

FLIGHT

International

THURSDAY 9 DECEMBER 1965

Number 2961 Volume 88

Editor-in-Chief

MAURICE A. SMITH DFC

Editor

J. M. RAMSDEN

Assistant Editor

KENNETH OWEN

BSc DCAe AFRAeS

Air Transport Editor

H. A. TAYLOR

Production Editor

ROY CASEY

Managing Director

H. N. PRIAULX MBE

In this issue

World News	994
Parliament, Press	996
Air Transport	997
The Case for High By-pass	1004
Sport and Business	1008
In the Air	1009
Macchi MB.335A	1013
Letters	1015
Industry International	1018
Spaceflight	1019
Defence	1025
Straight and Level	1026

Iliffe Transport Publications Ltd., Dorset House, Stamford Street, London, SE1; telephone Waterloo 3333 (STD.01). Telegrams/Telex: Flight Iliffe, 25137 London. Annual subscriptions: Home £4 15s. Overseas £5 5s. Canada and USA \$15.00 Second Class Mail privileges authorised at New York, N.Y.

Branch Offices: Coventry, 8-10 Corporation Street; telephone Coventry 25210. Birmingham, 401 Lynton House, Walsall Road, Birmingham 22b; telephone 021 BIRchfield 4838. Manchester, 260 Deansgate, Manchester 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow, 123 Hope Street, Glasgow C2; telephone Central 1265-6. Bristol, 11 Marsh Street, Bristol 1; telephone Bristol 21491/2.

New York, NY: Thomas Skinner & Co (Publishers) Ltd, 111 Broadway NY 6; telephone Digby 9-1197.

© Iliffe Transport Publications Ltd, 1965. Permission to reproduce illustrations and letterpress can be granted only under written agreement. Brief extracts or comments may be made with due acknowledgement.

Questions about the F-111A . . .

OUR French confrère Jean-Marie Riche, editor of *Air et Cosmos*, writes in a letter to *The Times* that Britain's proposed F-111A order is "regarded with foreboding in France." He comments that an F-111A order for the RAF is "very likely to endanger Anglo-French co-operation to the vanishing point."

We believe that this statement accurately reflects the mood in France at the present moment. We said on this page on October 14 that the French regard the Spey Mirage as the touchstone of Britain's intentions towards Anglo-French air collaboration. To them the very big Phantom order and the proposed F-111A order must seriously compromise their partner's need for the proposed VG aeroplane. There are indeed already signs that the French have decided to press on regardless with their own VG fighter, the TF-30-powered Dassault Mirage IIIG, on which design work and testing, with *Loi Programme* funds, has been going on for over a year.

Now three MPs and the chairman of the Air League have also written to *The Times* in a last-minute attempt to stop the F-111A order. We do not think that they, and other anguished writers to that newspaper, are exaggerating the consequences of the proposed F-111A order. At a huge cost in dollars it would both strengthen Britain's competitors and jeopardise her alliances.

The RAF's reasons for rejecting the Spey Mirage must be compelling indeed to outweigh the political, industrial and financial case for the aircraft. The trouble is that the RAF cannot be asked to give its reasons in public; its reasons cannot be seen to be good ones, thanks to the solemn fatuities of "security."

. . . and about the Spey Mirage

Just how unsuitable is the Spey Mirage? How far short of the OR.343 (TSR.2) payload-range requirement does it fall? Can it lift x lb from a y ft island runway in the Indian Ocean for a 3,000 n.m. high-low-low-high mission on a hot day? What would be the cost of re-engining the Mirage IV with Speys and modifying and testing the structure to meet the RAF's low-level performance requirement? Is it not the case that every Mirage IV from No. 50 on the Dassault line is in any case structurally modified for low-low missions? What is the cost of fitting British nav/attack and reconnaissance systems? Is all this technically feasible, and can it be done so that the aircraft will be in full RAF service by June 1969 at a unit cost of not more than £2½ million? BAC, Rolls-Royce and Dassault, and the equipment firms, have probably given affirmative answers to these questions. Can they give guarantees?

Instead of writing letters to *The Times* our Parliamentarians ought to have expert standing committees of both Houses insisting on their rights to have the answers to these questions. Indeed, if over the past 20 years there had been such expert Parliamentary committees regularly and vigorously checking the plans and policies of Britain's cloistered executive, there might well have been no argument today about whether the RAF should fly French or American. The RAF would have had British aircraft to meet its ORs at the right time and at the right price.

For the immediate present we believe that before any decision is made to buy F-111As there are a number of very serious questions that must be satisfactorily answered, in public, first.



WORLD NEWS

Visitors to Forth Worth

A large British Press party was flown by General Dynamics to Fort Worth last week for an intensive briefing, by company officials and USAF senior officers, on the F-111 programme. Ostensibly the visit was to counter what one GD official described as the bad press the aircraft had been receiving in Britain. The visit followed one week after a British Government party of 30 had visited the plant. Significantly, this party had arrived from Washington on the eve of the two-day Thanksgiving holiday, when the plant was closed, and was thus able to talk with GD officials undistracted by the demands of day-to-day affairs. A further British party, led by the Deputy Chief of Air Staff, Air Marshal Sir Christopher Hartley, is due at Fort Worth next week; and the belief is growing that this visit may culminate in an initial British order for the F-111 being announced. Britain's option on an initial batch expires on December 31, though it is hard to see a legalistic triviality standing in the way of a British order if it were not to be placed until after December 31.

Discussing the possibility that the F-111 might be re-engined with the Rolls-Royce Spey, GD officials claimed last week that only in one mission-profile would the Spey give any significant improvement over the present P & W TF30 engines (the troubles besetting

which they freely admitted but which, they intimated, were near solution). This assertion was also made to a *Flight* writer/illustrator team which visited Fort Worth in advance of the main British Press party.

Last week it was claimed that the F-111 had exceeded Mach 2 and 59,000ft, which indicates a considerable step in flight-test progress, for the previous week only Mach 1.2 was being claimed.

Although progress is being made in the weight reduction of the F-111B naval version, the United States Navy is still patently worried over the future of this aircraft; and a Navy-funded project study of an advanced development of the McDonnell Phantom, which could assume the F-111B's naval air-superiority role, is in an advanced stage at St Louis as a possible alternative.

Exports Rise by Nearly £30 million

British aviation exports for October 1965 totalled £11,386,000 in value, compared with £7,741,796 for October last year. Board of Trade figures published last week showed that the total from January to October was £107,061,000, compared with £77,259,222 for the first ten months of 1964.

