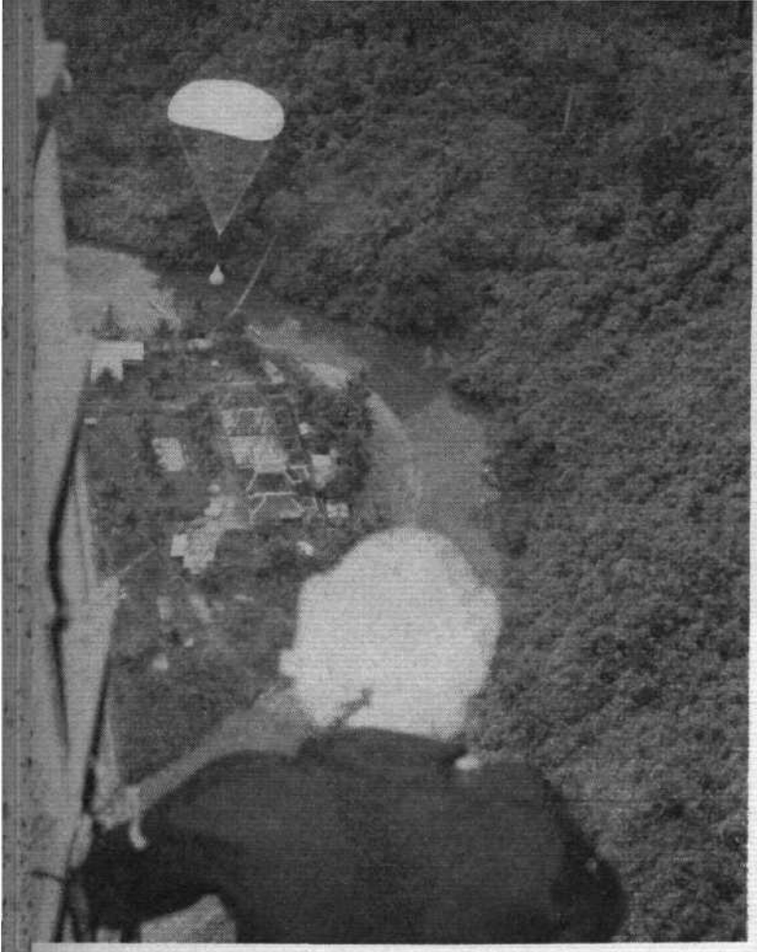
● I liked the following story in *Popular Rotorcraft Flying* of Raleigh, NC, USA.

First frost of the year and cold wintry breezes caused the teacher of the local school to warn her pupils against catching cold.

"I knew a neighbour boy," she said, "and one cool weekend he took out his gyroglider to fly, but didn't wear warm clothes. He was taken ill with pneumonia and three days later he died."

The school room was very quiet. Suddenly a boy in the back seat asked: "Where is the gyroglider?"

ROGER BACON



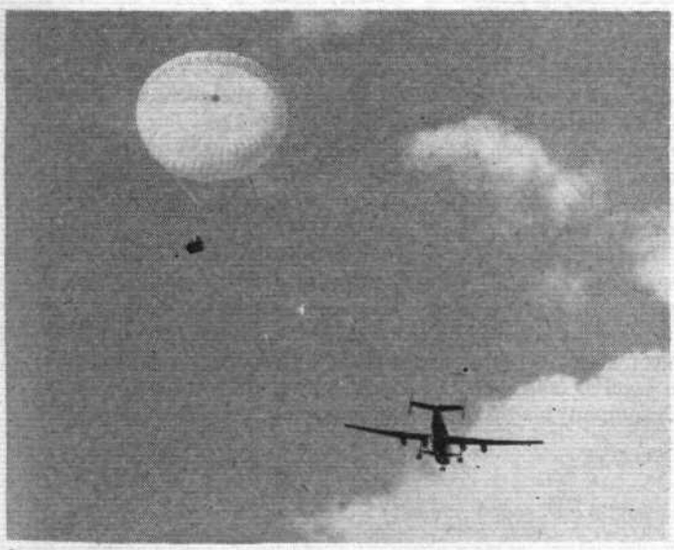
1

OUT OF THE BLUE...
...INTO THE GREEN

AERIAL SUPPLY and support for security forces in the Borneo territories of Malaysia by Far East Air Force units is shown in this remarkable set of photographs. In picture 1 an Army air dispatcher watches a one-ton supply container about to land in a small settlement at one end of a swinging rope bridge. In the vertiginous view 2 he and his colleagues lean nonchalantly against a container in a 34 Sqn Beverley banking steeply for its run-in over another dropping zone in a mountainous area, while in picture 3 a container is seen a fraction of a second after dropping over the Beverley's sill, its parachute pack still restrained by the static line. Members of the security forces—British, Malaysian and Gurkha—have the view of things seen in pictures 4 and 5, showing a container about to land on a small airstrip within yards of troops waiting to open it. On the same airstrip, in picture 6, stand two widely different military transports, a Scottish Aviation Pioneer of 209 Sqn and a Ferguson tractor with trailer. Operating the long and the short of RAF transports, 34 and 209 Sqns, both based at RAF Seletar, have had aircraft engaged in Borneo since the abortive Brunei rising began on December 8, 1962.

2

3



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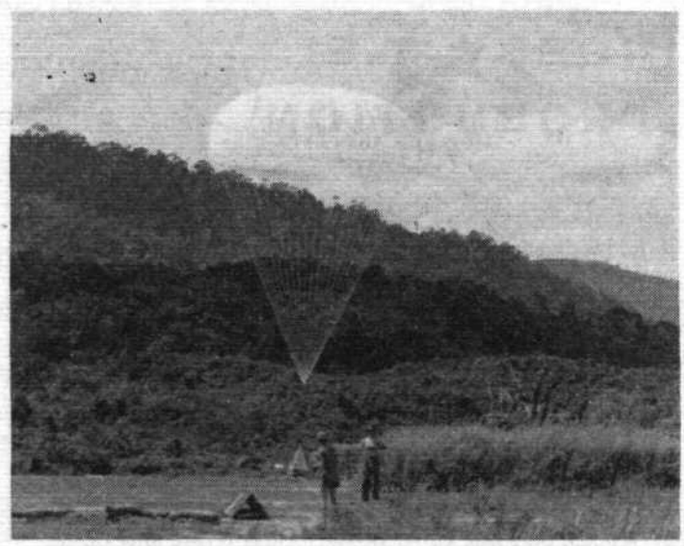

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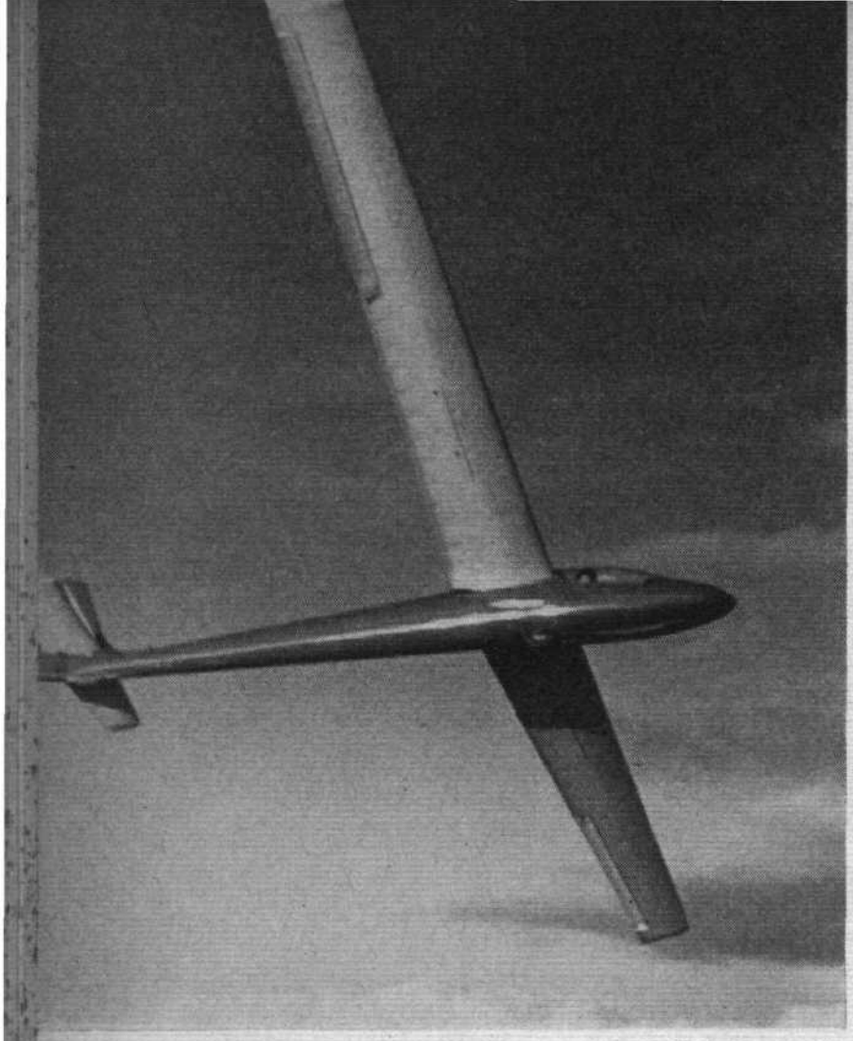
SPORT AND BUSINESS



New shape for soaring flight: the prototype Slingsby T.51, flown by Sqn Ldr L. A. Boyer, displays its 15-metre span, 18:1 aspect ratio and relatively small tail unit in the sky over Yorkshire

SLINGSBY T.51 IN PRODUCTION

A NEW British 15-metre sailplane, the Slingsby T.51, is now in initial batch production at Kirbymoorside and should make its debut in world championship flying next year. The prototype, which made its first flight on November 26 from Wombleton Aerodrome, near the company's factory, has since completed an intensive flight-test programme and has been returned to the factory for minor modifications. It is scheduled to begin British Gliding Association certification flight tests at Lasham next week.

The major part of the initial test flying was carried out by Michael Wilson of Slingsby Sailplanes and Derek Goddard of Lasham Gliding Centre. Other pilots involved were John Reussner, G. Bailey-Woods, Sqn Ldr L. A. Boyer, Frank Irving and Lorne Welch.

Prospects for the new sailplane appear to be good. Several are expected to be flying in this year's National Gliding Championships at Lasham and in next year's World Championships at South Cerney, and the type will be entered for the OSTIV standard-class design contest on the latter occasion. The first production aircraft are expected to be available in March.

The prototype T.51, finished in crimson and white, gives the impression of an orthodox but contemporary design. The fuselage is long and thin, and the tail units appear by usual Slingsby standards to be very small—a result of the long rear fuselage and the aft positioning of the tailplane on the fin.

Much more room is available in the cockpit than might be expected from the external appearance of the machine. The headroom complies with the proposed OSTIV 80cm rule, which is intended to discourage the use of pencil-thin fuselages. The seating position has adjustable seat-back and rudder-pedals, and appears to be capable of accommodating either small or large pilots. The general arrangement and size of the cockpit is the same as that of the Skylark 4, although the designers have managed to reduce the fuselage depth by four inches. This has been made possible by positioning all the flying controls along the side of the cockpit instead of beneath the pilot's seat. The seat is in fact a glass-fibre moulding which is connected directly to the bottom skin of the fuselage.

The layout of the controls is conventional. The control column is raked back to give plenty of clearance from the pilot's body, and the rudder pedals have an improved system of quick adjustment. The trimmer control, as a result of many requests from pilots, is operated by the pilot's left hand. The instrument panel is mounted on a pedestal located between the pilot's legs at the front of the seat.

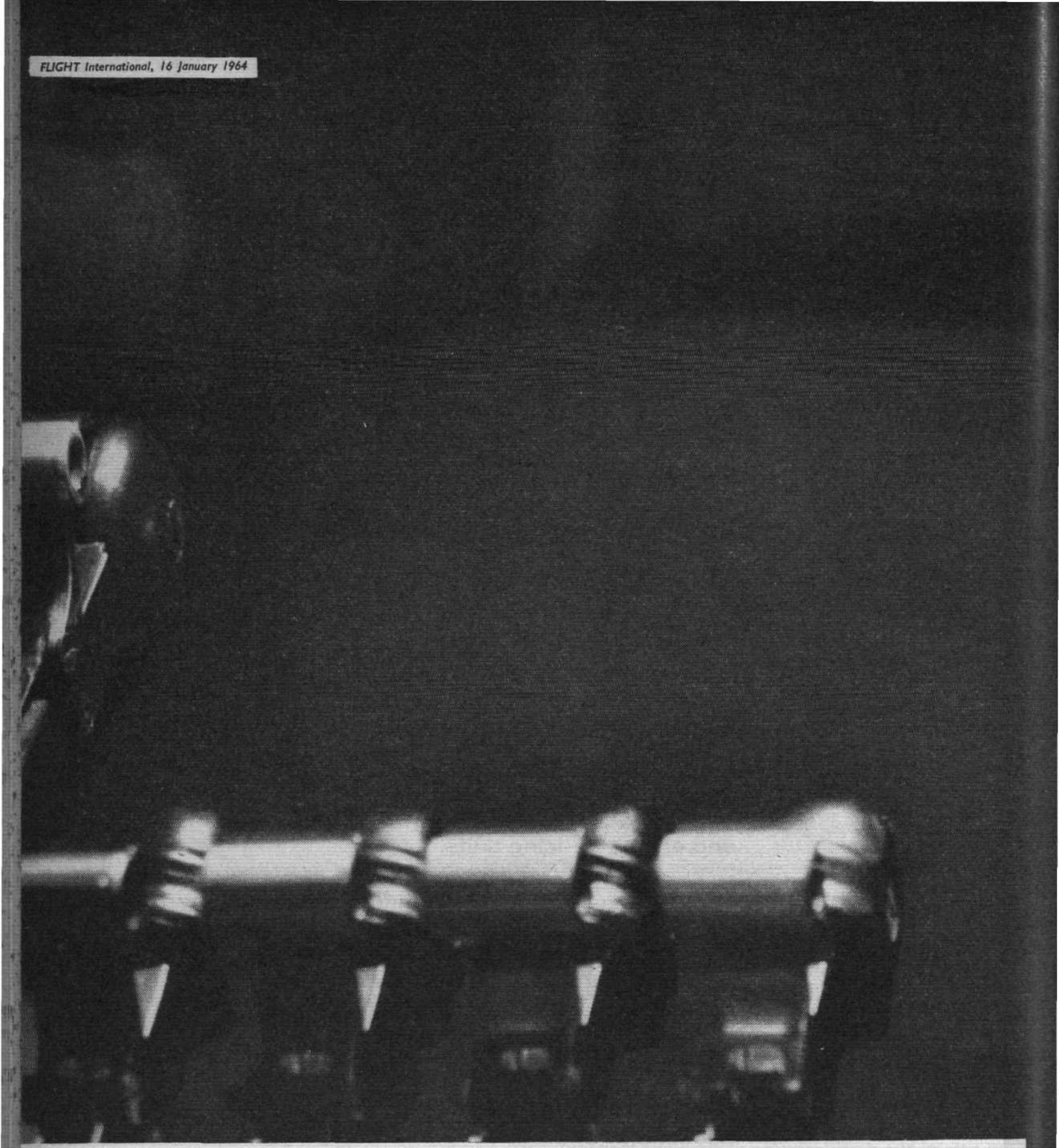
The transparent canopy is made by Slingsby's own moulding process, and visibility from the cockpit appears to be even better than that of the Skylark 4. Access to the cockpit is obtained by hingeing the canopy on the starboard side.

A large space aft of the cockpit is available for the stowage of equipment. Access to this area is obtained by removing the wing fairings, which readily come away by the release of one simple fastener. Access to the interior of the fuselage is provided by the use of tubular-steel bracings in place of the conventional plywood skin on the neck, and the available volume is estimated to be sufficient for the stowage of the largest oxygen bottles, radios and other equipment.

The landing gear appears to be robust, and consists basically of a main landing wheel and a faired-in tailskid. A nose skid is provided, but is intended to be used only in the event of nosing-over on over-severe application of the wheel brake. The wheel itself is large and is, in fact, the same component as used on the T.49 two-seater. A large internal expansion wheel-brake is fitted, and it is expected that production aircraft will have a glass-fibre fairing around the wheel.