Sir James Martin Honoured

A special lecture in recognition of the achievements of Sir James Martin, the ejection-seat pioneer and managing director and chief designer of Martin-Baker Aircraft Co Ltd, was held by the Test Pilots' Group of the Royal Aeronautical Society on December 3. Devoted to *Medical Aspects of Seat Ejection*, the lecture was given by Gp Capt A. J. Barwood of the RAF Institute of Aviation Medicine.

The whole procedure of escape from

high-speed aircraft was previously hazardous, Gp Capt Barwood emphasised, but "this hazard has largely been removed by Sir James." The total of successful M-B ejections was now 1,111.

Possible sources of injury included acceleration, impact with parts of the aircraft, air blast, rotation, anoxia and cold; and at seat separation, parachute deployment and parachute landing.

Physiological maxima of 20g acceleration, 200g/sec rate of change, and 5g in the first 0.01sec had formed the basis of the design of the cartridge seat. In live tests Benny Lynch had shown that these maxima could be increased by 25g and 300g/sec. Subsequent development of more advanced ejection systems were described and illustrated by the speaker, culminating in the highly advanced TSR.2 system in which the two canopies were released, restraint applied to the navigator and pilot, and both crew-members ejected in only 1.2sec from initiation.

AIR SAFETY . . .

. . . will be the theme of special features in next week's (December 16) issue of *Flight*.

Sir William Hildred Honoured

A gold medal conferred every two years for outstanding contributions to the development of international civil aviation, the Edward Warner Award, has been presented for 1965 to Sir William Hildred, director-general of the International Air Transport Association. The award was made by unanimous decision of the Council of the International Civil Aviation Organisation.

Air League Activity

In order to make the Air League more active in supporting British aviation two specialist committees have been formed which will disseminate the league's views "factually, forcefully and as promptly as possible." One of these is concerned with defence and the other with Parliamentary, Press and public relations.

Outlining the League's current philosophy at a Press lunch on December 6, Sir Archibald Hope, chairman, said that the League had continuously supported the Concorde; viewed with alarm the lack of Government requirements for the aircraft industry; and agreed with European collaboration where national skills could usefully be combined. It supported the development of jet lift for military purposes; believed that both the State airlines should fly British; and would continue to support the private-flying movement.

MEXICO BUYS AMERICAN

Air Transport, page 997

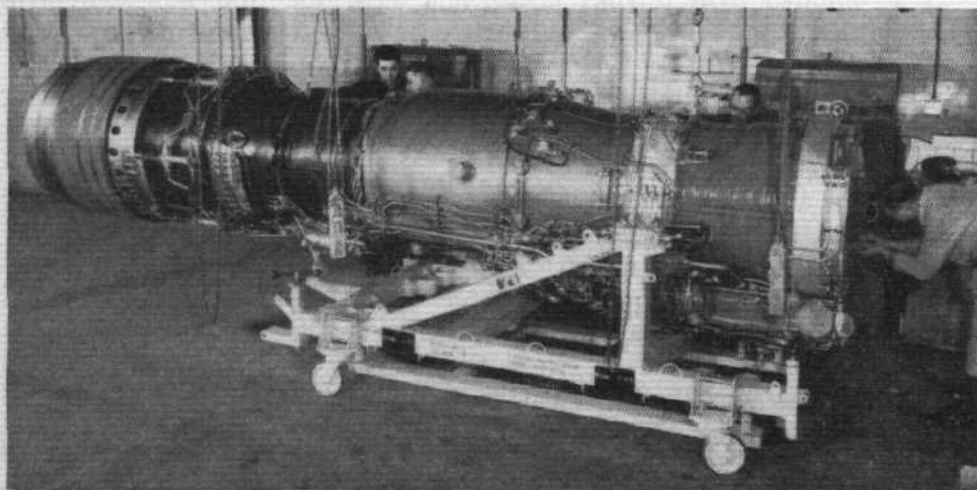
PROTON DETAILS

Spaceflight, page 1022

748s AND ONE-ELEVENS FOR RAAF

Defence, page 1024

First Picture of the final Spey 25R engine for Britain's Phantoms. This is the engine which, as reported in last week's issue, was despatched from Rolls-Royce Derby on November 27 for McDonnell's factory in St Louis. Though the Spey 25R is now flight-cleared, this particular engine will be used for ground tests





Mr P. C. Garratt, whose retirement from the chairmanship of de Havilland Canada is announced (see news item below)

DHC's Chief Retiring

After nearly 30 years with de Havilland Aircraft of Canada, Mr P. C. Garratt has announced his retirement from the chairmanship of the board at the end of the year. He is to continue as a director.

Now in his seventy-second year, Mr Garratt began his flying career with the RFC in 1916 and has piloted aircraft for almost 50 years. After a spell of barnstorming flying in 1920 he served for several years as a flying instructor with the Canadian Air Force, now the RCAF.

His association with DHC began in 1928 when, in addition to managing his own chemical business, he test-flew and ferried their aircraft. After winding-up his own business he took over the management of DHC in 1936 and, under his management, the company grew from a comparatively small aircraft-assembly organisation into an internationally recognised leader in STOL design and construction.

Lift from a Rotor Hub

A contract for a preliminary design-study for a "hot-cycle rotorwing" aircraft has been awarded to Hughes Tool Company by the US Army Aviation Materiel Laboratories, Virginia. The aircraft would function as a helicopter up to 150 m.p.h., the rotor being driven by air supplied from the propulsion unit and

expelled from the blades. Above 150 m.p.h. the rotor is stopped and lift is derived from the delta-shaped hub. The advantages claimed are a speed range between zero and over 400 m.p.h., the ability to lift twice the payload of a comparable conventional helicopter, and greater stability during transition than with other high-speed VTOL concept.

Ikara for RN

Hawker Siddeley Dynamics has been selected by the MoA to carry out development work necessary to suit Ikara for British conditions. This long-range, rocket propelled anti-submarine weapon system for the Australian Navy has been adopted in modified form by the Royal Navy. Service support for Ikara will be the responsibility of the HSD Whitley factory.

RAeS Awards

Three Honorary Fellowships, two Honorary Companionships and ten medals have been awarded by the Royal Aeronautical Society for 1965. Most of the awards are to be presented at the 54th Wright Memorial Lecture this evening, December 9. The first part of the list (the remainder will be given next week) is as follows:—

Honorary Fellows Sir Arnold Hall, managing director and vice-chairman of the Hawker Siddeley Group and vice-chairman of Bristol Siddeley Engines; B. S. Shennstone, technical director, BOAC; and John Stack, vice-president engineering, Fairchild Corporation.

Honorary Companions L. A. Wingfield, solicitor to the Royal Aeronautical Society; and Thurstan James, editor of *The Aeroplane* from 1945 to 1965.