The control mechanisms are a break-away from Slingsby's usual designs in that the ailerons and elevator are operated by open-circuit push-rod systems. These provide light, positive controls which are not affected by temperature variations. In particular, the aileron control is of interest in that a novel system is used to house the control components entirely within the profile of the wings. The company claims that the only point that will require lubrication

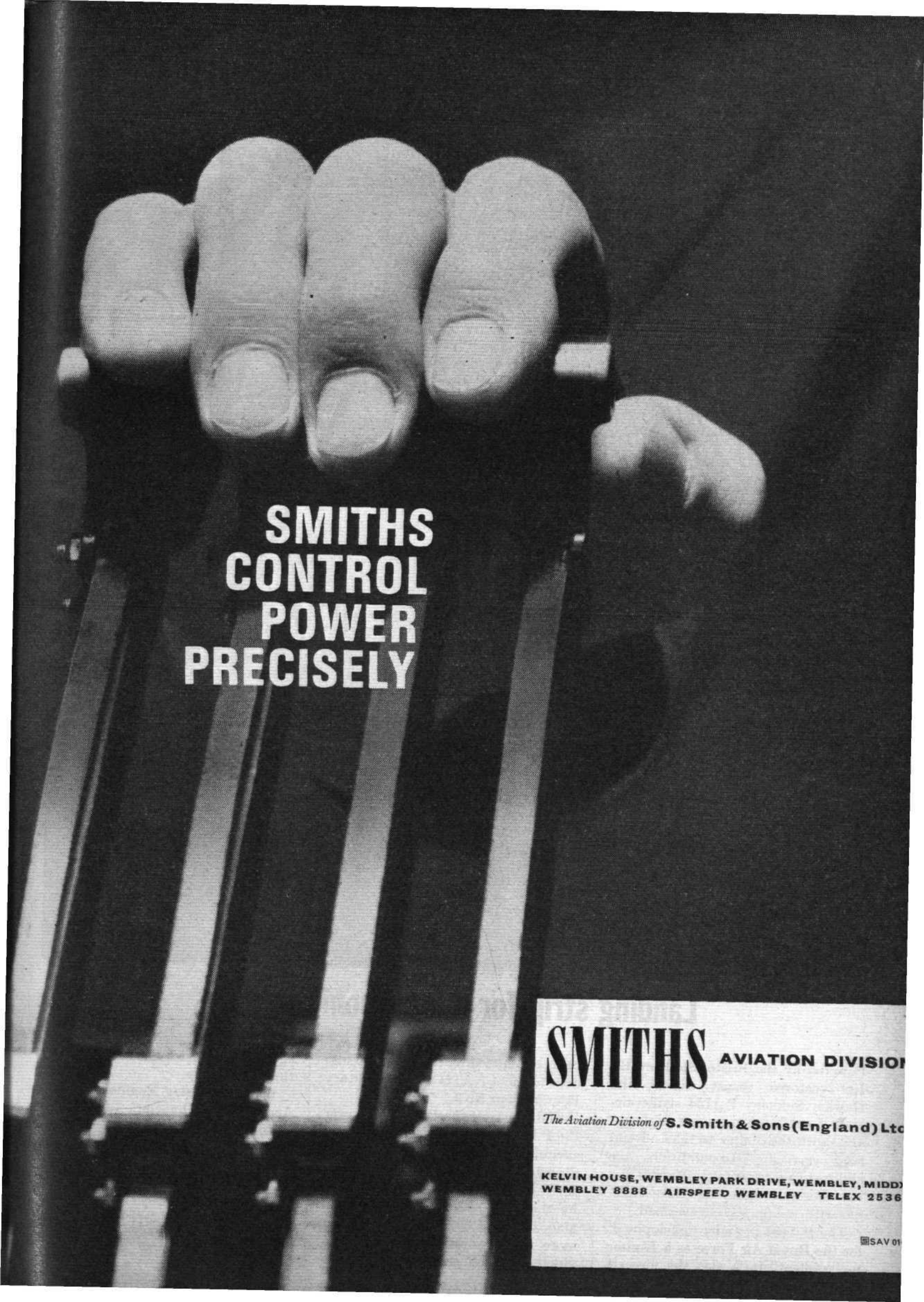
The distinctive tail of the T.51 meets with the approval of (left to right) Slingsby chief technician Bill Slater, Slingsby sales manager and test pilot Michael Wilson, BGA test pilots Lorne Welch and Frank Irving, and Slingsby general manager and director John Reussner



This pilot's hand has a grasp of confidence because SMITHS have provided him with instruments and systems that control and record engine performance precisely under all operating conditions. As engine power has advanced in step with aircraft design, the instruments and controls have been matched to each new need. SMITHS are already devising engine instruments and systems that will provide confident control for airline pilots of the supersonic age.

For precise control of power tomorrow, keep in touch with SMITHS today.

GUIDING FLIGHT INTO THE FUTURE



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SAV 01

Landing strip for a supersonic fighter

Powered by the Bristol Siddeley BS 100 vectored thrust engine, the Hawker Siddeley P 1154 strike aircraft combines supersonic performance with the ability to take off and land vertically. In addition, the ability to vector total thrust enables the aircraft to carry out short take-offs with an appreciable overload.

The P 1154 is under development for the Royal Air Force as a Hunter replacement. It is also the aircraft being submitted by the United Kingdom to meet NATO's Basic Military Requirement No 3.

The choice of the BS 100 to power the P 1154 follows closely on the successful trials of another Bristol Siddeley powered V/STOL aircraft, the Hawker Siddeley P 1127. Powered by the Pegasus vectored thrust engine, the P 1127 has been flying for more than two years and has convincingly demonstrated the advantages of the Bristol Siddeley vectored thrust principle.

Bristol Siddeley Engines Limited. Aero-Engine Division: PO Box 3, Filton, Bristol, England.

BRISTOL SIDDELEY
SUPPLY THE POWER

SPORT AND BUSINESS

on the production aircraft is the tow release. All pivots in the control systems have been fitted with either sealed aircraft bearings or p.t.f.e. plastic bearings, which should not require further lubrication after the aircraft leaves the factory.

One feature which has not been seen on Slingsby designs since pre-war days is the all-flying tail. This is positioned at the base of the fin and is neatly faired into the rear fuselage lines. Double anti-balance tabs are provided to give feel for the pilot, and these can be pre-positioned by the cockpit trimmer control for speed trimming in flight.

Although only limited performance checks have been completed, the aircraft gives a marked impression of having a high performance. In the early stages of the flight testing a flight was timed from release at 3,000ft; after a series of stalls and runs up to 90kt, the total duration of the flight gave an average sinking speed of 2.3ft/sec. A short comparison flight was made with a popular continental design, and the company's impression was that the T.51 was markedly better over a wide speed-range.

In flight, the aircraft is reported to be very quiet, and pleasant to handle at all speeds. In spite of the comparatively high wing loading the machine has pleasant slow-flying characteristics, and the controls are smooth and well-harmonized. At speeds around 70-90kt the aircraft is still quiet and smooth to fly. Aileron control is very responsive and produces a rate of roll which should be adequate for any purpose. The elevator control also is smooth and well-damped, and there is little tendency to hunt due to over-control either on the tow or in free flight. One point that the designers are dealing with at the present time concerns the comparatively low elevator-loads. Modifications are being made to the anti-balance tabs to provide more feel for the pilot with change of speed.

Pilots report that the stalling characteristics of the T.51 are much as one would expect from this type of aircraft. With the c.g. between the mid-position and full-forward the aircraft will not perform a full static stall. The nose of the aircraft can be raised to quite a high angle, at which point it proceeds to wallow and will not always drop into a full stall. When the stall is approached more quickly the nose comes up and falls away straight. As the c.g. goes further aft than the mid-position the aircraft can be made to stall by bringing the stick slowly back. In this configuration there is a tendency for one or other of the wings to drop and, as the c.g. moves to the full-aft position, this becomes more marked. Controls are fully effective right up to the stalls and recovery, either after a straight stall or with wing-drop, is rapidly obtained. In a spin the nose is well down and the rate of rotation quite high. The recovery is effected by normal actions within one-quarter of a turn.

Slingsby Sailplanes Ltd has not yet decided on a name for the Type 51. Whatever name is finally chosen, it seems certain that this sailplane will rapidly become well-known in the gliding movement throughout the world. A high initial rate of production is being organized at Kirbymoorside, and 70 orders have been received.

Auster Accident The establishment of "a simple qualification enabling private pilots to extricate themselves easily from temporary IMC situations" is recommended in the official French report into the accident to Auster J.1N flown by Mr Holland Birkett at Stella Plage, near Le Touquet, on July 8, 1963. Mr Birkett and his wife, who was a passenger in the aircraft, were killed in the accident.

Mr Birkett took off from Berck at 3.45 p.m. GMT for Deauville, with good weather over the land but fog over the sea. He had been advised not to fly via the coast, but flew over the sea after take off. Encountering the fog he tried to return to Berck, flying low along the coast, but passed Berck without observing the aerodrome and crashed on attempting to land on a beach. Under the heading "Causes of the accident," the investigating officer (the airport commandant at Le Touquet) states:—

"It seems difficult to determine with certainty the real cause of this accident, which appears to have been brought about by a side-slip followed by a stall at low altitude after the pilot, whose first thought was to land on the beach, had lost control of the aircraft. It is, moreover, certain that the pilot did not have adequate visual reference to the ground at the time of the accident. The sea fog was thick and came down to the surface of the water.

"In view of the advice which he had received it seems obvious that Mr Birkett took risks in resolving not to wait for an improvement in the meteorological conditions over the sea, since about 15 minutes after the accident the fog had cleared.

"Mr Birkett's aircraft was suitably equipped for a flight in IMC, but this equipment was recent (installed about a month earlier) and Mr Birkett appears to have been inexperienced; otherwise it would have been easy for him to climb above the fog layer, the thickness of which was not more than 1,000ft.

"There is no doubt that the underlying cause of this accident was the imprudence of the pilot, who persisted in continuing his flight without having exact knowledge of the meteorological conditions along his route. In addition, he could have taken off towards the east and flown to Deauville on a route parallel to the coast. The pilot was also undoubtedly lacking in experience.

"This accident, which is practically the same as two accidents which occurred on the same day, April 15, 1963, at Berck, gives rise to the following conclusions:—

"1. The necessity of reinforcing the regulations as regards clearance for the departure of private aircraft;

"2. The advisability of establishing a simple qualification enabling private pilots to extricate themselves easily from temporary IMC situations, for example by climbing above the cloud layer in order to find VMC."

First flight of the Moynet 360 Jupiter push-pull executive twin was made from Villacoublay on December 17. Powered by two 200 h.p. Lycomings, the aircraft was flown by André Moynet and Lucien Tieles. Developed by Engins Matra, the Jupiter accommodates 4-5 people; a 6-7 seat version (two 290 h.p. Lycomings) is envisaged

1 *High and mighty, the Belfast taxies out . . .*

A GREAT DAY FOR BELFAST

First Flight of Ulster's Big Transport: a Pictorial Record

NEVER in *Flight International*'s experience has the first flight of a prototype been so well recorded photographically as that of the first Short Belfast heavy logistic transport for the RAF, on Sunday, January 5. We therefore make no apology for repeating two photographs used in last week's issue to make a complete pictorial sequence, from the aircraft taxying out for its first take-off to the cracking of a well-deserved bottle of champagne after landing. In achieving such splendid coverage of the first flight, Shorts' publicity staff deserve great credit—none more so than Mr "Herbie" Edgar, the company's chief photographer, and his staff, responsible for these pictures, and Mr Jack Sherburn, pilot of the Queen Air 80 chase plane from which they were taken. Even when chief test pilot Denis Tayler made an overshoot on his first landing at Aldergrove ("I came in too high and too fast," he explained) the Queen Air did not slip in position a detectable ten feet—no mean feat when the difference in power and acceleration between the Belfast and a Queen Air is considered. The pictures should be studied in the sequence indicated by the caption numbers.

3 *At 6,000ft chief test pilot Tayler levelled out to try the cruising régime . . .*

2 . . . for her first take-off from Sydenham's runway, the 16ft-diameter propellers creating visible vortices in the damp air

4 . . . and, in his own words, "played around with the undercarriage a bit." Here, with gear down, the Belfast heels over in a bank . . .

5 Climbing to 10,000ft Tayler "messed about with flap" and put the aircraft through a practice overshoot—worthwhile preparation for the genuine one to come. In the Queen Air astern the pilot and a photographer had this view, past an obtrusive windscreen wiper, of the Belfast's distinctive flattened rear underside

(continued overleaf)

6 *Flaps and undercarriage go down for the bogus "approach" and . . .*

A GREAT DAY FOR BELFAST . . .

8 *With the limpet-like photographic Queen Air tucked in close behind, the Belfast heads for the shore of Lough Neagh on the approach to Aldergrove . . .*

9 *. . . to arrive over the runway rather high*

7 *. . . vortices stream again from the propellers as full power is called for the overshoot at altitude*

10 *The second time round, speed and height are nicely judged . . .*

11 *. . . and flare out for touchdown is about to begin*

12 *(Below) A gentleman's aircraft this, where smart suits and sheepskin jackets can be safely worn. Obviously pleased, Denis Tayler leaves the aircraft, followed by co-pilot Peter Lowe*

13 *(Below, right) Taking firm control of an enshrouded champagne bottle, the chief test pilot, flanked by joint managing directors R. E. Harvey and H. G. Conway and backed by his first-flight crew, drinks to the Belfast's success. Crew members, from left, are Peter Lowe, Malcolm Wild, Ricky Steel, Bill Mortimer, Alex Mackenzie and Gil Thomas*

Letters

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

Liquid Air Cycle Engines

SIR,—The article on liquid air cycle engines (*Flight International*, December 26, 1963) suggests the following questions:—

(1) A few years ago the ionosphere was held to be composed of hydrogen. Is accumulation of hydrogen at ionospheric heights feasible, whether as chemical fuel or working fluid for Rover-type engines?

(2) Is accumulation of fuel/oxidizer/working fluid for supra-orbital flight feasible at orbital speeds in lower orbits? Is this in fact the mission of projects Tory and Profac?

(3)—a real Goldberg this. Assuming a positive answer to either (1) or (2), is it feasible that a vehicle could, by negative lift, be held in orbit at escape velocity whilst accumulating a reserve of fuel/working fluid?

Ingatestone, Essex J. E. ENEVER

[*In the present state of the art the most that can be said is that accumulation of gaseous fuel by a vehicle in low Earth orbit appears technically feasible. Tory missions have not been detailed, but Northrop Norair's Profac is envisaged as collecting air at a height of only 70 miles. We leave question three to others; in any case, why orbit at escape velocity?—Ed*]

Non-IR Pilots in Airways

SIR,—In reply to his letter in your issue of December 26, Mr E. F. Allchin will find the necessary information for VFR flights in controlled airspace in the following publications:—

The 9th Schedule of the Air Navigation Order, 1960. Part B —Ratings. This lays down the privileges of an instrument rating, which are basically that you may fly in controlled airspace in accordance with Instrument Flight Rules. Note that no mention is made of VFR, so that it could be argued that you do not need an instrument rating to fly VFR in controlled airspace.

Rules of the Air & Air Traffic Control. Section IV. General Flight Rules 16 (2). Also *Section V.* 23 (b). These two sections specify the conditions for entering a control zone and controlled airspace in VFR.

Further amplification can be obtained from the *Air Pilot.* RAC 11. Chapter 3.

Normally one doesn't have these documents readily available to consult, but AIS units at the larger airports are often able to make them available for reference purposes and can also be of help in understanding the rules and regulations. Alternatively, most flight guides contain the necessary information.

Hove, Sussex E. W. CLAPSHAW

SIR,—Mr Allchin's letter of December 26 raises wider issues than his direct request for information, since surely the question is not *whether* a VFR clearance can be obtained for airways operation in this country—similarly to abroad—but, rather, *why* there cannot be official recognition for controlled VFR operation in airways (for want of a better description). Of the aircraft/pilot combination it is undoubted that a high proportion of modern light aircraft are sufficiently instrumented and equipped with radio navigation aids to allow airways operation under ground control; they are certainly also reliable enough and of suitable performance to operate in airways without causing control problems.

Regarding the pilot, and in the absence of an intermediate IF rating, present regulations make no distinction between a PPL holder who performs a minimum annual number of hours—without any form of radio or navigation apart from a map—and an advanced PPL holder using his completely equipped aircraft for extended journeys and who, if not actually considering the taking of an IF rating examination, is certainly capable of operating under ground control as evidenced by widespread ATC acceptance of special VFR clearance into and out of major airports under marginal VMC conditions—and very often IMC.

The former of these pilots would have no desire to travel airways but the benefits to the latter are very major indeed in that he could normally travel under conditions of comfort and good visibility above cloud level or, alternatively, in marginal conditions, with radar coverage and full knowledge of conflicting traffic. To this end, it appears that a lower airway could reasonably be created in addition to the airway itself, where the lower airway would be for controlled VFR operation only from say 3,000ft, up to a level of say FL70 or FL80, above which commercial aircraft normally operate in any case.

In my experience, ATC controllers are invariably most co-operative and helpful, and I very much doubt if they would resent this extension of special VFR clearance to controlled VFR airway operation; it would certainly make many PPL holders' flights not only much safer and more reliable to schedule, but more enjoyable in addition.

Woking, Surrey D. M. PARSONS

Pertinent Comment

SIR,—Your technical editor is a constant source of charming surprise. In his article "The Ten-year Gap" (December 19), he says ". . . it appears that only the MoA employs PERT principles."

At Elliotts we have been using PERT on a number of projects since 1961 and last year started using the later developments, PERT-COST and Line of Balance. As yet we haven't come across a better project control system. It's simple, easy to operate and makes engineers think out, rather than guess, development programmes before they start. For complex jobs we use an Elliott 803 computer, but short-term projects of up to about 200 events are handled manually.

We were introduced to the system by the Bristol Division of BAC and are very grateful for their initiative.

Rochester, Kent K. R. WARREN,
Manager, Airborne Display Division, Elliott Brothers (London) Ltd

That Top-storey Tiger

SIR,—As the contributor of the original "Are you all right?" photograph used in "Straight and Level" (December 19, 1963) I much regret the trouble created for you and your learned colleagues in supporting the legitimacy of the subject aircraft's family name. Since the tailwheel obviously tricked the Doubting Thomas in our midst it is perhaps just as well that the cockpits were out of sight, otherwise the sliding Perspex canopy would have caused an even greater fuss. Just as well, too, that it wasn't the Tiger Moth we fitted up with skis!

Mention of the Stearmans flown by your worthy editor-in-chief reminds me that that was the last genuine open-cockpit aircraft that I had the pleasure to ride in.

Whilst in reminiscent mood—there is one photograph which I would like to see appear in "Are you all right?" Unfortunately I do not have a copy myself, but I'm sure that some of your readers who trained in Canada during the war will have either direct or indirect knowledge of an incident which occurred with No 33 SFTS Carberry (Winnipeg) in 1941. This involved two Avro Ansons, one of which inadvertently "landed" on top of the other *in flight*, and both were brought safely back to Mother Earth pick-a-back fashion by (I believe) a *pupil* pilot. The story and a photograph featured in the Winnipeg newspapers at the time, and no doubt in other journals, so perhaps their archives would produce a picture for you on request. [Can anybody help? —Ed]

I was stationed at 32 SFTS with Ansons and Harvards at the time and I know that we considered it a reasonably praiseworthy effort for a "rival" unit.

East Kilbride, Lanarks F. CARLOSS

SIR,—Have no fear—you're in the clear! The aircraft concerned was a D.H. 82C Tiger Moth, and if I had had a proper filing system for my photographs I could have sent you another confirming the incident.

Although I don't know the exact date I can tell you that it happened between late March and early May of 1942. I happened to be on the same course at the time. Luckily for the instructor and pupil concerned, the fuselage finished up resting on a beam inside the hangar; otherwise they wouldn't have been able to walk away as they did—after having been helped down to ground level.

Glasgow S1 R. A. FORBES

Brickbat for Bacon

SIR,—Having demonstrated the superior recognition powers of *Flight International's* staff by extensive investigation of the Tiger Moth photo, you commit a HUGE howler by printing a "Straight and Level" heading photo captioned ". . . Piper, *or whatever it is.*" (January 2). Surely you know that the aircraft shown is from the Champion clan. The rear window shape gives it away from the start, and the tail unit shows it to be an Aeronca 7AC Champion. Compare it with a photo of G-AOEH and see what I mean!

Edinburgh R. W. SIMPSON

Wing Fences

SIR,—Just outside Twyford in Berkshire there is a fence composed of two wings. One appears to be off a Westland biplane (a Wallace?) which had originally been doped silver, but was then given a coat of green/brown camouflage on the upper surfaces with yellow/black target-towing stripes on the under surfaces. The other is unidentified, but has a metal leading edge with "6966; drawing No 5083-5" on a plate in the corner.

We have contacted most of the well-known authorities on the subject without result and we thought perhaps you or your readers could supply some information.

Staines, Middlesex S. G. WILLIAMS

The Longest Flight

SIR,—In *Flight International* for January 2, in the news item "The Longest Flight," you stated that Pan American's New York - Buenos Aires Boeing 707-320B flight was the longest all-the-year-round service.

I was wondering why Pan American's Los Angeles - London service was not mentioned. Using Boeing 707-320Bs PAA operated this service all throughout last year alongside BOAC, who used Boeing 707-420s. On certain flight plans, the BOAC 420s recorded over 5,500 statute miles, on the same Polar route as Pan American.

Camberley, Surrey PETER T. HUGHES

BEA v British Eagle

SIR,—Reference the report on page 787 of your November 14, 1963 issue, under the heading "The Competitors," I was astonished to read the quite ludicrous official statement* put out by "a BEA spokesman," quoted in your report, relating to the current state of affairs between BEA's domestic network and the newly granted routes being operated by British Eagle.

May I suggest that the spokesman should read and digest what his chief executive published in *BEA Magazine*, July 1961 issue, page 21. An extract from the concluding paragraph, written by Mr A. H. Milward, says: "*Let us be sure we remember our humble beginnings, and let no pompous spirit play any part in our lives today—we still have much to learn.*" The occasion of Mr Milward's message was the 15th anniversary of British European Airways.

Writing in the November 1963 issue of *Mainliner* (a magazine produced by United Airlines) Mr G. E. Keck, the company's president, says "as for exclusive service features, an advantage of this kind is short-lived *because the world's airlines readily borrow each other's innovations*. Any new method, will, if successful, be widely imitated . . ." Mr Keck goes on to say: "The really significant difference between airlines is not found in outer forms. It is found in the men and women who work for the respective carriers. It is found in human attitudes, competence, experience and training. . . ."

Nairobi, Kenya DENNIS M. POWELL

[* The statement said: "*We really do not know what Mr Bamberg is talking about. BEA have been expanding their routes and services for 17 years to cater for the growing demand for air transport and we do not really need to borrow any ideas from Mr Bamberg as to when and how to operate air services for the benefit of the travelling public.*"—*Ed*]

First Across the North Sea

SIR,—Readers may be interested in the following letter which I have received from Olav Wetting, Curator, Department of Aeronautics, Norsk Teknisk Museum, Fyrstikkalleen 1, Oslo:—

"On July 30th, 1914 the North Sea was crossed by airplane for the first time, Pilot Tryggve Gran, a Norwegian marine officer. It is 50 years ago the summer coming. The plane Mr Gran used was a Bleriot II with an 80 h.p. Gnome motor, flight time 4hr 10min from Cruden Bay to a point south of Stavanger on the western Norwegian coast. The machine is on display in our museum, in very good condition.

"In a full sense of the word, Tryggve Gran may be said to be an *avant courier* for the air traffic later developed between our countries, also for the brotherhood in arms in two wars. Tryggve Gran joined the British RFC in 1917, fought over London and on the west front. He is now living in Villa Capri, Fevik, Grimstad, Norway.

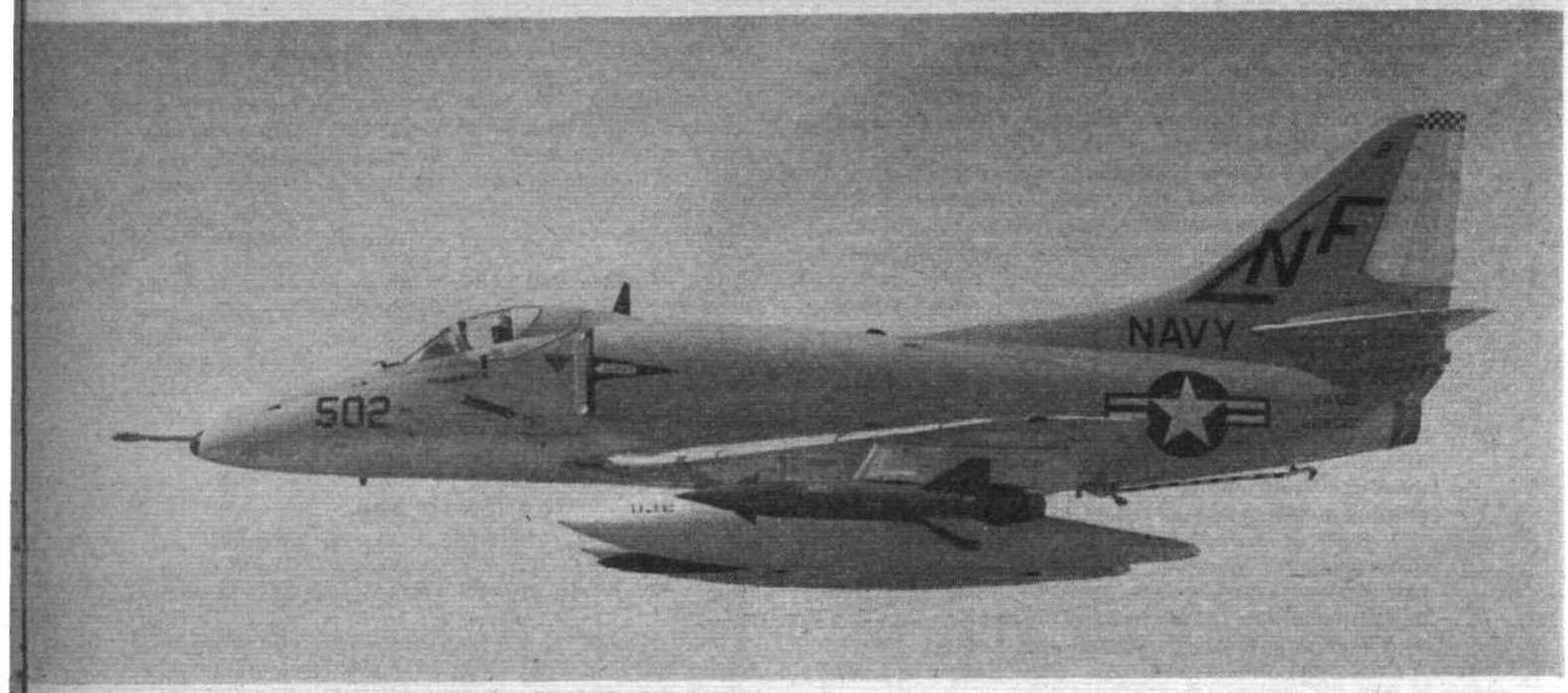
"On Sola Airfield south of Stavanger his flight will be commemorated this summer."

The flight was, of course, fully reported in *Flight* of August 7, 1914.

London W1 F. H. SMITH,
Librarian, Royal Aeronautical Society

FORTHCOMING EVENTS

Jan 17	*RAeS, Hatfield Branch: Social evening.*
Jan 21	*RAeS, Leicester Branch: "Future Trends in Space Propulsion," by A. V. Cleaver.*
Jan 21	*RAeS, Cambridge Branch and IME: "International Co-operation in the Aircraft Field," by A. H. C. Greenwood.*
Jan 22	*RAeS, Brough Branch: Young Peoples' Christmas lecture. "Space Travel."*
Jan 22	*RAeS, Weybridge Branch: "Medical Aspects of Space Travel," Col J. T. Heavey.*
Jan 22	*RAeS, Hatfield Branch: "Space Excursion," by H. E. Butler.*
Jan 23	*RAeS, London Airport Branch: Lecture by A. C. Lovesey.*
Jan 23	*RAeS, Glasgow Branch: "Development of the Trident," by J. P. Smith.*
Jan 23	*RAeS, Halton Branch: "Development of the Buccaneer," by D. J. Whitehead.*
Jan 23	*RAeS, Yeovil Branch: "Atomic Power and Propulsion," by J. Fell.*
Jan 27	*RAeS, Henlow Branch: "Powerplants for High Mach Numbers," by J. G. Keenan.*
Jan 29	*RAeS, Christchurch Branch: "Hovercraft," by D. E. J. Tipping.*
Jan 29	*RAeS, Isle of Wight Branch: Film evening on Materials.*
Jan 29	*RAeS Brough Branch and Institute of Transport: "Hovercraft Possibilities," by W. J. Eggington.*



THE A-4E SKYHAWK IN SERVICE

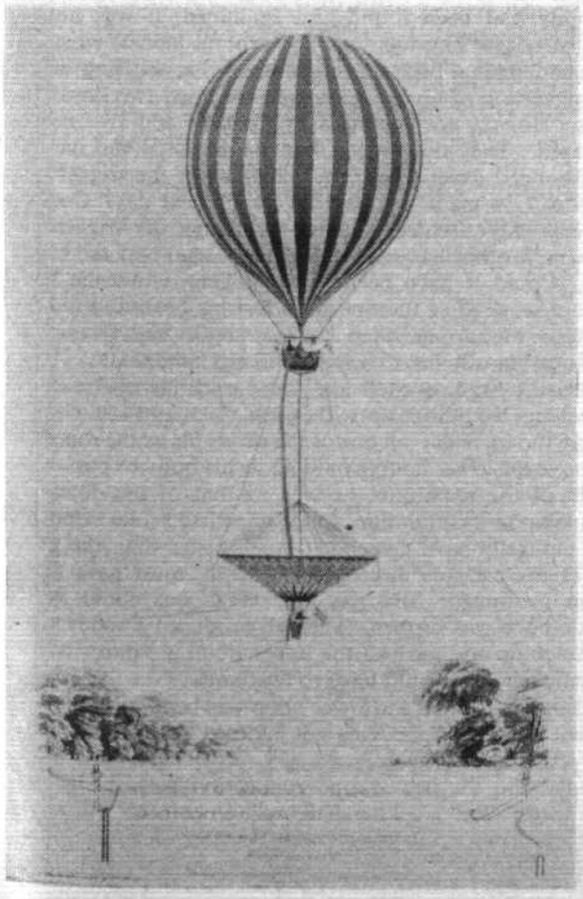
Ed Heinemann's "Bantam Bomber," the Douglas A-4 Skyhawk, has proved one of the most successful carrier-based attack aircraft. So small that its wing does not need to fold, it can carry almost any US Navy air-to-surface weapon, and the A-4E on the right is laden with 18 bombs and two Bullpup missiles, weighing in all 8,200lb. The A-4E is the latest version of the Skyhawk, with an 8,500lb-thrust Pratt & Whitney J52-6 two-spool turbojet which confers increased payload and range. The A-4Es above and below are based at Lemoore Naval Air Station in California.

What Happened to Robert Cocking?

BY HENRI HEGENER

The author is the doyen of Dutch aviation writers and is well known in this country, notably for the Harborough book "Fokker —the Man and the Aircraft." He is now engaged on another book, to be published in English, dealing at great length with the history of the parachute. Mr Hegener's researches have brought to light much little-known or hitherto unpublished material. The accompanying story is of particular interest in that, so far as Mr Hegener is aware, the details of Cocking's death furnished by the coroner have not previously been related in any work of aeronautical history.

Mr Hegener writes: "My greatest snag is to find photographs of the parachute jumpers and their equipment, of the hot-air and coal gas balloon era, which started in the late eighties as a revival of the days of the Garnerins, and which was continued till the First World War. Outstanding were the British aeronauts the Spencers, who did a lot of parachuting in the Far East, South Africa and other countries. I should feel greatly obliged if readers of "Flight International" who are able to help would contact me." Mr Hegener's address is Beukenlaan 24, Bennebroek, Netherlands.



ROBERT COCKING (1777-1837), the son of an Irish clergyman and by profession a water-colour painter, had witnessed the parachute descent by the Frenchman Jacques Garnerin in London on September 21, 1802. Although impressed by the performance as such, he could hardly be enthusiastic about the violent oscillations which the courageous Frenchman had to suffer. He became convinced that the apparatus as used by Garnerin was basically wrong and believed that it would be much more sensible to construct a parachute with the concave side placed uppermost. Experiments with home-made models, which he dropped from the top of the Monument near London Bridge and later on Hampstead Heath, using small hydrogen balloons, had confirmed his theories. In 1814 he read a paper on this subject at the London Institution.

The idea of the "inverted cone" parachute haunted him and he kept hoping to be able to carry out a full-size experiment. He fully realized that a rigid parachute would be a heavy affair and that it would be no simple matter to find a balloon of sufficient capacity to lift his contrivance off the ground. In 1835 he approached Frederick Gye, the manager of Vauxhall Gardens in London, where balloon ascents were frequently staged; but Gye rejected the idea. The construction of the large Vauxhall balloon—later to be known as the Nassau balloon, for its historical long-distance flight from London to Weilburg in Nassau in November 1836—brought Cocking's scheme a step nearer to its realization. But again the management of the renowned amusement park could not raise any enthusiasm. However, the aeronaut Charles Green, who had commanded the Nassau balloon on its great flight to Germany, regarded the scheme as quite feasible and declared himself prepared to undertake its execution. Gye and his associate then agreed.

According to the contract—the original of which is in the library of the Royal Aeronautical Society in London—the parachute was constructed at the expense of the management of Vauxhall Gardens. The first test would be carried out by Cocking without any remuneration, while for the next two he would receive 20 guineas each. For consequent descents he would be paid 30 guineas apiece.

In view of the unwieldy character of the apparatus, it was assembled in Vauxhall Gardens. The largest hoop measured 34ft in diameter and was made of tin tube. The smaller ones were probably of the same material, although one of the sources speaks of copper. They were interconnected by means of light spars of wood, braced by small lines and covered by 22 gores of Irish linen. The whole had a surface of 124 sq yd and was shaped as an inverted cone at 30°, with a height of about 10ft. The "cone" had been artistically decorated by an artist employed by Vauxhall Gardens. The weight, according to most sources, was 223lb, while Cocking himself turned the scale at 170lb. But in a statement before the coroner—for the experiment was to end in tragedy—there was a suggestion that the weight of the unmanned parachute amounted to more than 400lb, which in view of the light construction appears unlikely.

Monday, July 24, 1837 was the day of the daring adventure. A great multitude was present. The preparation took considerably longer than expected. Charles Green—on this flight seconded by the aeronaut Edward Spencer—had refused the responsibility of severing the connection between the parachute and the balloon, obviously with possible failure of the experiment in mind. For this reason there was a release mechanism, called the "liberating iron," which the parachutist, standing in the basket suspended

beneath the parachute, could operate himself. There had been a proposal to fit a rope-ladder between parachute and balloon, to enable Cocking to reach the balloon basket if he decided to abandon the descent; but the suggestion had been made that he might fail to summon the courage to use the ladder, so eventually it was decided to install a hoisting tackle.

Although the management of Vauxhall Gardens had given full support to the planned exhibition, one member was not particularly enthusiastic. After all, he argued, this was no job for a man of over 60! It appears that Cocking would not listen to suggestions of a test using a dead-weight load. Several times Cocking had been told that in case he felt like abandoning the scheme the management of the Gardens would willingly accept his decision.

On the afternoon before the event the matter was discussed again in the presence of a few workmen of the Gardens and two intimate friends of Cocking. Gye said: "Mr Cocking, since you have been in these Gardens, you have probably acquired some practical experience, and if you now think that your calculations are not likely to prove correct, that you have not so much surface as you think fit, that the machine is not of sufficient strength, or that your nerves should fail you, or that from any cause whatever you would rather decline making the experiment, I beg you to say so. Do not allow any idea of disappointing the public, or of any disgrace falling upon the Gardens in consequence of such a determination. I will willingly take the risk of that upon myself, for they had better pull the Gardens to pieces than that an accident should happen. If it were to become necessary, we would return the visitors the money they have paid . . ."

Cocking replied: "My dear fellow, this is very kind of you, but you know I have shown my calculations to several scientific friends and I am fully satisfied of their accuracy." He also declared to *The Morning Chronicle* that, if there were any danger in the undertaking, it would threaten the two aeronauts when, after release of the connection, the balloon would become several hundred pounds lighter.

Evening was well advanced, at 35 minutes past seven, when the band of the Surrey Yeomanry struck up the national anthem and the majestic balloon sailed aloft with the parachute beneath it and Cocking standing in its small wicker basket. An incident—which, however, did not affect the course of events—occurred shortly after the balloon left the ground; a linen tube to be used for dropping ballast clear of the canopy became detached and fluttered earthwards. Only when the built-up area had disappeared under the balloon and that there was no danger that people might be hit, could the balloonists throw out complete bags of sand clear of the parachute.

The Fateful Moment

Cocking would have preferred to rise to 8,000ft, because he reasoned "the greater the distance to fall, the greater would be the atmospheric pressure under the parachute, and therefore the easier descent." [*sic*]. But Green now called down that he could not get the balloon to rise any higher. "Then I shall very soon leave you," Cocking replied, "but tell me whereabouts I am." The answer was "we appear to be on a level with Greenwich." Green asked once more how he felt and whether he was quite sure of his undertaking. Cocking called back: "Yes, I never felt more comfortable or more delighted in my life." A little later he called: "Well, now I think I shall leave you." Green shouted back "I wish you a very good night and safe descent, if you are determined to make it and not to use the tackle." To these last words there was no other reply than: "Good night Spencer, good night Green."