RAeS Gold Medal Prof M. J. Lighthill, Royal Society research professor at Imperial College, "for his outstanding original work in many fields of aeronautics."

RAeS Silver Medal Dr R. R. Jamison, assistant chief engineer and head of the advanced propulsion research group, Bristol Siddeley Engines, "for his outstanding work on ramjet design and development"; and R. Stanton Jones, chief designer and special director, Saunders-Roe Division, Westland Aircraft Ltd, "for his outstanding contributions to satellite launchers and air-cushion-vehicle development."

RAeS Bronze Medal H. L. Cox, Basic Physics Division, National Physical Laboratory, "for his work in advancing structural theory and data presentation."



Cleanest-ever Hub?

This model shows the unusual delta-shaped rotor hub—with forward blade stowed in the high-speed flight position—which characterises a new Hughes design-study (see "Lift from a Rotor Hub")

SENSOR

Dan-Air are negotiating with BOAC for the purchase of several Comet 4s at about £450,000 apiece. These potentially 100-seater four-engine jets offer excellent performance and range for IT and general charter operations.

United Arab Airlines are again seriously considering the Trident as their Comet 4C replacement. The Trident 2E is the most likely candidate.

Formerly air correspondent of the *Daily Sketch*, Mr Desmond Clough is joining the Society of British Aerospace Companies as public relations executive, responsible to the director, Mr Edward Bowyer. Overall public relations policy will continue to involve Frank O'Shanohun and Associates, acting as consultants to the SBAC.

The chief information officer of the British Airports Authority will be named soon. He is to be Mr Philip Gordon Marshall, who was Bristol's publicity manager in Mr Masefield's Britannia days, and has recently been handling Piper's UK advertising. Between 1946 and 1952 he was a director of Airspeed, controlling, among other things, the sales and publicity campaign for the Ambassador/Elizabethan.

A sub-contract worth about £250,000 is expected to be placed with British Aircraft Corporation by Junkers for part of one of the European Space Research Organisation's highly eccentric orbital satellites. The Junkers proposal has been selected by the European Space Technology Centre but has yet to be approved by ESRO Headquarters. The BAC work will include the star-lock system of the spacecraft.

The German charter operator Sudflug is expected to go in for the North Atlantic "IT" and group charter business with DC-8s leased from KLM, which controls Sudflug.

Germany, Japan and New Zealand are considered by McDonnell to be the three best export prospects for the Phantom at the present time. These are the countries on which sales efforts are being concentrated. The Spey Phantom is not being especially pushed as the export model; McDonnell is simply offering it as an alternative to present and projected J79-powered versions.

Negotiations have been broken off with Alaska Airlines over the sale of two Belfast freighters. The airline first showed interest in the big transport at the Paris air show, but now the talks are off because Alaska favoured leasing to buying and the difficulties could not be resolved owing to Short Brothers' ten-aircraft commitment to RAF Transport Command.

Price of the BAC One-Eleven 300 to British Eagle's specifications is £1,145,000 per aircraft.

parliament

KENNETH OWEN

In the lull before Parliament gets its teeth into the Plowden Report, aviation interest at Westminster last week passed from the floor of the House to the calmer atmosphere of Committee Room 12, where the Air Corporations Bill began the committee stage of its passage through the Commons. This followed the unopposed second reading in the Commons the previous week in which the fundamental principles of the Bill were accepted by all parties. Now the detailed scrutiny of the Bill, clause by clause, is being tackled by Standing Committee A under the chairmanship of Dame Edith Pitt, Conservative Member for Edgbaston. Although the Conservative aviation spokesmen gave notice that they would be raising a number of further points during the committee stage, these must be points of detail. Once the second reading is passed, amendments in committee which would change the general intention of the Bill are out of order.

With the first French satellite launched from Hammaguir and the last Black Knight fired from Woomera the Minister

of Aviation, Mr Roy Jenkins, cannot delay much longer his announcement of a go-ahead for Britain's Black Arrow satellite launching vehicle. In a speech to Young Conservatives at Folkestone on Sunday, November 28, a former Minister of Aviation, Mr Julian Amery, complained that the Labour Government still could not make up its mind whether or not to go ahead with the all-British launcher. France's achievement was a reproach to Britain, he said. "Until quite recently we led the French in space launcher and missile development. More than a year ago I announced the Conservative Government's decision to develop the Black Knight into an all-British space launcher to be known as Black Arrow." When Mr Amery did announce this decision, during the week of the 1964 SBAC Show, the managing director of Westland, Mr E. C. Wheelodon, said "I'll believe it when I see the contract." Let up hope Mr Wheelodon has not got much longer to wait.

Another MP with spaceflight on his mind at present is Mr Ronald Brown, Labour Member for Shoreditch and Finsbury and brother of Mr George Brown, Secretary of State for Economic Affairs. As *rapporteur* for the space activities committee of Western European Union, Mr Brown was the author of a paper *State of European Space Activities: the Political Choice* (Flight, November 25) whose recommendations were approved by the WEU Assembly in Paris on November 17. Now he is making a

detailed study of space communications as one of several follow-up WEU investigations.

On Wednesday, December 1, the Minister of Aviation was asked by Mr William Shepherd (Conservative, Cheadle) about the hours flown by BOAC pilots. Their average weekly flying hours, he said, were roughly two-thirds of those of American airline pilots; would the Minister amend his regulations to allow more flying? In a written answer Mr Jenkins agreed that the weekly flying hours of BOAC pilots was "generally somewhat less" than those of their American counterparts, but this was not because of the regulations on permitted flying hours. "These regulations are aimed at preventing excess fatigue on the part of flight crew to a point where safety could be affected, and I have no intention of sanctioning any increase."

Another question came from Mr Peter Doig (Labour, Dundee West) who, as the House is by now aware, is in favour of an air service to Dundee. These Scottish MPs are nothing if not persistent. In view of the failure of British European Airways to provide the services to Dundee which had been recommended by all committees which had examined Scotland's air services, would the Minister of Aviation now appoint a new chairman of BEA? Alas for Dundee and Mr Doig but fortunately for Mr Anthony Milward, chairman of BEA, Mr Jenkins replied "No."

press

ROBERT BLACKBURN

The Air League's aim is "to work for a national understanding of the importance of British air power, upon which our commerce, communications and existence depend." On Wednesday, December 1, the League was to have held a press luncheon at which its chairman, Sir Archibald Hope, was to have talked about changes in the League's organisation and its views on current aviation questions. On Friday, November 26, however, the Air League put out a note postponing the press lunch—which had been in correspondents' diaries for nearly three weeks—until Monday, December 6. The reason, it explained, was "the invitation to air correspondents and editors from General Dynamics to go to Fort Worth on November 30 to see F-111 progress." Alas for British air power. While the Air League was postponing its press lunch, and Sir Archibald Hope was drafting a letter to the newspapers (published on December 2) Mr Brian Trubshaw and Sqn Ldr Brian Taylor were

taking RAF Transport Command's first VC10 on its maiden flight. Arthur Narracott of *The Times* went to Weybridge to see it take off and his paper carried a report the next day. By and large, however, the emergence of Transport Command's big jet went nationally unnoticed in a flurry of bag-packing for Texas. It could prove, however, to have been a moment of history. Every wholly British new type of aircraft ordered for the RAF has now made its first flight. There may never be another.