Cocking pulled at the line, but nothing happened. He pulled again, more strongly. This time the release worked. The parachute started the descent in an apparently normal manner, but only for a short time. After three or four seconds, Professor Airy of Greenwich Observatory, who had a telescope aimed on the parachute, saw the saucer-shaped construction suddenly collapse. Rotating about its vertical axis, it started to oscillate violently. Part of the linen covering tore loose and flapped wildly. After half a minute the wrecked parachute had disappeared behind the trees. "The man sitting in it is dead," the Professor said, and hurried in the direction of Lee, where the parachute had come down. A Mr R. Underwood of Regent Street, who had followed the balloon on horseback, was one of the first on the spot. To farm workers who had gathered he said that a human being had come down with it; at a couple of hundred feet the basket had broken away from the main structure. He promised five guineas to the man who could locate the victim. After a search of four fields, Cocking was found. He was carried to the Tiger's Head Inn, where doctors could only pronounce him dead. The publican was, it seems, an opportunist, for he quickly made a show out of the tragedy: for threepence anyone could have a look at the wreck of the parachute, for sixpence at the body of the victim.

Meanwhile, after the parachute was released, the balloon shot up with tremendous force, oscillating violently and pulling wildly, exactly as many had expected. The gas was rushing in torrents from the upper and lower valves, particularly from the latter, so that the aeronauts were almost immediately deprived of sight; this state of total darkness lasted four to five minutes. The diameter of the lower valve, or inflation sleeve, had as a precaution been increased from 18in to 25in. Had they not provided themselves with mouth-pieces connected by pipes with an air-bag, both aeronauts would have been suffocated. The balloon landed near Malling, seven miles west of Maidstone and 28 miles from London. The flight had lasted 80 minutes. Only the following morning, when they arrived at Wrotham, did the balloonists learn of the tragic ending of the experiment.

Contradictory Stories

There are many contradictions in the various reports of the tragedy, which, according to the historian Hodgson "evoked an inordinate amount of attention in the press altogether out of proportion to its aeronautical interest." While, for instance, it was reported that Cocking came down in the basket at a considerable distance from the parachute, a shepherd boy declared before the coroner that the man was found in the basket *under* the parachute. And whereas some historical treatises tell us that the main hoop of the parachute was made of solid section tin tube, is referred to at the inquest. During its construction Cocking was often advised to make certain components, such as the hoops, more substantial, but he kept on saying: "Don't let me have it so heavy." The inquest also brought out the fact that the parachute was intended to be steerable: by means of ropes and blocks or pullies. Cocking could probably cause a distortion of the cone that would have enabled him to sideslip.

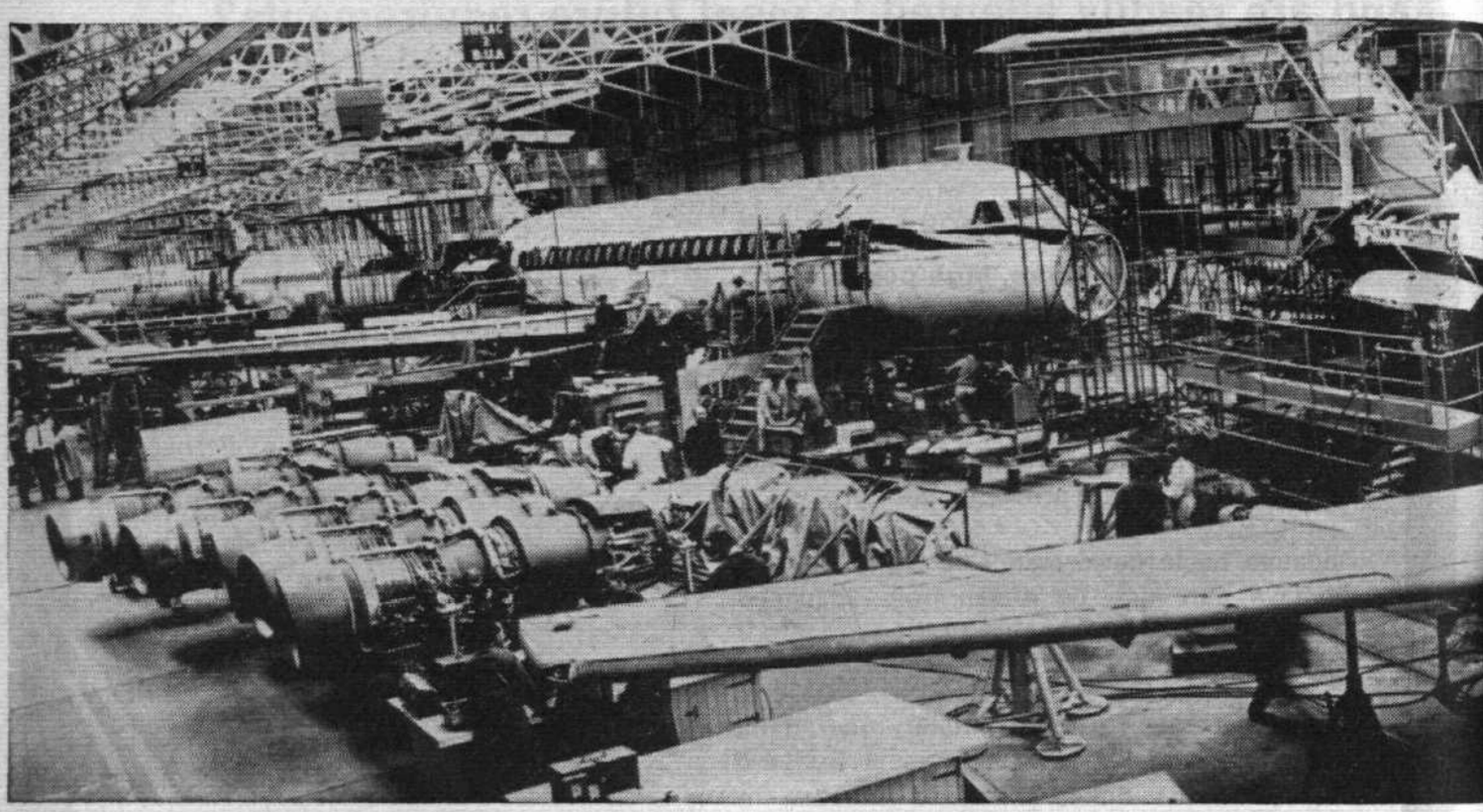
In none of the reports or narratives which we have come across through the years, has any attention ever been given to the statement which was made before the coroner by Frederick Gye. After Cocking's body had been found and examined, it was noticed that a piece of trigger line was wrapped around his left wrist and that the line had made a deep incision there. Gye, hearing of this and at the suggestion of Green, examined the body two days after the accident. He was accompanied by Spencer and two friends of the deceased. They did indeed find in the wrist the incision which corresponded exactly with the thickness of the trigger line. In view of this, Gye made a statement on the next day. Cocking had been expressly warned against wrapping the trigger line around his arm, for this line was attached to the balloon and would rise with it. Could it have been that Cocking, when the hook release did not work after the first pull, lost his head and did not realize what he was doing when he wound the line around his left wrist? It can hardly have happened in any other way.

Thus, when the hook opened and the parachute was released, Cocking was rapidly pulled up with great force and—as Gye explained before the coroner—up out of the car as far as the ropes immediately above the lower hoop would allow his body to pass. The whole weight of the apparatus, as well as that of the deceased, instantly came upon this thin line, and it of course broke. Cocking then would naturally have descended much faster than the parachute, and as the car was directly underneath, must have fallen into it. Gye continued: "By this fall, which was about eleven feet, his ankle bone was broken. This fall produced a sudden jerk upon the parachute and gave to the upper hoop a strain which it was never anticipated it would have to encounter."

But it is also possible that the lower hoop was bent and collapsed at the moment when poor Cocking got jammed against the braced parts of the structure.

Finally, what did the heavy rope connection between balloon and parachute do after Cocking had pulled open the "liberating iron"? This taut rope, having been released, may well have struck the thin main hoop of the parachute with great force.

ON SCHEDULE



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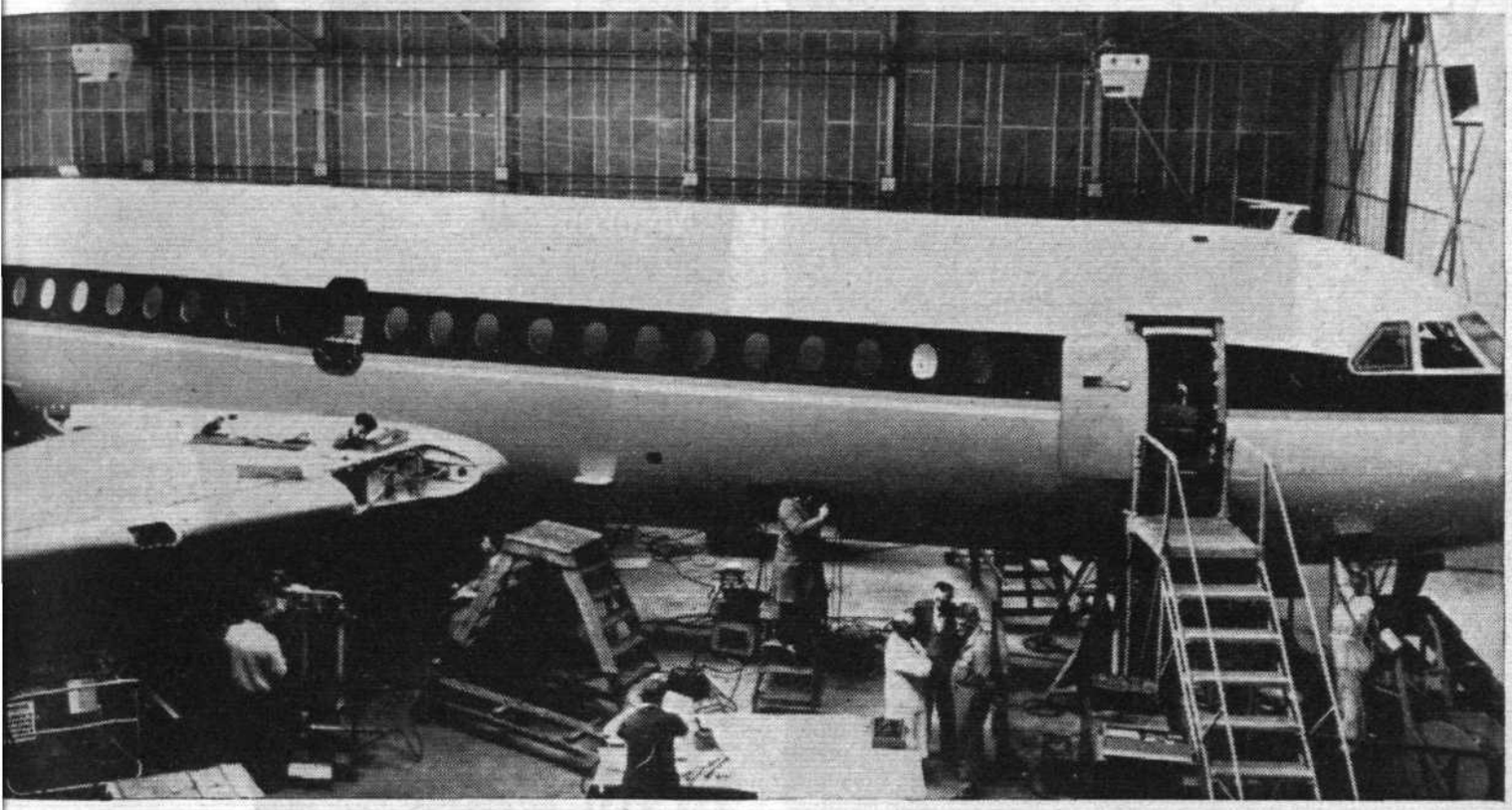

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Stories of the Caterpillar Club

3 Autumn 1958

Explosion at 56,000 feet! Testing a new Canberra jet-bomber high over Derbyshire, Flight-Lieutenant De Salis was ejected from his disintegrating aircraft.

As his seat separated from the Canberra, a piece of flying wreckage sheared off the stabilising drogue parachute; the seat promptly somersaulted and spun violently. Seconds later an automatic device released him from the seat, and De Salis found himself flung downwards in a rapid blur, revolving like a high-speed gramophone record. After falling more than eight miles through the upper atmosphere, and when on the point of unconsciousness, the Irvin barometric release opened his parachute. Despite his eyes having been affected by four minutes violent rotation and only being able to see through narrow slits, De Salis managed to make a good landing in a small field. De Salis was soon re-united with his co-pilot, Flying Officer Lowe, who had made a more orthodox descent.

These two officers held for a long time the unofficial record for the highest emergency bale-out and the longest free-fall.

Leslie Irvin, founder in 1922 of this, the most exclusive club in the world, decided that there would be no social premises, no entrance fee and no subscription. The only class of membership would be "life", the only privilege "its continued enjoyment". Membership would be limited to those who had saved their lives in an emergency with a parachute of Irvin design. The gold caterpillar badge has the name and rank of the recipient engraved on the underside—and over 40,000 members proudly wear it.

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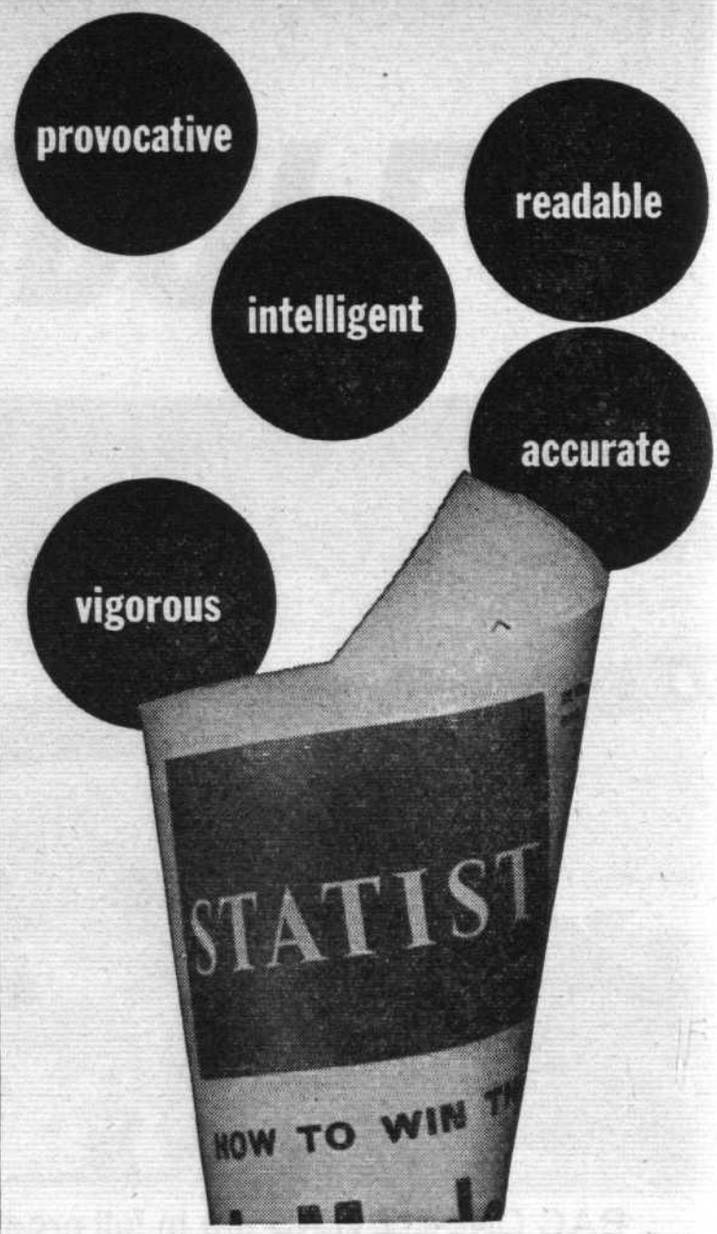

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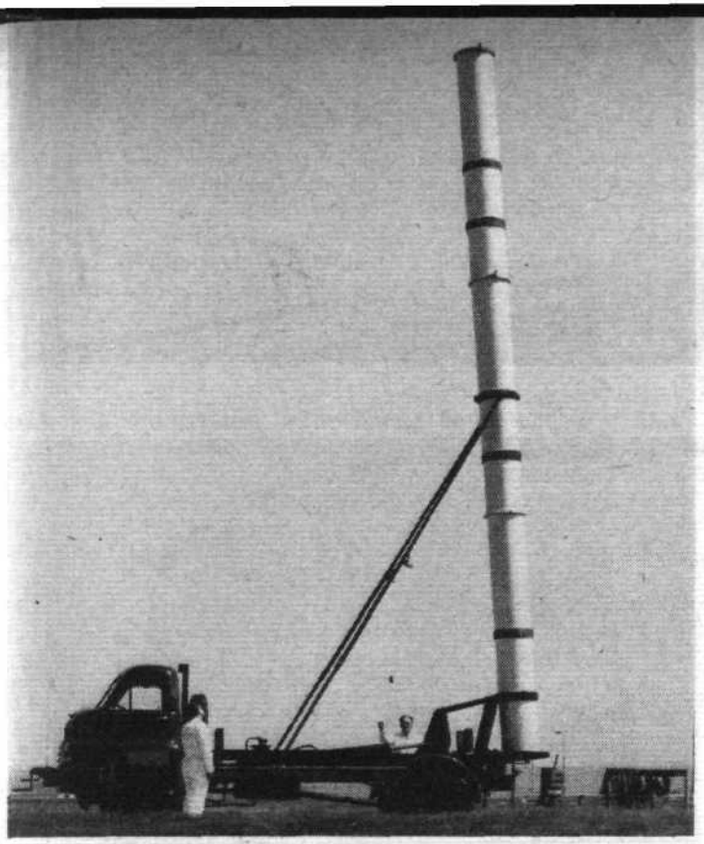
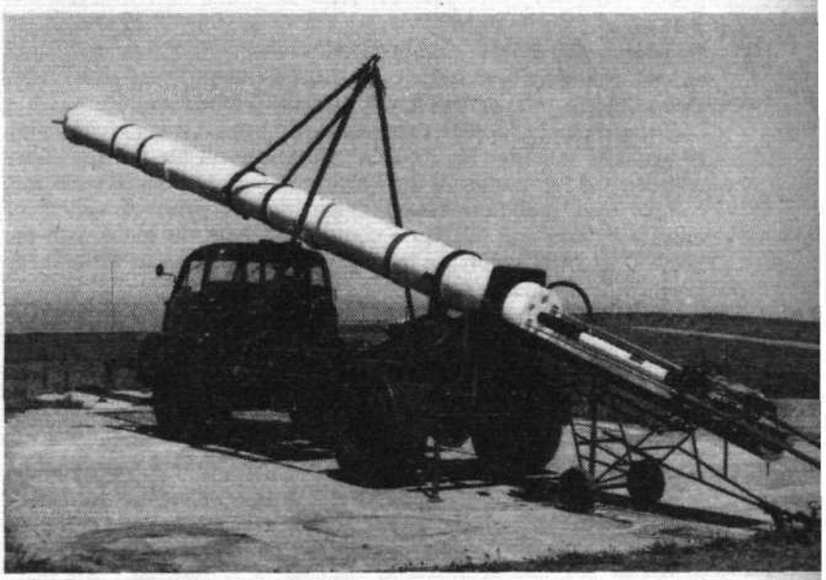


Operational firings of the 5in-diameter meteorological rocket were scheduled to begin as part of the IQSY programme from South Uist this week (see "Weather Rockets Launched"). Above, launching tube in launch position; above right, one of the proving firings; right, rocket (with boost motor attached) and launcher



Missiles and Spaceflight

WEATHER ROCKETS LAUNCHED

On Monday last, January 13, a series of firings of the new British 5in-diameter meteorological rocket was scheduled to begin at South Uist in the Hebrides as part of the worldwide programme of research scheduled for the International Years of the Quiet Sun (IQSY). The rocket (illustrated above) has been designed and developed by Bristol Aerojet Ltd and the Rocket Propulsion Establishment.

The Meteorological Office are using the rocket to extend their measurements of winds and temperatures in the upper atmosphere to 200,000ft or higher, into regions which cannot be reached by aircraft or balloons. The aim in developing this particular design has been to provide a cheap and simple tool which can be launched safely from small, simple ranges.

The rocket is 8ft long and 5in in diameter. Weighing about 80lb, it can carry a payload of 10lb to heights of nearly 40 miles. The vehicle is unguided, and is launched from a 32ft tube at a speed of about 200 m.p.h. by means of a small boost motor which descends by parachute and is recovered for refilling. The payload may be varied to suit the requirements of the Meteorological Office, a normal load consisting of a temperature-measuring sonde carried on a radar-reflecting parachute which is ejected from the rocket at the peak of its flight. The parachute is tracked by ground radar to determine the winds, and the temperature transmitted by the sonde is recorded at a ground station.

554 ICBMs Four squadrons each of nine Titan 2 ICBMs became operational with Strategic Air Command of the USAF last month, two at McConnell Air Force Base, Wichita, Kansas, and the other two at Little Rock Air Force Base, Arkansas. This brought the total number of operational Titan 2s to 54 and the total number of operational ICBMs in the USA to 554, according to a Defense Department statement. Other individual totals comprise 320 Minutemen, 126 Atlases and 54 Titan 1s. A Titan 2 was fired 5,700 miles down the Atlantic Missile Range from Cape Kennedy on December 12.

President, Congress and the Moon President Lyndon Johnson signed the 1964 Appropriations Bill containing an appropriation of $5,100m for NASA on December 19, but criticized the provision in the Bill which prevented NASA funds from being used without the consent of Congress for any manned lunar landing which the US might carry out jointly with any other country. The President said: "While it will have no practicable effect, since there is no chance of our being engaged in a joint manned lunar landing with any other country during the remainder of this fiscal year, I believe such a restriction to be undesirable in principle. It impairs the flexibility which we should seek to retain in our relations with other countries. It may raise some doubts as to our willingness to work co-operatively with other nations in the most important space effort of this decade."

The observatory of Skalnaté Pleso, located 5,850ft above sea level in the High Tatra mountains, is one of a number of Czechoslovak stations used for the optical tracking of Earth satellites. Right, Dr Ludmila Pajdusakova, director of the observatory, which recently completed 20 years of active astronomical studies

Missiles and Spaceflight

SOVIET SPACE PROSPECTS

The often-mentioned but still anonymous "chief constructor of Soviet space vehicles" gave his forecast of the next five years in space in an article printed in *Izvestia* at the turn of the year. In this he expressed confidence that, within this period, near-terrestrial space would have been sufficiently studied and mastered technically, and would be used extensively for practical purposes.

One can expect, he said, that permanent orbital systems consisting of artificial satellites for different purposes will be created. They will be used for studies of the Earth, the Sun, weather forecasting, control over radiation in space, and cosmic rays. A system of universal radio and television communications via space with the help of satellites revolving in synchronized movement around the Earth will be widely used.

The chief constructor said that it seemed that several projects for using space would also be worked out during the five-year period, first of all for urgent mail and freight deliveries and later for passenger travel. In service the systems of satellites and to conduct scientific research, permanent stations would also be created in orbits near the Earth.

Looking back on 1963, the chief constructor said that the launching of new Vostoks, Cosmos satellites and Polyot in the USSR during the year had the task of accumulating experimental materials and data primarily about near-terrestrial space, the checking of methods and improvement of up-to-date equipment. All these systems were worked out in accordance with a co-ordinated plan for the scientific exploration of outer space.

In the years to come, he said, it would most probably be possible to carry out direct explorations round the Moon and on its surface only with the help of small, automatic apparatus, with the transmission of information back to Earth by radio.

In another year-end comment on Soviet space activity, Lt-Col Valery Bykovsky was quoted by Tass as saying that new and more complicated experiments were scheduled under the Soviet space exploration programme. Concerning Polyot I, the cosmonaut said: "Its ability to make various manœuvres in space opens great possibilities for establishing new heavy stations in orbit, and for making flights to other planets." He added that Soviet designers and scientists "have developed powerful boosters and spaceships such as the United States does not have. In our ships, all systems worked faultlessly."

Earlier last month, *Red Star* stated that the Soviet cosmonauts were in intensive training again for "more complicated tasks." It added that Yuri Gagarin had been promoted to full colonel, and was directing a new programme of training for other cosmonauts such as Herman Titov and Pavel Popovich.

COMMUNICATIONS VIA THE MOON

In addition to their use in connection with the West Ford project (involving the reflection of radio signals by an orbiting belt of copper dipoles) the two West Ford ground stations at Millstone Hill in Westford, Massachusetts and Camp Parks in Pleasanton, California, have made extensive measurements on reflections from the Moon. These measurements have been made at X-band frequencies (near 8,000Mc/s, wavelength 3.6cm).

The surface of the Moon resembles an orbital belt of dipoles as a reflector of radio waves in two important respects. First, it produces many multiple reflections from somewhat different distances, each reflected signal arriving at the receiving point at a slightly different time: thus a single transmitted pulse produces a smear of many overlapping pulses of various amplitudes at various arrival times, and the modulation-demodulation system must bring order out of this chaos without sacrificing precious power from the already feeble reflected signals. Second, because the reflecting elements are all moving at various different velocities with respect to the fixed transmitter and receiver, the received signals will no longer be at the same frequency as the transmitted signals; they will be smeared over a much wider range of frequencies, and the modulation-demodulation system must also cope with this kind of distortion.

Using advanced techniques of modulation developed for the West Ford experiment, the West Ford ground stations have achieved digital data transmission rates, over the transcontinental lunar-relay circuit, of 50,000 bits per second, a capacity that would accommodate hundreds of simultaneous teletype channels—considerably greater than the capacity of lunar relay circuits currently in operational use. Good-quality voice communication over this circuit has also been achieved.

In another experiment, in April 1962, the West Ford ground terminals achieved the first transmission of a television picture via a communications satellite, bouncing a picture from Camp Parks in California to Millstone Hill in Massachusetts, 2,700 miles away, by way of the orbiting Echo I space balloon. This was the first successful Earth-space-Earth television video transmission, and it is likely to remain the only such transmission by *passive* satellite until such time as another Echo-type satellite is placed in orbit.

In April 1963, the Royal Aircraft Establishment at Farnborough announced successful reception of good teletype copy at 60 words per minute, transmitted by way of the Moon from Camp Parks in California, 5,333 miles away. This experiment was part of a continuing co-operative programme between Britain and the USA. The success of the experiment was made possible by special modulation equipment developed for West Ford use.

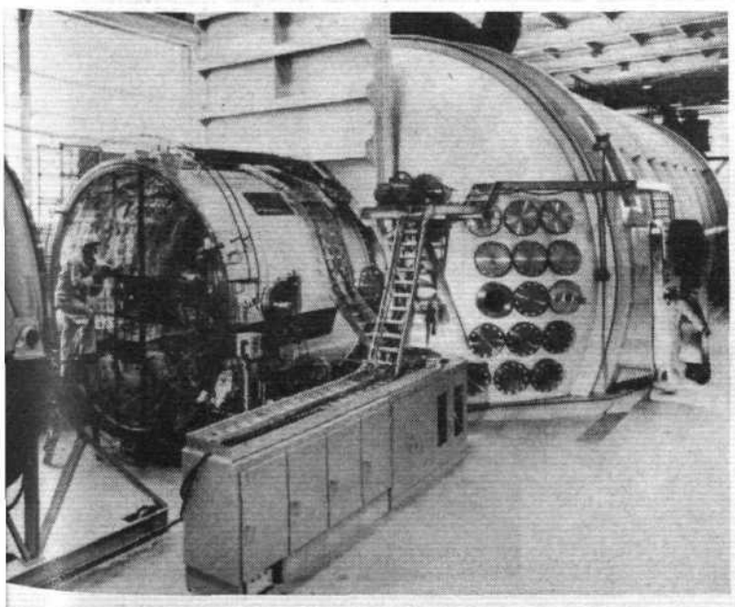
US Budget Cuts On January 8 President Johnson announced that the "new obligational authority" requested by the Defense Department for the 1965 fiscal year for " military functions " had been cut by $9,563m to a figure of $49,737m and that for "military assistance" had been cut by $290m to $1,000m. The NASA obligational authority, he said, had been cut by about $668m. The President's full budget message is to be delivered to Congress on January 21.

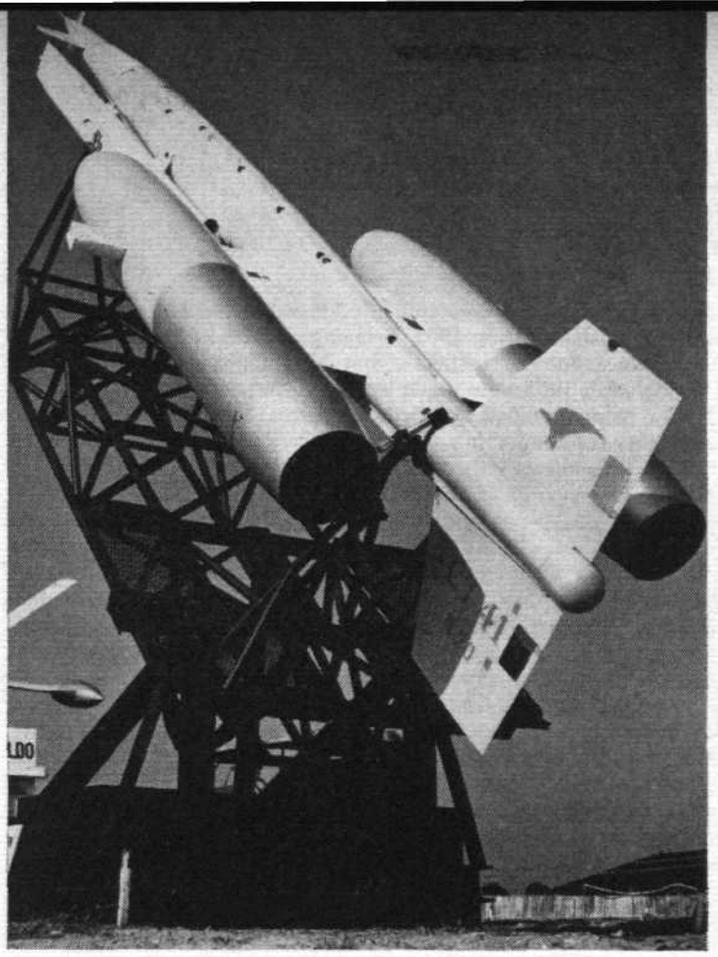
Relay 1 Still Operating The timing device aboard NASA's Relay 1 communication satellite, which was to have switched off transmission power aboard the satellite 12 months after launch (from Cape Canaveral on December 13, 1962) has not yet functioned. The device comprised an electrolytic solution which was to have eaten through the main power lead to switch off the transmission power. NASA and RCA scientists have speculated that the temperature around the destruction device might have been colder than anticipated and the erosion therefore slower. The next Relay satellite, scheduled to be launched on January 21, will not carry any automatic cut-off device. It will be used to test the longevity of a communication satellite in addition to continuing the scientific and communications experiments begun with Relay 1.

Rockets with nuclear warheads of different power have greatly increased the combat potential of Soviet anti-aircraft rocket forces, according to Air Marshal Vladimir Sudets, Commander-in-chief of Soviet Air Defences. Writing in *Izvestia*, the air marshal said that anti-aircraft radio engineering troops had successfully solved the problem of early detection and continuous tracking of means of air attack. These forces were capable of detecting—at great distances, at any time of the day or year, and regardless of weather and interference—any means of air attack, to identify them, establish precisely their co-ordinates and supply timely target acquisition data to anti-aircraft rocket forces and to rocket carriers.

Japan's Space Programme On January 3 it was reported from Tokyo that a headquarters to co-ordinate Japan's space development programmes will be set up during 1964. The Government's Science and Technology Agency has been planning to set up such a headquarters in order to raise the country's space development efforts to the international level. The proposed headquarters will deal with the planning and development of artificial satellites and rockets, the launching of satellites, and space observation. It is also scheduled to develop multi-purpose satellites for observation purposes and large-size rockets for launching such satellites into orbit, under a 37-billion-yen, five-year programme.

NASA technicians prepare for an experiment in the 25ft × 80ft space-environment chamber in the Electric Propulsion Laboratory of the Lewis Research Center, Cleveland, Ohio





Successful flights by Nord CT.41 target drones were made recently at Hammaguir and Point Mugu, as reported in our December 12 issue. Cruise propulsion is provided by two Nord ramjets

US Nuclear Warheads In his State of the Union message to Congress on January 8, President Lyndon Johnson said: "We must not stockpile arms beyond our needs or seek an excess of military power that could be provocative as well as wasteful. It is in this spirit that in this fiscal year we are cutting back our production of enriched uranium by 25 per cent, shutting down four plutonium piles and closing many non-essential military installations . . ." US officials commented on the same day that, in the past three years, the USA had increased its inventory of nuclear warheads by 50 per cent, and recalled earlier public statements that the nation had stockpiled "tens of thousands" of such weapons.

"Alone if Necessary" The only reference to space in President Johnson's State of the Union message to Congress on January 8 was the following declaration: " We must assure our pre-eminence in the peaceful exploration of outer space, focusing on an expedition to the Moon in this decade—in co-operation with other powers if possible, alone if necessary."

Radiation measurements made by 15 Soviet satellites in the period between August 1960 and June 1963, according to Soviet Information Service, have enabled Soviet physicists to determine the daily fluctuations in radiation levels along various space trajectories. Data were analysed from the flights of Vostok craft between 175 and 237km, and from radiation measurements by Cosmos satellites at heights up to 405km. The diurnal radiation doses (11-60 milliroentgens) were stated not to be dangerous for cosmonauts at the altitude of 175-405km. Tissue doses of radiation received by cosmonauts Bykovsky and Tereshkova aboard Vostoks 5 and 6 were quoted as 55 milliroentgens (after 119 hours) and 33 milliroentgens (after 71 hours) respectively.

Alouettes for Woomera The Australian Government has placed an order with Sud Aviation for the purchase of three Alouette helicopters, with spares and equipment, at a total cost of more than £A300,000. Delivery is scheduled for mid-March. Mr Allan Fairhall, Australian Minister for Supply, said that the helicopters would be used at the Woomera rocket range for search and recovery of missiles after trials, for ferrying staff to outlying posts and for range safety work. The Alouette, he commented, was the best type to meet the particular requirements of the range.

Missiles and Spaceflight

X-15 IN 1963

North American X-15 research aircraft completed 21 flight missions without mishap during 1963, bringing the total number of flights to 97 since Scott Crossfield's first X-15 flight on June 8, 1959. All flights in 1963 were made by X-15s numbers 1 and 3; aircraft No 2 is being modified by North American to increase its speed and capability for conducting aerospace experiments.

The three-aircraft programme is conducted jointly by the National Aeronautics and Space Administration, USAF and USN at NASA's Flight Research Center at Edwards Air Force Base, California. Some of the newer studies assigned to the X-15 include missions related to studies of aerodynamic heating, ultraviolet stellar photography, measurement of infra-red rocket-engine exhaust signatures, and horizon-sensing stabilization equipment for spacecraft. Some two-thirds of the X-15 research work is in support of space science, and the remainder is aeronautical.

During 1963 the X-15 team at Edwards completed major phases of boundary-layer studies, USAF "optical degradation" experiments, and investigations to determine the effects of air pressure, speed and angle of attack on aerodynamic heating. Experimental work was accomplished in 1963 on stability and control during re-entry from high altitudes, on advanced flight control systems, structural dynamics, and the measuring of physiological effects on pilots under extreme flight environments.

Evaluation began during the year of a new system of stability augmentation which increases the pilot's ability to control the vehicle precisely in regions of low dynamic pressure. Current experiments with ultraviolet stellar photography are intended to yield data usable in developing the Orbiting Astronomical Observatory, and a separate, newly assigned horizon-definition experiment will test the feasibility of a spacecraft pilot performing the control task required for initial acquisition of a star as a reference. Data obtained will contribute to the development of the Apollo navigation system.

On December 5, 1963, Maj Robert A. Rushworth, USAF, set a new Mach number record for the X-15 of M=6.059. His speed was 4,057 m.p.h., slightly less than the 4,104 m.p.h. achieved by NASA pilot Joseph A. Walker on June 27, 1962. Walker's Mach number on this occasion was 5.92. On August 22 Walker established an unofficial world altitude record for winged vehicles when he flew X-15 No 3 to 354,200ft.