By December 2 we were receiving reports from Fort Worth. On BBC radio we heard Reginald Turnill politely asking a General Dynamics spokesman about the prospects of somehow fitting in the Spey: the effect of the reply could be described as a shrug. The same question was answered in the headline to Angus Macpherson's story in the *Mail*: "Rolls' F-111 hopes take a dive." But the *Financial Times* headline was less gloomy: "Rolls-Royce Spey engines could be fitted to F-111A aircraft." The most arresting headline, I thought, was in the *Guardian*: "Half-size F-111A is a possibility," and there was food for thought in David Fairhall's suggestion that "General Dynamics will not rest until variable sweep is embodied in a whole range of military aircraft."

BUA press conferences are highly regarded by most journalists, thanks partly to the attention given by John Loader, chief publicity officer, to details

which matter. I particularly remember the announcement at short notice of the BUA South American services, when he provided—among other services—on-the-spot passport photography to enable journalists invited on the proving flight to get their visas in time. On December 1 BUA held a conference to give details of its domestic jet plans. The airline's general commercial manager, Mr Munroe Blakemore, had the unenviable task of taking the inimitable Mr Freddie Laker's place at the top table, but performed it creditably. Another difference was the absence, as noted, of many of the regular air correspondents. However, the story got reasonably thorough, if uninspired, coverage in the following day's papers. BEA and British Eagle were probably a bit put out by the concluding line in the *Mail's* story ("BUA declare jet war"), reporting that BUA's competitors fly "slower and bumpier turboprop airliners on the inter-jet routes."

The *Times* published a leader on December 3 advocating an immediate order for between 40 and 50 F-111As for the RAF. Its correspondence page on Monday presented counter-arguments for the Spey Mirage IV—from Mr Allen Greenwood of BAC and Sir Archibald Hope for the Air League who was doubtful whether the paper's case against the Mirage would stand up to "an impartial examination" unrestricted by the rules governing Security in this country.



AIR TRANSPORT

MEXICO BUYS FROM DOUGLAS

HOPES of a sale of British civil aircraft to Mexico were dashed last week with the announcement by Douglas of orders for DC-9s and DC-8s from Aeronaves de Mexico. A visit to BAC by Mexico's Director of Civil Aeronautics three months ago and, more recently, one to Mexico by Mr John Stonehouse, Parliamentary Secretary to the Minister of Civil Aviation, had given rise to the belief that the Mexican airline might buy from Britain.

The order is for nine DC-9 series 10 for delivery during 1967 and for three DC-8-50s for delivery in the autumn of 1966. The order from the Mexican State-owned airline has been authorised by the country's President and by the Ministry of Public Credit. Orders and leases for the DC-9, which entered preliminary service with Delta Airlines on November 29, now total 228. Orders for DC-8s total 312, of which 243 have been delivered.

THE \$22 MILLION DOLLAR QUESTION

TWO British independent airlines have turned, or may turn, to the USA for their jets. As forecast by Sensor, one, Caledonian Airways, has already placed an order for a multi-purpose, long-haul jet—a Boeing 707-320C—for delivery in the spring of 1967. The other, Channel Airways, has been negotiating with Boeing for the possible purchase of four short-haul 737s at a cost of about £5½ million (\$15 million). Channel has found that the 737 meets its requirements for capacity and runway performance—Southend's 06/24 runway is only 5,265ft long with a possible future extension to 5,500ft. The airline has explained its requirements to the British Aircraft Corporation and hopes that a variant of the One-Eleven can be offered in time for a decision to be reached at or about the end of the year. BAC is "working hard" to try to meet Channel's requirements.

Caledonian's decision has followed an analysis of all avail-

able types. Three factors, says Caledonian, influenced its choice; the 707's proven economics over a variety of routes; passenger/freight convertibility; and the worldwide use of 707s which simplifies engineering and spares problems on long-haul charters. Although Caledonian's primary need is for a passenger-carrier, the ability of the -320C to be converted quickly to a wide variety of freight/passenger layouts is an important factor.

The value of the order is about £2½ million (\$7½ million). The range of the -320C, Caledonian says, will permit non-stop 165-passenger flights over stages such as Prestwick-San Francisco or London-Colombo. The development of transatlantic inclusive-tour flights is obviously going to demand the use of jets when competing with US carriers such as World Airways—which has five 707-320Cs and has recently been given authority by the CAB to operate group charter flights to and from Europe/Asia.

The -320C is at present in trouble over British certification. The ARB has approved BOAC's aircraft for freight operations pending modifications—most of which are of a minor nature, but which include means of altering the stalling characteristics which are unacceptable under the board's present philosophy. Caledonian's -320C is not due for delivery until 1967 and these problems will certainly have been ironed out by then.

Channel's need for 120-seat capacity in its short-haul jets is interesting. No doubt the 737s or One-Elevens will, if ordered, be used primarily on inclusive-tour work and this big capacity will be valuable. But, to maintain high utilisation, Channel's jets will presumably also be used on scheduled services—and few of those routes available to the independent airlines have the traffic which justifies the use of capacity of this order.

Unlike the two State airlines, British independent carriers are entirely free (if they can obtain the currency) to choose any aircraft, British or otherwise, which suits their requirements. It is bad for BAC that Caledonian has had to order a US aircraft and it will be worse still if Channel eventually orders the 737. But facts have to be faced. The -320C is a Super VC10-sized transport; there is no such thing

The first air-to-air picture of a BAC One-Eleven 401 for American Airlines, who have 30 on order and are calling them "400 Astrojets". An FAA type-certificate for the 300/400 series was awarded on November 22 (see last week's issue, page 949)



AIR TRANSPORT...

yet as a firm convertible passenger/freight version of this aircraft; and there is no immediate prospect of matching the potential payload/range performance of the -320C. BAC will try hard to offer Channel a One-Eleven version to compete with the 737's specialised performance and capacity—but such a variant, if it is to be worthwhile, will need to be tailored to meet the requirements of more than one operator.