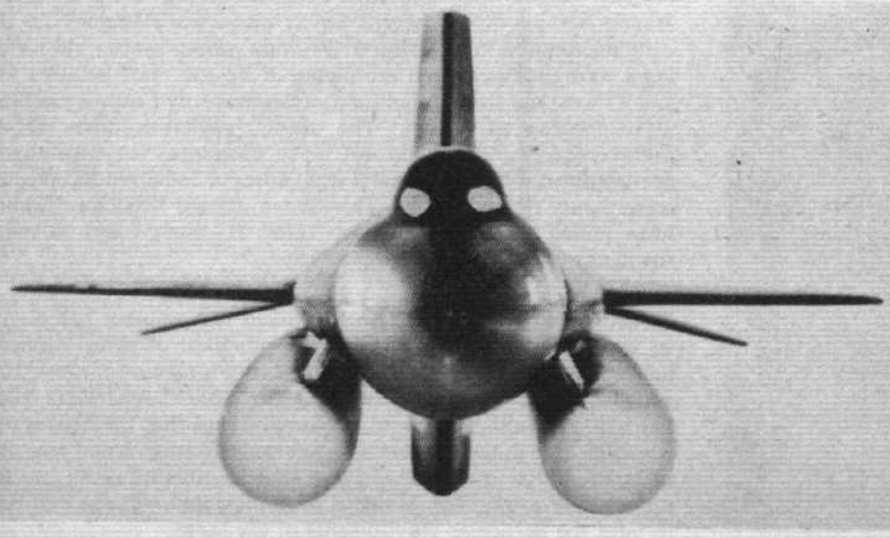
Five pilots are assigned to the X-15 programme. They include Capt Joe H. Engle, USAF, and Milton O. Thompson of NASA, who made their first X-15 flights during 1963. For the future, the first flight is expected next summer of X-15 No 2 modified to carry two large external propellant tanks (*Flight International*, November 14, 1963). This will give increased flight duration and speed.

First flight photograph of the Northrop NV-101 drone, recently tested over San Nicholas Island near Point Mugu, California (see "Autogyro Drone")

Autogyro Drone First flight of "the Free World's first autogyro drone aircraft" was announced by Northrop Corporation from the US Navy's Pacific Missile Range on January 6. Designed and built at Newbury Park, California, by Northrop's Ventura Division to meet the US Services needs for a low-cost, multi-purpose, remote-controlled vertical-take-off drone, the aircraft is designated the NV-101. It is designed to fly battlefield reconnaissance missions at speeds up to 140 m.p.h. and heights up to 20,000ft with a flight duration exceeding one hour; simulate a helicopter or low-flying aircraft for gunnery and rocket target practice; and deliver 300lb of supplies to frontline troops in jungle or rough mountain terrain. Powered by a 75 h.p. McCulloch engine, the drone is equipped with three 12ft variable-pitch rotor blades in place of the standard fixed wing. At the start of a flight the blades are accelerated to 450 r.p.m. by compressed air or a small propellant charge. Northrop Ventura has supplied more than 65,000 radio-controlled unmanned aircraft to US and allied forces, including KD2R-5 target drones for the Royal Navy and SD-1 reconnaissance drones for the Royal Artillery. UK representatives for Northrop Ventura are Aerial Targets Ltd of 27 Ashley Place, Westminster, London SW1 (Tate Gallery 8631).

Typhon Cancelled The US Defense Department announced on January 8 that development of the US Navy's Typhon air defence missile, on which about $230m had been spent to date, was to be stopped. Instead, the Navy is to develop a standardized version of its present Tartar and Terrier missiles.

The second X-15 is being modified to carry two large external propellant tanks, as shown below (see "X-15 in 1963"). Right, Capt Joe H. Engle, USAF, newest and youngest of the X-15 pilots



Hybrid Propulsion

By D. D. Ordahl and W. A. Rains*

ONE of the most promising products of current propulsion research is the hybrid concept. It uses a combination of solid and liquid propellants, and is a cross product of the practical experience and research on both all-liquid and all-solid systems. The development of hybrid engines is the most promising means for meeting the complex propulsion requirements being encountered in many advanced military and space missions. This is because, as in most hybrid products, proper selection enables the designer to emphasize the strong and suppress the weak features of each element in the combination. Typically, the features of controllable thrust, high-energy performance, and low propellant cost that are normally associated with liquids can be combined with the structural simplicity, high density, and wide-range storability of solids. Engines designed in this manner can provide optimum performance where combinations of such features as outer-space storability, high-impulse performance and intermittent operation with demand thrust are required. A significant extra advantage of some of the preferred hybrid combinations is that they can provide the greatest safety in manufacturing, handling, and operation of all possible high-energy chemical propulsion systems.

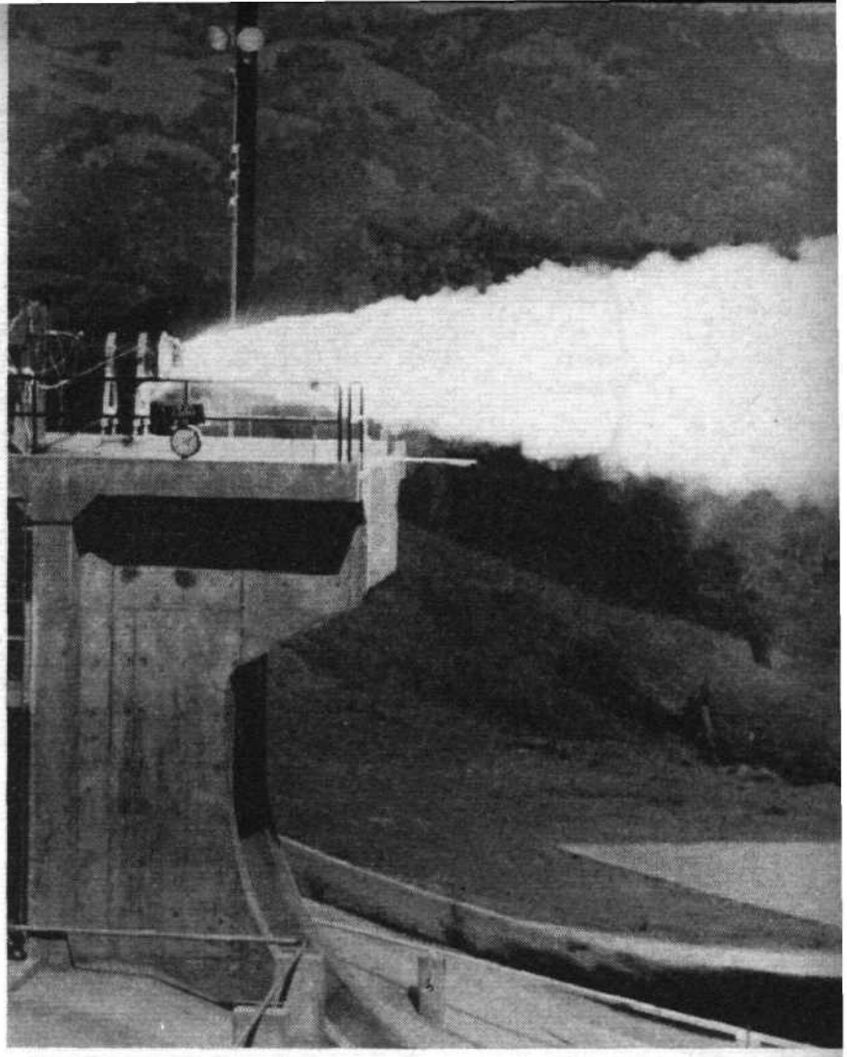
Although most of the potentials of hybrids have been recognized and widely discussed for at least ten years, no substantial effort was made to exploit the concept for ordnance or space systems until the Navy started a small exploratory investigation in 1958. Progress in the last two years has been sufficiently encouraging to warrant the redoubled effort that is being expended, and hybrids are being given serious attention by the National Aeronautics and Space Administration as well as each of the defence agencies. No problems have been identified that cannot be solved by known engineering methods, and the use of hybrid propulsion is fully expected to appear in developments of the near future.

To facilitate an understanding of the operation of a hybrid engine it is convenient to refer to typical examples of the basic technologies from which the concept has been derived. In a typical storable liquid-propellant engine (Fig 1) liquid fuel and oxidizer are packaged in separate tanks and the rate of flow into the combustion chamber is controlled by appropriate valves on both feed lines. Driving forces that cause the liquids to flow are provided by pressurizing the tanks with a gas generator or an auxiliary gas bottle. The ratio of the oxidizer and fuel (as well as the total mass flow) is controlled by adjusting the valves on the propellant lines. Ignition is usually accomplished by hypergolic reaction. Where the propellants are not themselves hypergolic, a small quantity of a third material is injected with the first portion of fuel or oxidizer.

The other technology which makes up the second half of a typical hybrid propulsion system is the mechanically simple solid engine (Fig 2). A normal solid propellant contains all of the fuel and oxidizer required for complete reaction in a continuous solid matrix. Chemically, the solid propellant is considerably more complex than the usual liquid combination, because the mixture must contain chemical agents to accomplish the function provided in the liquid engine by the control valves. In other words, the mass flow is controlled by catalysts and ballistic modifiers and by surface geometry rather than by mechanical means. These propellants are ignited by means of either a pyrotechnic or a hypergolic igniter, and no modulation of thrust is generally possible; however, for some propellants thrust can be terminated by a suitable drop in pressure.

Hybrid systems classically employ the same oxidizer delivery as the storable liquids, and the same motor construction as the solids. The simple concept illustrated by Fig 3 depicts an engine in which liquid oxidizer such as nitrogen tetroxide is pressure pumped into a chamber containing a typical hybrid fuel such as rubbery polymer

* United Technology Center (a Division of United Aircraft Corporation, Sunnyvale, California).



Test-firing of a 10,000lb thrust experimental hybrid rocket engine at United Technology Corporation's development centre near Morgan Hill, California, last summer. The UTC hybrid uses a solid fuel and a liquid oxidizer

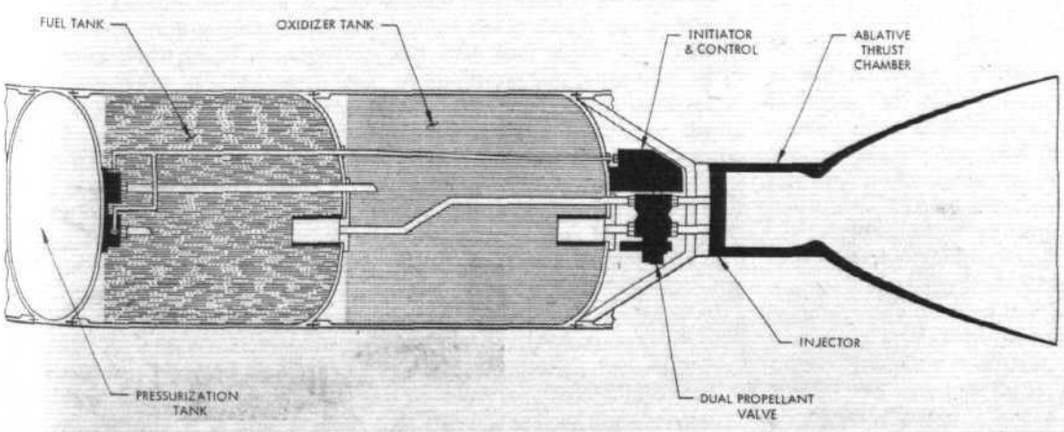


Fig 1 Liquid bi-propellant system

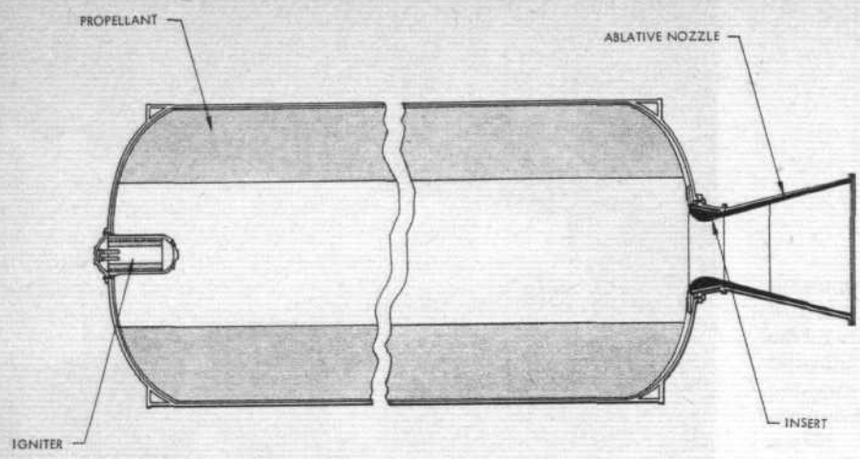


Fig 2 Solid-propellant system

loaded with powdered metal. It may be noted that only one liquid tank is needed, and consequently only one valve and one pressurizing unit, and the injector handles only one material instead of two. In fact, research has shown that the function of the injector in a hybrid engine is simply that of introducing the oxidizer in a highly atomized, readily vaporized form. The solid phase of the hybrid propellant combination has the same general design as a solid propellant unit, but contains no oxidizer. As a consequence, it does not sustain combustion. This feature gives the hybrid engine the capability of on/off operation and thrust modulation, since the burning rate is determined by the rate of flow of the oxidizer.

The key to successful hybrid propulsion is the understanding and control of the combustion process. As in any chemical system, the control of this process determines the efficiency with which the potential energy is recovered from the desired reactions. The combustion of hybrid propellants is believed to proceed by a process of thermal diffusion, decomposition, and chemical reaction (Fig 4). The first step is the injection of liquid oxidizer in droplet form to contact the cold surface of the solid fuel. If the reaction is hypergolic, a cyclic, auto-catalytic process is started which generates the heat to cause continued decomposition of the fuel. This decomposition produces a mixture of vaporized fuel and decomposition products which can then react further with the available oxidizer. Diffusion of the combustible products away from the surface of the fuel is actually countercurrent to the diffusion of the oxidizer spray towards the surface of the fuel.

After the initial phases, which take place over a very short time interval, the reaction process is stabilized with the active combustion zone established a significant distance from the surface of the solid phase. Heat from this zone is transmitted in two directions. Some returns to the surface of the solid where it causes vaporization and decomposition to generate further material for the active combustion. The remainder is transferred to the gaseous combustion products which flow along the charge and out of the nozzle. After the reaction is started very little oxidizer contacts the surface of the fuel, and most of the regression is caused by thermal decomposition. The overall reaction rate is regulated by the mass flow of liquid without which the primary combustion reaction could not take place.

In the classical hybrid system the solid does not burn alone, and the mass flow is governed entirely by the flow rate of the liquid and the rate of reaction between the liquid and the solid. This is the ideal type of hybrid reaction, since complete demand thrust can be achieved and the effects of solid-surface geometry are relatively unimportant. In early experiments by Moore and Berman,* a hot gas was flowed over a solid containing no oxidizer and smooth combustion was obtained with linear regression rates of the solid. It has also been demonstrated conclusively by more recent tests that demand thrust can be achieved by controlling the flow of liquid oxidizer.

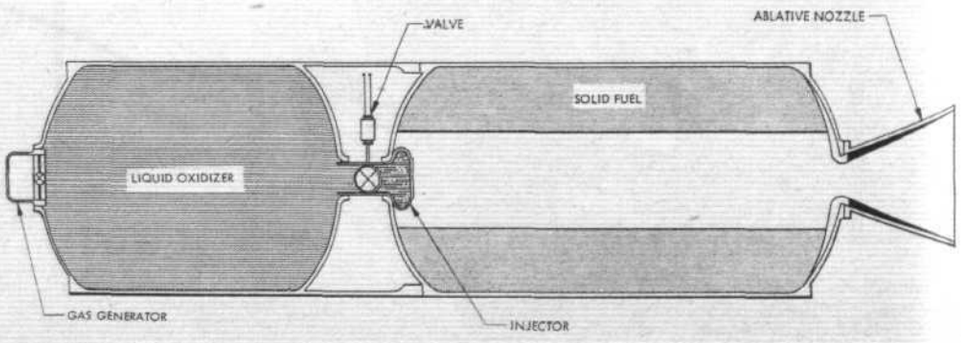
It may be noted that the limiting step is the decomposition or vaporization of the material in the solid phase and its diffusion into the principal reaction zone. If the flame temperature is increased or located nearer to the solid surface, the combustion rate is increased. The ideal type of solid fuel is one with a very low latent heat of vaporization and having the characteristic of decomposing without leaving an ash or solid products that are difficult to burn. Materials that melt at a low temperature but vaporize at a high temperature are difficult to handle in a hybrid system, since the melted material tends to flow and be expelled from the nozzle, resulting in poor combustion efficiency and a low apparent specific impulse. The familiar plastic polymethyl methacrylate possesses most of these desirable properties, and is found to be a nearly ideal fuel for moderately high performance hybrid engines.

Two basic features of a hybrid rocket affect the materials and processing disciplines: (1) the complete separation of the fuel from the oxidizer, and (2) the capability to use the optimum combination of propellant ingredients regardless of whether these are liquid, solid, or mutually incompatible because of chemical reactivity. These characteristics of hybrids establish the mechanical property requirements of the solid phase, the plant processing requirements, handling and storage procedures, and the materials required for fabrication of engine components.