The total value of these actual and potential orders is \$22 million (£8 million).

BUA DOMESTIC TRUNK...

ON January 4 British United Airways expects to start BAC One-Eleven services on the three domestic trunk routes from London Gatwick to Glasgow, Edinburgh and Belfast (see also *Flight* for November 25, page 880). Proving flights have already been made. If the results of British Eagle's appeal against the revocation of its licences are not known by that date then there will be three operators competing on the routes—BEA and Eagle from Heathrow, and BUA from Gatwick. BUA "InterJets," as they are being called, will be twice daily to and from Glasgow; once daily to and from Edinburgh, increasing to twice daily from April 1; and once daily to and from Belfast. The One-Elevens will have all-tourist class layouts with 74 seats. A full bar service will be available; meals, including breakfast, with varied hot and cold menus will be provided as appropriate; trickle-loading will be used where possible; and there will be a seat-selection system. Normal and stand-by fares will be £6 1s and £4 17s single, respectively, on all routes.

These are the basic facts of the services which could bring in a new era of competitive operations on British domestic trunk routes. British United does not expect to make a profit for the first year and probably not in the second year with these limited-frequency operations, which involve a utilisation of no more than 3,200 aircraft hours a year. The services will obviously help to increase the traffic on BUA's international routes and inclusive tours, but, discounting this invisible advantage on the credit side, a loss of up to £80,000 may be expected in the first year, assuming an average load factor of 49 per cent. A total of about 200,000 seats will be offered in a year at initial frequencies and BUA expects 98,000 to be filled. Because of the uncertainty over the result of the appeal BUA is keeping down the initial proving, demonstration and sales promotion costs so that, if the earlier ATLB decision is reversed, too much will not have been lost. BUA already has sales offices in the three cities.

The initial planning of the services is based on the need to attract domestic passengers rather than on catering directly for the interline traffic—so, for instance, the timings of the Glasgow services (the potentially most lucrative) are designed for the benefit of the business traveller between the two cities. BUA believes that there is a very real requirement for domestic services from Gatwick. As an extreme example of possible time saving for those persons living south of London, a passenger from Brighton can reach Glasgow via Gatwick in more or less the same time that it would take to travel from Brighton to Heathrow. A total of 3½ million prospective passengers live within an hour's travelling time of Gatwick by comparison with a total of about 4 million for Heathrow. An arrangement has been made with British Rail whereby BUA passengers are allowed a special 10s return fare between Victoria and Gatwick. Centre-to-centre times for BUA's One-Eleven services will be about the same as for BEA's Vanguard services. A decision about ordering more One-Elevens will not be taken by BUA before mid-1966 at the earliest.

... AND BUAF VEHICLE-FERRY PLANS

REDUCTIONS in some of the rates for vehicles, including a specially low rate for smaller cars, and extensions of the network, with the addition of three new British departure points, are features of the 1966 programme of British United Air Ferries. The new departure points are Manchester (with a service to Rotterdam), London Gatwick (with, subject to approval, services to Le Touquet and Jersey) and Southampton (with services to Cherbourg, Jersey and Guernsey). Other new services are from Coventry to Le Touquet and, subject to approval, to Ostend. The new services from Manchester will extend the vehicle-ferry network into the north of England for the first time. Silver City had similar plans several years ago but they were not put into effect because it was not felt, in those days, that the traffic could be found for services penetrating deeply into Britain.

The vehicle-rate reductions—up to 24 per cent—apply in particular to larger cars on the shorter routes where the present off-season fare will apply throughout the year except at peak season weekends. New low rates, on a year-round basis with similar exceptions, apply to small cars (under 11ft in length) travelling on short routes. Big reductions for all vehicles will also be made on the longest routes (to Geneva from Southend and Lydd) through the summer season, and there will be general reductions on the rates from Lydd to Deauville (the most southerly destination on the short cross-Channel network) and an increase in frequency. The last two reductions are designed to boost the traffic on these routes. Passenger fares will remain unaltered.

Simulators for Air Canada's DC-9 and Trans-Australia Airlines' Boeing 727 fleets are to be seen in this picture of work in the Redifon shops at Crawley, Sussex. The most recent order has come from Lufthansa





At the BALPA reception last week the association's gold medal for 1965 was presented by its president, the Duke of Hamilton, to Mr R. R. Goodison of the Ministry of Aviation, for his work in improving air safety. From left to right are Air Cdr P. E. Warcup, BALPA general secretary; Capt J. R. Jeffrey, BALPA chairman; the Duke of Hamilton; Mr Goodison; and Mr Roy Jenkins, Minister of Aviation

THE BATTLE OF STANSTED

THE public inquiry into the proposal to develop Stansted as London's third airport opened last Monday, December 6, at the County Hall, Chelmsford. It is expected to last for at least four weeks. A number of organisations are opposing the plan, including the North West Essex and East Herts Preservation Society and the Essex County Council. NWEHPA (for short?) is newly formed and has grown up to represent 40 local town and village committees and is affiliated to 29 other bodies.

CHANNEL'S RE-EQUIPMENT PLANS

NEGOTIATIONS between Channel Airways of Southend and Continental Airlines of Los Angeles, for the purchase of the US carrier's fleet of 11 Viscount 812s and spares were well advanced last week. Channel already has eight Viscount 701/707s, and also has two HS.748s with two more still to be delivered. Continental's Viscounts are being taken out of service gradually as the airline's 12 DC-9Cs start to enter service next year.

Channel also has a requirement for four short-haul jets and has been negotiating with Boeing for the purchase of 737s and with BAC for a variant of the One-Eleven to match the capacity and performance of the 737 (see also page 997).

737s FOR NEW ZEALAND?

REPORTS from New Zealand say that the board of the National Airways Corporation has decided to buy Boeing 737s to replace the airline's Viscounts. This decision was, it is believed, made at the beginning of last month, but political pressure has held up approval by the Government because of New Zealand's dependence on the British market for meat and dairy produce. A two-month delay is now likely before a decision will be announced. One point in favour of the BAC One-Eleven (or DC-9) is that deliveries of the 737 will not be possible until late in 1967 or early in 1968 and by that time NZNAC is likely to be short of capacity on its domestic services.

707-320C for Caledonian An order for a Boeing 707-320C convertible passenger-freighter has been placed by Caledonian Airways for delivery in the spring of 1967 (see also pages 997-998).

MEA to Lease 720B? An MEA team has been in Addis Ababa recently to negotiate the lease of a 720B from Ethiopian Air Lines from January 1 for use on West African, European and Gulf services.

Two More One-Elevens for Eagle The expected firm order for two more BAC One-Elevens was announced last Friday by British Eagle International, making five in all (see last week's issue, page 950), with options on a further two.

Caledonian ITs Approved The President of the USA has approved Caledonian Airways' operation of 14 inclusive-tour charter flights between the UK and the USA during the April-October period next year.

NY Heliport Approval A decision to allow New York Airways to use the heliport on the top of the 59-storey Pan American building in New York has at last been reached. Final approval has been given for a December 15 start.

Longest Helicopter Flight? A Bristow Helicopters Gnome-Whirlwind (G-APWN) reached Lagos, Nigeria, on December 5 after a 20-stage flight from the Bristow base at Redhill starting on November 22. This is believed to be the longest point-to-point distance flown by any helicopter.

Czechoslovak Sales Drive Hawker Siddeley and BAC are at present talking with Czechoslovakia about possible sales of HS.748s, 125s and Trident 2Es, and VC10s. Hawker Siddeley recently sent to Prague a six-man presentation team, led by Air Cdre F. R. Banks.

No Survivors in DC-3 Crash A DC-3 of Edde Air Lines, on a non-scheduled flight to Albuquerque, New Mexico, struck a mountain ridge during a snow storm about 20 miles south of Salt Lake City on November 27. There were no survivors among the ten passengers and crew of three.

Fourth DC-8 for Air NZ? Government authority is being sought by Air New Zealand to order a fourth DC-8-50 for delivery in mid-1967. The general manager of the airline has predicted a requirement for seven or eight DC-8s by 1969, with interim deliveries at the rate of one a year.

The Lake Michigan Accident The flight recorder from the United Boeing 727 has still not been recovered from the bed of Lake Michigan, though the recorder's outer casing has been brought up. Wreckage representing 75-80 per cent of the total dry weight of the aircraft had been recovered by late November.

Award for Safety The BALPA gold medal for 1965 has been awarded to Mr R. R. Goodison for his work in furthering air safety during the past five years. Mr Goodison was, until recently, Under Secretary, Aviation Safety and General Group, Ministry of Aviation; he is now under Secretary, Aviation Overseas Policy Group (see picture on this page).

BAA Appointment Mr G. J. Warcup has been appointed controller of technical services, Heathrow, by the British Airports Authority; he will be responsible for all operational matters. Mr Warcup, 53, a war-time pilot, has held a number of official civil aviation appointments at home and abroad since 1946 and for the past two years has been Director of Technical Services, London Airports.

"Cinesymposium" at Hamble Another Flight Safety Committee "Cinesymposium" was held at the College of Air Training, Hamble, on December 1. The familiar and valuable film series—including "Tyre Hydroplaning" and "Slush"—were shown, with discussions after each. The chairman of the committee, Mr R. O. Belton, introduced the films. Members of the committee, senior pilots and members of the Southampton branch of the RAeS took part.

Survival Extraordinary An Eastern Airlines L-1049, flying on the Boston-New York shuttle, and a TWA Boeing 707 on the New York-San Francisco service collided at 11,000ft over North Salem, Conn. on December 4. The 707 lost 15ft of its port wing outboard of No 1 engine and had parts of the Constellation in its fuselage, but was landed safely at Kennedy Airport with 58 passengers and crew. The L-1049 was force-landed near the Connecticut-New York border and caught fire. Four persons were killed and about 30 injured among the 54 passengers and crew.

AIR TRANSPORT ...

ARE SEAT BELTS ADEQUATE?

TURBULENCE incidents and accidents continue. A serious one is recorded in a recent CAB summary report of US air-carrier accidents. During a descent through a line of thunderstorms a Northwest Boeing 720B encountered severe turbulence. The important feature of this incident is that, although all crew and passengers had their seat belts fastened and inspected, one passenger was thrown from her seat and seriously injured. No apparent malfunction or failure of the belt was disclosed in later investigation. A cabin attendant also received serious injuries when a fire extinguisher came loose from its mounting bracket. Again, no fault could be found and when the extinguisher was re-installed it could not be dislodged.

During the three-minute period of turbulence the descent of the 720B was effectively stopped by updraughts for a period of 1½ minutes, with g forces up to +3.3.

AERALPI's SKYVAN PLANS

SINCE Aeralpi ordered the Short Skyvan earlier this year their whole philosophy of operations has undergone a dramatic change. The airline was originally formed to bring air services to some of the more isolated parts of northern Italy. This it has achieved with the Turbo-Porters currently in operation to such effect that it became necessary to order a larger aircraft. But now that the airline's forward planning has been able to include use of the Skyvan, Aeralpi hope to develop their operations throughout Italy.

On a recent visit to Britain, Dr Lionello Fabriani, manager of the airline, outlined some of the plans made possible with the Skyvan. "Italy is a country divided, as it were, into 'compartments' and communications are sometimes difficult. This is particularly so during the winter when the larger airlines operate fewer services and traffic falls to a point where it is uneconomic to operate aircraft of Viscount size. This is where the Skyvan can play its part and it will be particularly valuable in providing services linking inaccessible places, having small fields, with airports such as Verona, Turin and Genoa, which in turn feed the international airports at Rome and Milan."

Aeralpi plans for the Skyvan include probable tie-in services in collaboration with Swissair, Air France, Alitalia and other major airlines, serving mountainous or seaside resorts in the north. There is also a distinct possibility that Aeralpi will

Dr Lionello Fabriani, managing director of Aeralpi, in the Skyvan's cockpit with Mr E. G. Collinson, Shorts' chief mechanical engineer



take over certain routes during the winter, including services extending as far south as Sardinia. The industrial triangle of Milan, Turin and Genoa is considered to be particularly suited to Skyvan freight operations.

Although Aeralpi's plans for the future are built mainly around the four Skyvan aircraft they have on order, the Turbo-Porters will still have their part to play. There is a considerable requirement for the type of mountain flying which involves landing on glaciers. In the past the Porters have been so busy fulfilling their regular airline commitments that it has been difficult to release them for such charter flights. When the Skyvan comes into operation the Porters will have more time available for this type of flying.

Development of services to the south of the current operational area is not expected to detract from Aeralpi's original *raison d'être*, which is to provide services for the isolated and mountainous north. This side of the business continues to expand. Each district in this area is anxious to have its own airstrip; several of these are at present under construction and others are planned.

Aeralpi began operations in 1962 and, since that time, have achieved a satisfactory growth. In three months of 1962, for instance, they flew 136hr and carried 678 passengers. For a full year's operation in 1964 the figures were 1,727hr and 4,915 passengers. This total of passengers has been exceeded in the first eight months of 1965, up to August they had carried 5,887 passengers in 1,426hr—fewer hours than were flown in the previous year.