Some of the most difficult problems arise from the fact that the solid charge must not deform or crack, nor can malfunctions result from major pressure deviations. To prevent mechanical failure, the

* *"A Solid Liquid-Rocket Propellant System," by G. E. Moore and K Berman. "Jet Propulsion," Vol 26, No 11, November 1956, pages 965-968*

Fig 3 Hybrid propellant system



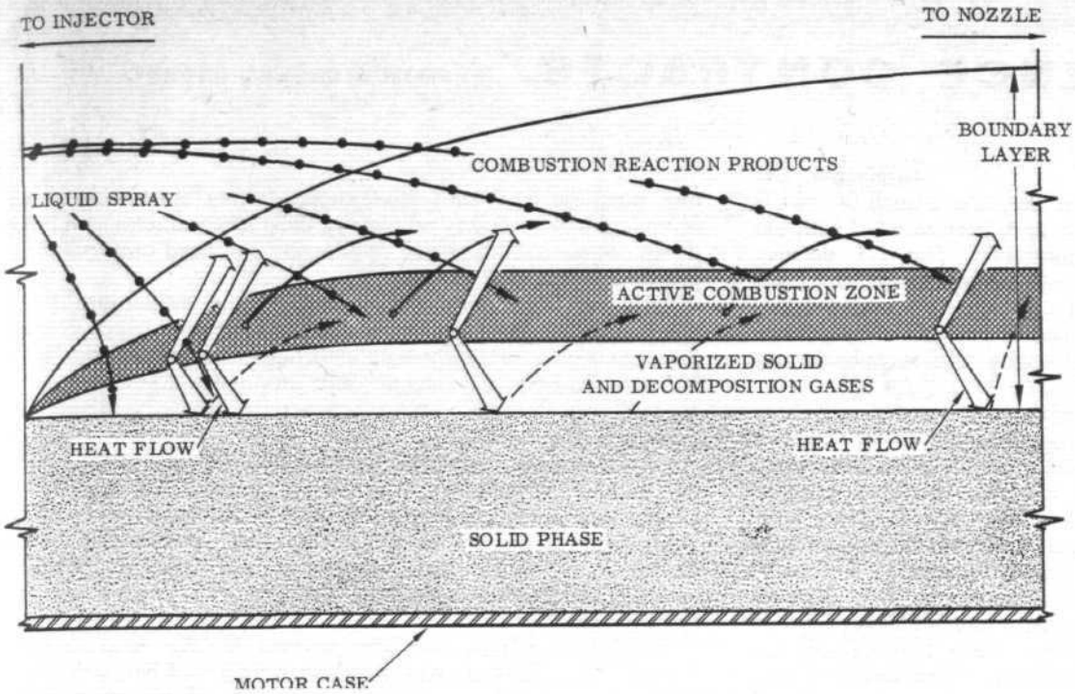


Fig 4 Combustion process for hybrid propellants

charge must resist the forces of sudden pressurization (ignition), gas flow, acceleration, and expansion and contraction. The structural properties of solid propellant (and a hybrid fuel) depend largely on the amount of polymer or binder used. To maintain the desired impulse, a solid propellant must be limited in binder content to the lowest practical level (usually 14 to 18 per cent). This tends to produce low strength and poor tolerance to deformation. On the other hand, the binder or polymer level in an optimized composition of solid fuel for a hybrid is at least 50 per cent, and may be almost 100 per cent. The immediate result is a most helpful influence on mechanical properties. At the same time, the consequences of cracks and deformation are unimportant. Since the hybrid burning process is controlled predominantly by liquid flow, the solid grain surface does not determine the pressure. Therefore —unlike solid propellants—cracks or holes in the hybrid fuel grain do not lead to faster or uncontrollable burning. The independence of pressure from surface area of the hybrid grain as compared to the conventional solid propellant has been verified by firing segmented motors in which the segments were not bonded to each other or to the wall. Burning did not occur either in the cracks or between the grain and wall.

Hybrid grains will generally not sustain combustion, and there is no possibility of inadvertent ignition or detonation. As a result, plant processing problems are reduced and it is now possible to prepare the fuel and oxidizer separately in conventional chemical plants without regard for the quantity/distance requirements so familiar to the solid-propellant industry. The inert solid component can be manufactured in standard facilities without the extra expense involved with explosion-proof equipment and remotely controlled operation. Each component may be handled and stored independently. With reasonable selection, therefore, the hybrid can be the safest of all possible high-energy propulsion systems. With few exceptions, even the high-energy components are inert to shock. If a tank is punctured, the liquids drain away, producing fires only when there is actual contact with fuel materials. This flexibility of the hybrid system leads to minimum shipping costs, as well as versatility in storage and handling. The fuel and oxidizer may be stored at different locations until just before use, or the inert components may be shipped separately and the oxidizer loaded at the launching site.

One of the most important aspects of the hybrid concept is the ability to separate the fuel and oxidizer phases. This permits the use of many advanced components which cannot be directly utilized in either liquid or solid engines because of chemical incompatibility. This ability also means the attainment of high flame temperatures (as high as 9,000°F in systems currently under evaluation). This temperature, coupled with the previously mentioned incomplete reactions, results in a severe materials problem for nozzles, injectors and insulation. It is now evident that there is a need for thermal and oxidizer-resistant materials in addition to the usual requirement for heat and ablation resistance.

Small hybrid engines are immediately applicable to a variety of tasks for space missions, such as position and attitude control (steering) of satellites. Further extensions of this concept provide the propulsion characteristics required for some of the more complex operations in space such as rendezvous, soft landings, and take-off from the surface of the Moon even after a period of extended exposure to the lunar environment.

Longer-range applications for much larger systems where the boosters will weigh in the order of 20,000,000lb can also make practical use of the hybrid concept. In such applications the features of complete safety and structural strength of the fuel are expected to be predominant. The fuel portion can be formulated to be no more hazardous than a rubber tyre, and conveniently constructed in much the same manner in which large buildings are

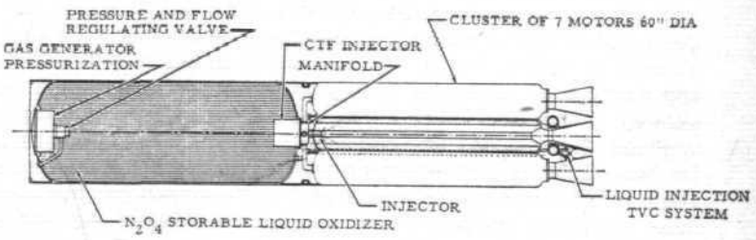


Fig 5 Clustered fuel charges for very large hybrid engines

assembled today. Tubes of fuel for these engines can be built in factories that exist today. These tubes can be small enough for convenient transportation. Assembly at the site can be accomplished without the need for remote control or any risk from fire, poisoning, or explosion. A storable liquid can be readily pumped into the assembled vehicle in the manner now used to transport oil.

For vehicles of extreme size, multiple thrust units will undoubtedly be necessary with any type of propulsion system (Fig 5). A problem of general concern in such designs is the necessity of igniting or controlling the thrust to all units simultaneously. A final advantageous feature of hybrids, particularly for manned vehicles where reliability is critical, is that any number of engines can be ignited at a very low thrust level and allowed to idle until the take-off signal is given.

US DEFENCE CONTRACTS

FROM A CORRESPONDENT

Washington, DC

SINCE World War II neither the executive branch of the US Government, nor the Congress, have been satisfied with the administration of defence contracts. The US defence industry has not been entirely happy with the way things have been done, either. While the varieties of criticism were innumerable, much of it has concerned profits earned or not earned by defence contractors, and the criteria used in awarding defence contracts and allowing or disallowing profits.

Virtually every US Secretary of Defense has wrestled with these problems, but credit for the most concrete results so far achieved clearly is going to go to Robert S. McNamara, the present Secretary for Defense. McNamara has taken a less-than-most-popular attitude by saying that one of the chief faults of US defence contracting is that the companies engaged in defence business cannot make enough money. Once he advocated broadening the use of incentive-type contracts to allow profits ranging up to 15 per cent (before federal corporation income taxes, usually at 52 per cent) of the total dollars paid for the work done. Recently he revised this approach considerably, enlarging the criteria for defence contracting and allowing contractors up to 20 per cent. However, to get 20 per cent a contractor must run the gamut of a complex system of ratings that provides rewards for meeting schedules, good administration and performance, using non-government facilities, and a variety of other considerations.

McNamara first issued his new policy on profits in defence contracts last August 8, but it received little notice at the time. The Secretary made plain his feeling that "existing defence profit policy is too general and imprecise to result in the proper use of profits as an inducement to cost reduction." He noted, as a result of one or more of the innumerable studies undertaken by the Department of Defense since he took office in 1961, that the average profit on defence contracts was only 3 per cent. The study further showed that the range of profit realized by one contractor compared with another reflected very little of whether the contractor did his assigned task well or poorly, whether he used his own facilities and capital or those of the government, and whether he was willing or unwilling to undertake the work at substantial risk.

"More Rational" Plan

Up to 60 per cent (about $18 billion) of US defence purchases of all types are negotiated in an atmosphere that tends to be non-competitive, a fact which continues to raise nettling questions of how much profit a defence firm should be permitted. The new plan, according to one of McNamara's assistant secretaries of defense, Thomas D. Morris, is a "more rational, systematic and disciplined approach" for determining how much profit (or loss) should be allowed. Heretofore, US military services have not been uniform in applying contract rules. One company, under the jurisdiction of the US Navy, may be working under quite a different set of interpretations of US defence purchasing rules than its competitor a hundred miles away who happens to be under jurisdiction of Air Force personnel.

Mr NcNamara, whose experience in the automobile industry has made him familiar with much higher rates of return for perhaps less risk, feels that 3 per cent is far too low. Though the Secretary of Defense has undertaken a tough-minded programme to cut defence costs, he says; "We mustn't expect the savings to come from the three cents profit the average defence contract now provides . . . instead, we must seek to cut the 97 cents of costs." Towards this end, McNamara and his aides have come up with their system of "weighted guidelines" to give defence contractors larger profits for more risk, for better performance, and a host of other considerations. On September 1, 1963, a sort of report-card system was put into effect to evaluate the performance of defence contractors. Along with it came new Armed Services Procurement Regulations (ASPR) which set up the weighted guidelines. In 1964 these guidelines are to become a permanent part of ASPR.

The new rules generally have the effect of rewarding good performance and punishing poor performance by raising or lowering the percentage of profit allowed and in determining a company's fitness for future contracts. Contractors will be graded on how well they purchase parts and other supplies from outside their own company, how well they administer their subcontractors, and such things as manufacturing and engineering overhead costs, administrative expenses, and so forth.

Risk will form an important part of the evaluation. "This risk factor," declares the Department of Defense, "which is apart from the contractor's responsibility for contract performance, takes into account what resources are necessary and what the contractor himself must do to accomplish a conversion of ideas and materials into the final product."

Included in the evaluation of the subcontracting factor will be the number of suppliers available for a particular item that is needed, new sources of supply that must be developed, and whether given materials can be "bought off the shelf" from public sources of supply, or whether the materials must be developed under a detailed subcontract that calls for extensive engineering and development.

All projects running over $5m per year or $20m total are to be put on the report-card system. Each project will be given a new evaluation for performance every six months. Performance evaluation groups sent out by the Department of Defense will, at such intervals, according to the present plan, review the evaluations of local military contracting officers. Findings will go into a computer in Washington, DC, and information on the performance of different contractors will be drawn from time to time in judging their fitness for new contracts.

The fee formula system divides into three main categories—purchasing and subcontracting, management, and the types of contract (risk element) under which the work is done. The profit factors are assigned as follows:—

(1) **Purchasing performance** (percentage of outlay to be allowed as a profit before taxes)

Purchased parts	1-4 per cent
Subcontracted items	1-5 per cent
Other materials	1-4 per cent

(2) **Management performance** (percentage of outlay to be allowed as a profit before taxes)

Engineering labour	9-15 per cent
Engineering overhead	6-9 per cent
Manufacturing labour	5-9 per cent
General and administrative expense	6-8 per cent

(3) **Contract Risk** (various type contracts reflecting more or less risk will be rewarded by the following scale of profit percentages for the overall work done)

Cost-plus-fixed-fee contract (virtually no risk)	0-1 per cent
Cost-plus-incentive-fee contract, with only cost factor evaluated	1-2 per cent
Cost-plus-incentive-fee contract, with cost, performance and schedule taken into account	1½-3 per cent
Fixed-price-incentive contract, with only cost factor evaluated	2-4 per cent
Fixed-price-incentive contract, with cost, performance and schedule taken into account	3-5 per cent
Prospect for price redetermination after experienced gained on the work to be done	4-5 per cent
Firm, fixed-price contract, with no chance for later readjustment	5-7 per cent

In addition, a contractor who does a very unsatisfactory job incurs a supplemental penalty rating that could be as high as 2 per cent administered as a deduction, and the contractor who does a particularly outstanding job could earn up to an additional 2 per cent. However, regardless of a particular contractor's score, he will not be permitted to earn a profit (before taxes) in excess of 20 per cent.

Since its first announcement last August, there has been a slow but nonetheless growing awareness of the new policy among defence contractors until today there is even a certain amount of cautious enthusiasm for the scheme.

Not quite up to Cranwell standards in bearing, but looking infinitely warlike, this guard of honour of local tribesmen greeted AVM J. E. Johnson, AOC Middle East Air Forces, when he recently flew into RAF Salalah (an isolated staging post on the shores of the Arabian Sea) by 105 Sqn Argosy to open a new NAAFI club house. The guard turns out for all important visitors to Salalah. Second from the left is the OC Salalah, Sqn Ldr R. B. Lamb

SERVICE AVIATION

Air Force, Naval and Army Flying News

New Year Promotions

THE VICE-CHIEF OF AIR STAFF, Air Marshal Sir Walter Kyle, was promoted to air chief marshal in the sixth-monthly list of promotions which took effect on January 1. AVM D. R. Evans, AOC-in-C designate, Technical Training Command, and AVM J. G. Davis, Air Member for Supply and Organization, were promoted to air marshal. Five air commodores in the GD branch, R. C. Ayling, G. R. Magill, H. N. G. Wheeler, C. N. Foxley-Norris and D. G. Smallwood, became air vice-marshals, together with Air Cdre H. G. Leonard-Williams, in the Technical branch and Air Cdre G. L. Seabrook in the Secretarial branch. Among other officers promoted were Gp Capt D. Crowley-Milling (of Battle of Britain fame), to air commodore, and Wg Cdr Roger Topp, OC of "Treble One" Sqn during its aerobatic career a few years ago, to group captain.

New chairman of the CENTO Permanent Military Deputies' Group is Air Marshal Sir Leslie Bower, RAF, here seen receiving the gavel of office from the retiring chairman, Lt Gen Kemalettin Gökakin, of the Turkish Army. Every year the chairmanship rotates among the five CENTO countries

The New "Eagle"

A VIRTUALLY NEW CARRIER will join the Royal Navy in the spring, when HMS *Eagle* re-joins the fleet after a four-year modernization at Devonport Dockyard, reliably estimated to have cost £20,000,000 and to have engaged 3,000 workers. Contractors' trials in the Channel begin later this month, and will last about three weeks.

During the almost-total gutting and re-assembly she has received, *Eagle* has acquired a fully angled flight deck, Seacat defensive missiles and the very latest in tactical radar installations. Her complement of 2,600 will have more space than before, for an extra deck has been added beneath the flight deck.

Squadrons to embark in *Eagle* when she recommissions have not been announced but it can be assumed that her aerial equipment will include Buccaneers and Sea Vixens.

HMS *Ark Royal*, recently returned from a commission in the Far East, will shortly begin a routine refit; but with no other carrier scheduled to be taken out of service for as long a period as *Eagle* the effective carrier fleet will be increased by one.

The Unpowered RAF

GLIDING ENTHUSIASTS IN THE RAF logged approximately 7,000 flying hours and 23,000 cross-country miles in 47,460 launches during the year ended October 31, 1963, the recent a.g.m. of the RAF Gliding and Soaring Association was told. Thirteen clubs, with 1,134 members, using nearly 80 Association-owned aircraft, are now affiliated to the RAFGSA, and more are about to be formed.

The days when its membership totalled five, with one glider, on its foundation in 1949 were recalled by the presentation of The Founders' Trophy to the Association by Air Cdre G. J. C. Paul, now secretary-general of the Air League. The inscription records that the Association was formed in a taxi on the way to a Chinese restaurant.

Among notable feats by RAF glider pilots in 1963 was the winning of the National Aerobatic Competition by Flt Lt Douglas Bridson; a new UK 200km goal speed record of 71.1 m.p.h. by Flt Lt Ian Strachan; a second place in the National Gliding Championships; and the recapture of the inter-services championship from the Navy by Plt Off John Williamson.

A BELVEDERE twin-rotor helicopter of 66 Sqn last month returned to its base at RAF Seletar after a year's unbroken service in Borneo, flown by the same pilot who flew it there when the Brunei rising began in December 1962—the squadron commander, Sqn Ldr P. G. Sawyer. During its year in Borneo XG474 flew over 270hr on operations, carrying some 300,000lb freight and over 3,000 troops in and out of jungle clearings.

The new First Lord of the Admiralty, Earl Jellicoe, paid his first visit to RNAS Lossiemouth on January 6 and there sampled flying à la Buccaneer. The First Lord is seen here, in the observer's place, anticipating the flight

RAAF CANBERRA B.20 BOMBERS of No 1 Sqn supported by 36 Sqn's Hercules transports will exercise in Papua-New Guinea next month. The squadron will fly from its base at Amberley, Qd, to Port Moresby and there exercise between February 1 and 12. C-130s will airlift a complete mobile communications network to Papua.

THE TERM OF OFFICE of the Australian Chief of Air Staff, Air Marshal Sir Valston Hancock, has been extended from May this year until May 1965, it was announced in Canberra recently.

Lt Cdr Peter Williams, senior pilot of 864 Sqn, FAA, has been made a member of the Most Blessed Order of Stai Nagara Brunei, by the Sultan of Brunei, for his many hours of helicopter operations in Borneo since December 1962. On one occasion, flying a Whirlwind over Tebedu, Sarawak, he encountered two Indonesian Mustangs and a B.25, which at the sight of him turned and fled

INDUSTRY International

Products
Flight Systems
Company News

Great Britain

Eurocontrol's Simulator As reported last week, the contract has been signed in Brussels for Eurocontrol's traffic simulator, the largest in the world, to be made jointly by Decca Radar Ltd, the French C.S.F. company and the West German Telefunken company. With a total value of £1.5m, the project has been divided according to engineering effort involved, though the financial interest of the three companies has proved to be approximately equal. The order was won in competition with proposals made by five groups, consisting of IBM and Marconi; G.P.S., Ferranti and C.F.T.H.; Elliott-Automation and SINTRA; Redifon and CEA; Solartron and General Electric. The simulator is to be installed at the Eurocontrol experimental centre at the French flight test centre at Brétigny and should be working by May 1, 1966, 28 months after contract signing.