CUNARD AND BOAC's RECONSTRUCTION

DURING the debate on the Air Corporations Bill (see last week's issue, pages 955-956) Mr Roy Jenkins, Minister of Aviation, referred to a letter received from Sir Giles Guthrie giving an assurance that no benefit would flow to Cunard from the financial reconstruction of BOAC. Mr Jenkins had also, he said, asked BOAC's auditors to give him a certificate, at any time, to assure him that no part of the reconstruction involved was in fact flowing to Cunard.

For the record, here is the letter sent by Sir Giles to the Minister:—

"You recently told me that you considered it essential to be able to make it absolutely plain to Parliament that no part of the aid to be provided to BOAC in the promised financial reconstruction Bill would find its way into the hands of the shareholders of the Cunard Steam-Ship Company.

"As you are aware, this aid will in effect be applied in two ways, first to the elimination of BOAC's accumulated deficit and secondly to the establishment of a reserve. It is clear that the elimination of the accumulated deficit cannot have any effect on the shareholders of the Cunard Steam-Ship Company. As regards the application of the reserve, this is something which, even under the existing statute, is in your control; no part of it could pass directly to the shareholders of the Cunard Steam-Ship Company without your express knowledge and consent.

"What I think you may have in mind is that under the arrangements between BOAC and the Cunard Steam-Ship Company, which must properly remain confidential for commercial reasons, some indirect benefit may flow to the latter, which would not have occurred had there been no reconstruction. I can assure you that there are no circumstances in which I can foresee that this is likely to happen, or, indeed, in which BOAC would permit it to happen.

"The basic arrangement between the two organisations is that BOAC operates as part of its own fleet the actual fleet of aircraft jointly owned with Cunard. BOAC-Cunard pays for the services operated by BOAC on its behalf at full cost as established for BOAC's own operations on the basis of the company's ownership of a fleet of Boeing 707 and Super VC10 aircraft. The capacity produced by Super VC10 aircraft used on the company's behalf over and above the output of the basic fleet of 11 Boeings is costed to the company at full rates.

"These charges can reflect no element of the Government's assistance to BOAC, since they are related to the actual costs of the aircraft as they appear in BOAC's books. Unless, with your consent, reserves were applied to subsidising the operating cost of aircraft, or some similar purpose, the charges in BOAC's books could not be affected.

"At the present time the fleet owned by BOAC-Cunard consists of 11 Boeing 707s and four Super VC10s, all of which have been or are being paid for (through debentures) by BOAC-Cunard as a normal commercial transaction and at the proper price and no element of the intended Government aid is reflected in the acquisition prices of these aircraft."

This DC-4 (D-ABAG) was registered in April this year with a new German non-scheduled operator, Transportflug of Hanau. It is on the apron at Singapore's Paya Lebar airport



PRAISE FOR BLACKOUT CONTROLLERS

THE resourcefulness of the FAA air-traffic controllers during the November 9 blackout in north-east USA has been praised by several airline chiefs, including the chairmen of Pan American, Mr Juan T. Trippe, and of United, Mr W. A. Patterson. The controllers' performance is described in varying but glowing terms. Mr Patterson said, according to *Aviation Week*, that the "magnificent performance" of the controllers prevented "complete chaos," and Mr Trippe said that "the resourcefulness and ingenuity with which FAA personnel established alternative means of communicating with these aircraft . . . was a major factor in the safe, uneventful arrival of all of them at alternative airports." Their work, said another comment, "rose to heights of brilliance in re-routing hundreds of flights."

Nevertheless, the difficult and dangerous situation would not have arisen if New York's airports had been provided with proper back-up power supplies. A few days after the emergency the FAA authorised the shipment of heavy duty generators from Oklahoma City to New York's Kennedy and La Guardia airports. The blackout cut off all lights, ILS, radio and radar systems at both these airports. Emergency battery-powered radio equipment and some lighting went rapidly into operation, but the main systems were out of service for most of the night. Good weather and a full moon were instrumental, with the controllers, in preventing incidents or accidents.

RATIONALISATION IN CANADA

THE Canadian airline industry heard in mid-November that substantial progress had been made by the Government during the past year toward the establishment of a policy to cover all operators. Mr Rolland Lafrancois, president of the Air Transport Association of Canada, said in his annual report that he was confident that Canadian air transport was getting closer to that point of development where it would be regarded as an economical and stable industry. "I am convinced that remedial measures will not stop with the main line and major regional carriers, but that a proper system or framework devised for all other carriers will follow," he said.

He was referring to the policy statement last June by the Transport Minister, Mr J. W. Pickersgill, which, for the first time, established international areas of operations for the two Canadian flag carriers, Air Canada and Canadian Pacific. This was the statement which, so to speak, gave Northwest Europe, England and the Caribbean to Air Canada and the Pacific and Southern Europe to CPA. At the same time the Minister had said that his department had decided to employ an aviation consultant (Mr Stephen Wheatcroft) to advise whether the

growth of the domestic line service would permit some further degree of competition between CPA and Air Canada on transcontinental routes.

Mr Lafrancois, who is president of Nordair, said that the Minister also stated that the five major regional carriers had been asked to submit briefs on what could eventually be regarded as feeder operations into the mainline routes. Some of these briefs have been completed—by Pacific Western, TransAir, Nordair, Quebecair and Eastern Provincial—and will be forwarded to the department.

The major regionals are seeking a long-term policy statement which would cover at least ten years and allow them to programme their equipment needs and operations to the type of service they feel they could provide or be required to provide. "Some feel that if they are to fly scheduled services on routes that do not prove profitable, then they want to be able to withdraw rather than accept subsidies to continue operations," Mr Lafrancois said. But it would require a clear-cut Government policy statement on what areas of service the regional operators would be called upon to provide before they could undertake it.

The ATA has been pressing the Government for years for the establishment of a national air policy and now feels that some strong gains have been made and is waiting for development. A factor that is making the waiting much easier this year is the profit that the industry is making.

TWA DC-9 Services Trans World Airlines will introduce the DC-9 into service on February 15 next year. The initial schedule will replace Constellations between St Louis and Indianapolis, New York and Kansas City. All TWA's piston-engined aircraft will be retired by the end of 1966.

BOAC New York-Nairobi . . . Two services are now co-ordinated by BOAC to give a one-stop service New York-Nairobi in 16hr. The Boeing 707 service leaves New York in time for passengers to connect on Thursdays with the VC10 leaving for Nairobi.

. . . and London to Fiji A twice-weekly BOAC Boeing 707 service between London and Fiji began last month. It was the first BOAC 707 to land at Auckland's new Mangere Airport.