The simulator will allow Eurocontrol to experiment in both procedural and radar control of up to 300 aircraft over the whole Eurocontrol airspace, with provision for simulation of various types of primary and secondary radars in a main network of six stations, simulation of performance of various navaids, control centre layouts and displays and the full gamut of air/ground and surface communications. All exercises can be recorded in a 60-channel recording system and played back for subsequent analysis. The complex real-time calculations involved are to be performed by a Telefunken TR4 high-speed digital computer, which is already in production. The overall system will incorporate about 100,000 transistors.

The simulator system will include accommodation for 20 "blip-drivers," each controlling 15 tracks, 20 procedural controllers and 11 radar positions of various types. The supervisory position is provided with radar and procedural displays, input and output devices and a large-screen Kelvin Hughes rapid processing projector system displaying the overall situation.

The Telefunken computer can handle eight simultaneous programmes in time multiplex and will up-date information on 60 aircraft every three seconds, convert them to radar co-ordinates and add secondary radar codes. It will compute other elements of radar displays every ten seconds and will be able to handle three random requests for information every second. The information is passed to the simulation system to be produced by C.S.F., who are also responsible for simulation of the communications network and for co-ordination and installation of the complete system. For the radars, aerial aperture, p.r.f., range and r.p.m. can be varied, and MTI and video map, permanent echoes and other characteristics of a great variety of radars can be simulated. Both active and passive decoding of secondary radar are possible.

Decca Radar are supplying displays from the Series 5 range, tabular displays and a variety of associated facilities in a flexible form to allow operational experiments in centre layout as well as traffic experiments. The Eurocontrol order brings to well over £1.5m the value of orders so far received for the Series 5 equipment.

The whole system has been designed in response to a very detailed technical specification produced by Eurocontrol itself. This is the first major equipment contract placed by Eurocontrol, which is to take responsibility for upper airspace control on April 1, without initially being able to do more than make use of the existing national control organizations.

The Teal, a 6/8-seat dinghy for business aircraft, introduced by the R.F.D. Company of Godalming, Surrey. It packs into a 30in × 20in × 13in container and weighs 86lb. CO_2 inflated, it has a maximum effective buoyancy of 1,935lb. Buoyancy and canopy fabric is of nylon textile, with synthetic rubberproofing and fitments including a boarding ladder, water stabilizers and a sea light atop the canopy

TSR.2 Gust Vibration Simulator One of the physiological problems likely to be encountered by aircrew in the BAC TSR.2, the effect of gusts when travelling at high speed close to the ground, has been successfully simulated on special equipment by Vickers Research Ltd of Sunninghill, Berks, under BAC contract. As a result of exhaustive tests in which both aircrew and civilians have taken part, and which have yielded new knowledge about how the human subject reacts to random vibration, it was decided that it would not be necessary to "isolate" pilot and navigator from the airframe in the TSR.2. Thus a potential design problem has been eliminated from the aircraft.

Vickers Research's work on random vibration in high-speed low-level flight has been in hand over a period of two years.

Test equipment was specially constructed to produce vibrations of an appropriate range and intensity and to simulate flying conditions for the subjects examined. The "cockpit" had an ejection seat and vibration was applied by hydraulic jack in response to an input of signals derived from a magnetic tape. On the latter was recorded information derived from precomputed equations. The "pilot" subjects were provided with a head-up display and "navigators" with sideways-looking radar, and both types of subject had to perform a typical operational task.

These experiments established that both pilot and navigator could perform their work efficiently in an environment of random vibration such as is likely to be experienced in the TSR.2, including occasional peaks. The findings, based upon a large number of subjects, helped to establish that isolation was unnecessary and crew positions have been integrated with the fuselage structure as in conventional military aircraft to date. From the investigations at Sunninghill it is clear that, as far as the effects of random vibration are concerned, the human frame is not a limiting factor in TSR.2 flying.

Melt on the Spot Last year's severe winter has encouraged new thoughts about snow clearance in Britain and interest in the mobile oil-fired snow melters becoming common in the USA to replace "collect, cart and dump" methods. Now Whittock (Contractors) Ltd, of 7 Mount Ephraim Road, Tunbridge Wells, Kent, have become sole distributors of "Thermal" snow melters and are offering mobile or static machines with clearance capacities of 25, 40 and 70 tons an hour.

Fed by snow blowers or tractor shovels the snow melters are fitted with one or more 5m Btu high-pressure, engine-powered

oil burners. The burner fires downward in a stainless steel tube situated at the centre of a large diameter weir tube in which water is maintained at a constant level. The hot gases from the burner pass direct into the water and cause a constant flow of warm water to cascade over the lip of the weir and descend on snow dumped in the main tank, from which the run-off is so fast that even in sub-zero conditions it does not freeze but runs away freely through drains and sewers.

The 25 ton/hr capacity model uses about 1½gal of fuel, at 11d a gallon, to melt a ton of snow, and in volume, capacity is about 2,500 cu ft an hour. During last year's protracted 72-day snow period, when the machine could have been used for about 1,200hr, the total hourly operating cost would have been about £3 7s, the distributors claim. For a more normal utilization of 300hr a year, the estimated cost is £4 6s 2d.

Mr H. Pearson, BA, FRAeS, MIMechE, whose appointment to the new post of director of personnel and administration in the Aero Engine Division of Rolls-Royce Ltd was announced early this month

Cossor Transponders Following ten months' bench and flight evaluation of all available transponder equipment, BOAC have ordered the Cossor SSR 1600 equipment for their VC10s and Super VC10s. The SSR 1600 complies with ICAO and Arinc characteristic 532B standards for both two- and three-pulse sidelobe suppression and full encoding and automatic reply in modes A, B, C and D. The equipment is fully transistorized except for the final transmitter stage, using under-run components, and there is a built-in self-test facility. Cossor are already supplying four SSR ground stations for the UK Southern FIR. The SSR 1600 is currently flying in the VC10, BAC One-Eleven and HS Trident.

Floors for the One-Eleven Included in the specifications of all the 40 BAC One-Elevens already sold is Aerolam flooring, developed and made by Palmer Aero Products Ltd, Penfold Street, London NW8. Under a contract recently received, Palmer will supply 35 full aircraft sets and 10 part sets, each full set comprising 54 panels. Aerolam comprises two thin aluminium skins sandwiching a layer of Plasticell rigid p.v.c. foam. A thin layer of Durestos may also be incorporated on the top skin, to reduce wear to a minimum. Although only $\frac{1}{16}$in thick, the panels will withstand a load of 100lb on any sq ft, factored to 6.5g.

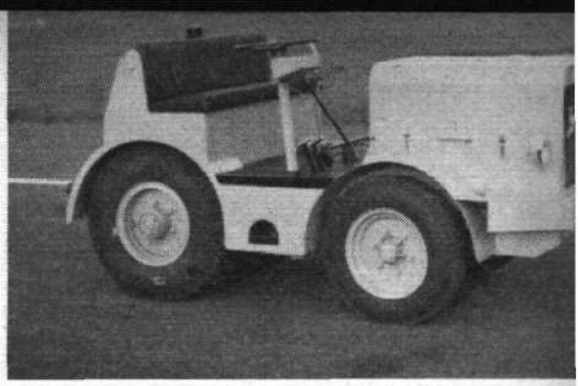
In addition to the One-Eleven floors, Palmers are making Aerolam panels for replacement floors in Viscounts; in this case the foam layer is increased in thickness as the panels are of a greater area. Another type of Aerolam, with a load-spreading plywood top layer, is suitable for freight aircraft floors.

Texas Managing Director On January 1 Dr J. A. Powell, assistant managing director of Texas Instruments Ltd, succeeded Mr A. N. Provost as managing director. Mr Provost, Semiconductor Group manager for Europe, the Middle East and Africa, is moving to Geneva, where he will be devoting more of his time to directing consolidation and expansion in the European market.

Castrol Research Laboratories Move Castrol's main research laboratories have now moved to a new centre at Bracknell, Berks. The engine test department remains at Hayes, Middx. The address of the laboratories is: London Road, Bracknell, Berks (Bracknell 2550).

Read about Resins Bakelite Ltd has produced an illustrated booklet which classifies the 34 types of polyester resins produced by the company into separate groups by function. The booklet is available free of charge from the Resin Sales Dept, Bakelite Ltd, 12-18 Grosvenor Gardens, London SW1.

Standard for Machmeters The BSI has prepared a new British Standard, G.182, to give general design requirements and test procedures for Machmeters used in the range Mach 0.5 and Mach 1.0 at altitudes up to 50,000ft. The standard is concerned primarily with instruments for use in transport aircraft, where a high degree of accuracy is required only from 20,000ft. The requirements of the standard are, therefore, relaxed at high Mach numbers at low altitudes and low Mach numbers at high altitudes. G.182, in addition to providing details on construction and calibration gives information on suitable type, production and quality tests for these instruments. The standard costs 4s, from the BSI Sales Branch, 2 Park Street, London W1.



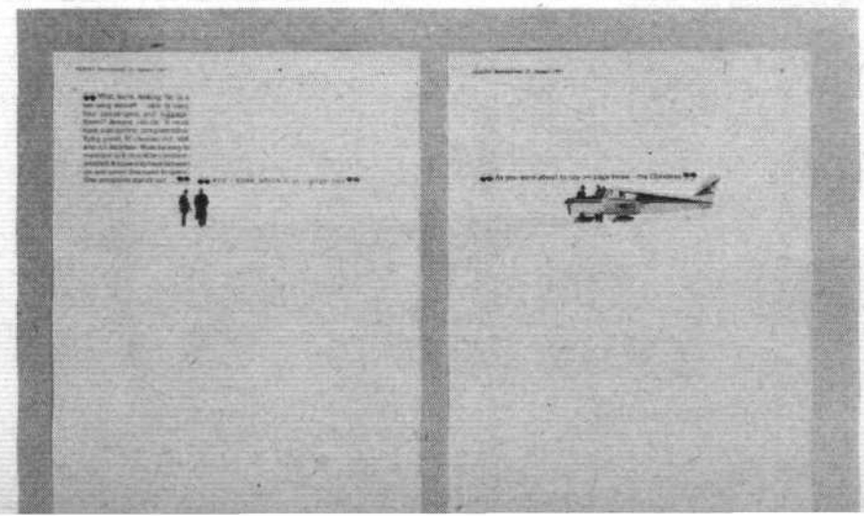
A recently announced addition to the Douglas range of aircraft tractors is this small but powerful vehicle, the Tugmaster NS4. Tractive effort is 4,000lb, and manual or automatic (torque-convertor) transmission is available to choice. F. L. Douglas (Equipment) Ltd, Arle, Cheltenham, Glos, are the manufacturers

USA

Titan III Tooling Only 15 per cent of the tooling used in manufacturing the three liquid-propellant stages of the US Air Force Titan III Standard Space Launch Vehicle has been developed specifically for the programme, according to Martin Company officials. Conversion of tooling required for Titan III has been integrated into the Martin-Denver schedule; production of Titan II and Titan I vehicles is unaffected by Titan III, and in addition Titan III programme costs have been cut by several million dollars.

According to Mr John P. Healey, Titan III factory manager for Martin-Denver, only some 5,647 man-hours have been spent modifying dome, barrel, and other weld fixtures (jigs) for Titan III, although over 63,000 man-hours were spent fabricating comparable tools for welding the aluminium

This advertisement, which appeared as two separate, non-facing, pages in "Flight International" for January 31, 1963, has been judged joint winner of the 1964 Layton annual advertising awards, Group E (covering engineering products of all kinds). The text on the first page, a duologue, concluded with the words "one aeroplane stands out" . . . "and I know which it is—page five"; and the continuation page simply said "as you were about to say on page three—the Cherokee." The advertisement appeared exclusively in this journal, and the advertiser was CSE Aviation Ltd of Biggin Hill, Kent; the agency was Longleys and Hoffman Ltd of Kingsway, London



INDUSTRY International . . .

alloy used in Titan. He continues: "We were able to convert these fixtures for welding work on the Titan III even though the tank thicknesses will be increased 50 per cent and more. But we very deliberately retained the same inside tank diameter, and allowed our increased thickness to move the outside skin line." Gauge thickness of the tanks must be increased because of additional weight and thrust. The Titan III-C version will include a pair of solid-propellant motors, each rated at more than 1,000,000lb thrust (this journal, August 1 last).

United Technology Center will build the solid motors, which will be attached to support forgings built into the core vehicle. These forgings—extensions of existing motor mounts—will be standard for all vehicles, even those that will be flown without the solids. With an entirely new upper "Transtage," the core vehicle will be used as the booster for a variety of space projects.

Transtage, which will be capable of multi-restarts in space, will generate 16,000lb thrust. Its tanks will be constructed of titanium. "The weight savings we will make using titanium are extremely important," Mr Healey says, "since all weight reduction in Transtage can be translated directly to payload. It is harder to work with, however, and requires special handling to avoid scratches and contamination at weld joints." Fuel and oxidizer tanks in Transtage will be milled down from a 0.5in forging to a thickness of 0.0625in. Although it is a new stage —and tooling is being developed to solve new machining and welding problems—some Titan I fixtures are being adapted for Transtage production.

Equipment for F-111 Simulation A contract worth $1m has gone to General Precision's Link Division, of Binghampton, NY, from General Dynamics, for equipment to be used in the development of the F-111 variable-sweep tactical fighter for the USAF and USN. The equipment to be supplied includes a Mk 1 digital simulation computer, a motion system, instrumentation, control-loading equipment and a visual target display which will be integrated with General Dynamics' own cockpit and tactics simulation equipment in DORA—a Dynamic Operator Response Apparatus. This will test and verify the interior design and operation of the two-seat F-111 cockpit, leading to the most effective arrangement of controls, instruments and tactical equipment.

Link's Mk 1 digital simulation computer is already in use in airline 707 flight simulators and will soon be used in USAF C-135 and C-141A simulators and Gemini manned satellite simulators for NASA.

Record Lycoming Contract The largest-ever single production order received by Avco's Lycoming Division, of Stratford, Conn, was placed recently for T53-L-11 1,100 h.p. gas turbine engines for the US Army's UH-1 Iroquois helicopter. The contract is worth $41,631,605. Another Army contract received at about the same time is for another version of the engine, the T53-L-7, also rated at 1,100 h.p., for OV-1 Mohawk reconnaissance aircraft. Value of this contract is $4,935,636.

Contracts for Hiller and Bell Both Hiller Aircraft and the Bell Helicopter Co were awarded big follow-on contracts last month to continue production of three-seat, piston-engined light observation helicopters for the US Army: presumably the Army's last purchase of aircraft of this class before selection is made of its future turbine-powered observation machine, a potentially vast contract for which Hiller, Bell and Hughes are competing.

Hiller's new contract, worth $6,029,100 is for 210 OH-23G Ravens, and follows one worth over $4.3m awarded early last year. It will continue OH-23G production into the autumn of next year.

Bell will build a further 115 OH-13S helicopters under their $3,731,750 contract, after the expiry of a $4,655,934 contract for 150 awarded in January last year. The OH-13S is a military version of the civil Bell 47G-3B.

More Space for Piasecki The Piasecki Aircraft Corp has leased two buildings at Philadelphia International Airport which increase its plant there by 51 per cent. Ground leased will enable a threefold future expansion to be made. Expansion plans have also been made for the 70,000 sq ft factory which the company operates at Mayfield, Pa.

Leach International Appointment Mr Bayard Fox has been appointed vice-president and general manager, Europe, of Leach International SA, the Geneva-based European subsidiary of the Leach Corporation electronics firm, of San Marino, Calif. Leach International have manufacturing facilities at Geneva and Munich.

LI European Operations Mr Garry G. Gould has been appointed manager of European operations for the Litton Industries Inc Data Systems Division, Canoga Park, Calif. With headquarters at Schwamendingenstrasse 5, Zurich, Switzerland, Mr Gould will be responsible, in his newly created post, "for European marketing of command and control systems developed and manufactured by the division and other business activities affecting the company's sales growth in Europe."

Latin America

Foothold in El Salvador The Central Bank of El Salvador recently announced that a company to assemble spare parts for jet aircraft, and to undertake jet aircraft overhauls, was being set up at Ilopango. It was hoped it would be in operation this month. The company, Sociedad de Jet Avion International de El Salvador, is understood to be associated with Jet Avion Corp, of Miami, Fla. Capital of the new company, raised locally, from the USA and from neighbouring Central American countries, is 3½m Colones (about £500,000), the Central Bank statement said.

USSR

New Polymers Developed A heat-resistant polymer—polynitryl—possessing the properties of a semiconductor has been obtained from nitryl. It can withstand momentary heating to 1,000°C.

A group of Moscow University chemists, working under the direction of Academician Valentin Kargin, developed theoretically a method of nitryl polymerization that differs radically from the conventional technique. It is this that made possible the polymerization of nitryl which chemists thought could not be polymerized.

Employing the new method, Moscow chemists have also obtained a polymer of acetone. They are now planning to extend considerably the range of substances from which entirely new polymers with unusual properties can be obtained.

A US MATS C-133 Cargomaster takes on fuel from a 41,500 gal Goodyear Pillow tank. Four of these huge tanks, plus pumps and plumbing provided by Bowser Inc, constitute an air-transportable refuelling facility being used by USAF units throughout the world, particularly on undeveloped airstrips. Many units utilize two systems simultaneously—one for JP-4 and one for Avgas

FLIGHT International

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R.A.F. Officers' uniforms purchased, good selection of R.A.F. officers' kit for sale, new and reconditioned. Fisher's Service Outfitters, 86-88 Wellington Street, Woolwich. Tel.: 1055. [0567

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Castle Donington Airport is being developed by a Joint Committee formed by representatives of the County Councils of Derbyshire, Leicestershire and Nottinghamshire, the City of Nottingham and the County Borough of Derby, and it is hoped that the airport will be opened for operations early in 1965. An Airport Manager is to be appointed in the near future and he will probably be required to take up his duties early in 1964 in order to assist the Joint Committee during the construction period.

Full details of the terms and conditions of service are obtainable from the undersigned, by whom applications will be received until the 31st day of January, 1964.

Canvassing disqualifies.

Council House, Corporation Street, Derby.
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