New IATA General Counsel Mr Julian Thomka Gazdik has been appointed general counsel of the International Air Transport Association. He has been secretary of the association's legal committee since 1947 and is a specialist in international air law.

Statistical Summary of Charter and Contract Operations by BIATA Members

	1962-63	1963-64	% Change	1964-65	% Change
Capacity ton-miles available . . .	34,485,000	51,241,000	+ 49	95,497,000	+ 86
Load ton-miles . . .	26,208,000	38,079,000	+ 45	70,500,000	+ 85
Passengers carried:					
Civil . . .	82,916	142,475	+ 60	173,063	+ 21
Military . . .	52,223	74,596	+ 43	155,116	+108
Total . . .	135,139	217,071	+ 61	328,279	+ 88
Passenger-miles:					
Civil . . .	42,183,000	104,786,000	+148	241,354,000	+ 13
Military . . .	95,094,000	160,083,000	+ 68	642,071,000	+301
Total . . .	137,277,000	264,879,000	+ 93	883,431,000	+234
Freight (short tons) . . .	4,689	4,014	- 14	10,722	+167
Freight ton-miles . . .	12,315,000	12,424,000		8,678,000	- 30
Aircraft miles . . .	4,379,000	6,014,000	+ 37	12,691,000	+111

In "Flight" of November 18 (page 843), commenting on BIATA's report for 1964-65, we referred to the absence of the usual tables showing the non-scheduled operations of BIATA members. The secretary-general of BIATA, Mr Hugh Brilliant (see letter on page 1016) has had this three-year table prepared, giving non-scheduled traffic by BIATA members—but excluding the Air Holdings Group companies and Britannia Airways (which did not join BIATA until 1964)

AIR TRANSPORT...

FLIGHT-DECK SYMPOSIUM—2

Comments on the Papers and Discussions

WHEN asked which particular displays were to be discussed at BALPA's symposium (see last week's issue, pages 951-952), the organisers explained that the descriptive title used, "flight-deck displays," meant exactly what it said. *Everything* on the flight deck which displayed information to the flight crew was to be examined and discussed—flight instruments, engine and system instruments, controls and selectors, maps and charts, and warning systems. An examination of the report of the meeting will reveal that this considerable task was completed with a good deal of success, although the summary speech at the conclusion of the meeting pointed to some omissions—including, surprisingly enough, weather-radar displays.

In order to guarantee that a lively discussion followed each paper it was arranged to have a nominated speaker, believed to hold opposing views to those put forward in the papers, to lead each discussion period. Some of the information and opinion which was revealed by this procedure is summarised here.

Scanning Patterns—Human Factors MR J. ROLFE of the Institute of Aviation Medicine was the first speaker to point out that the arrangement of individual instruments into an integrated display is a vitally important feature, and one which materially affects the rate at which a pilot can extract information from a display. CAPT E. PRITCHARD of BALPA had already said that his personal opinion is that the practice of integrating various information inputs into a single instrument has already gone too far, in that this militated against a monitoring of the other important activities and displays in the cockpit. There seemed, however, to be a general feeling that, as an instrument approach reaches its most critical stages, the pilot's attention becomes more and more concentrated on a small central area. MR M. BROWN of Bendix agreed with this and said that future instrument design is likely to reflect an acceptance of this fact. The basic "T" arrangement of flight instruments was supported by almost everyone, including BLEU, but CAPT J. NICHOLL revealed that BOAC's Boeing 707s do not have this arrangement, although the VC10s do have it. Capt Nicholl, who is the corporation's training manager, said that he favours having the vertical speed display in line with the horizontal bar—that is, at the top right position in the "T." The question as to whether this is because of the inadequacies of the pitch-attitude information displayed on the horizon/directors was not pursued. CAPT D. S. KIRKLAND of BEA said that the Trident aircraft has the "T" layout and that the same philosophy had also been applied to the autopilot controller. He admitted that not enough is yet known of the pilot's requirements for information—an opinion which was supported by many. Mr Brown's case for the use of vertical-scale instru-

ments arranged in a "T" layout, received strong support from a film record of the scanning patterns of these instruments compared with a typical display of dial instruments. The new "tape" instruments produced much the best results.

A cautionary note was introduced when medical opinion was quoted to the effect that, under stress, scanning patterns can be reduced to an extent where "tunnelling" of vision occurs; the term used to describe this—"fascination"—was mentioned by several speakers. When discussion got around to head-up displays one delegate said that a pilot could become so intent on the director elements of these displays that he might not see the real world beyond. There was a large measure of agreement among the delegates that there is a great need for more human-factors research.

Electronics Displays A major topic was the potential of electronics displays for displaying flight, navigation, engine and communications information. Both head-up and head-down systems received attention.

The case for head-up displays has been put forward at several recent conferences, including the IFALPA meeting at Rotterdam (*Flight* for November 4, pages 761-762). The greatest support for these systems is for their use in operations in reduced weather minima, and particularly for the difficult transition to visual flight at low altitude and in poor visibility. Other valuable uses would be as take-off directors and for landing roll-out guidance. At this meeting opposing points of view were put forward—particularly and predictably by the manufacturers of head-down displays. Difficult questions were asked such as: What reliability can be expected of cathode-ray tubes? What stand-by instruments will be required? How can HUDs be engineered into the flight deck? Some answers were forthcoming, but it is doubtful if all the answers were so convincing as to persuade the airline representatives present to reach for their order books.

What did emerge, after the meeting had looked at photographs of the Concorde flight-deck displays, was an agreement that the maximum use must be made of the limited space available on such aircraft. There are many instruments on modern aircraft which are only looked at from time to time. It was suggested that for these particular instrument functions an "address book" or time-sharing system of display would be appropriate. Electronic rather than electro-mechanical displays might come into their own here—as is also possible in the presentation of information from centralised navigation systems. MR D. S. GREEN of Specto Avionics, MR R. A. CHORLEY of Smiths, and Messrs P. A. HEARNE and K. R. WARREN of Elliotts all put forward proposals to this end. Mr Green claimed that if electronic methods were used for the pilot displays in the Concorde a considerable saving in space would result. Mr Hearne showed examples of the complex electro-mechanical instruments now used in aircraft and claimed, with a good deal of justification, that, compared with these, the electronic displays would be much more simple. As might be expected, comments made by officers from the Ministry of Defence revealed that the military authorities are much less inhibited than their civil counterparts when considering new equipment proposals. As Sir George Edwards, managing director of BAC, pointed out in his closing address, the airlines learn to live with obsolescence in the interests of economy.

Vertical-scale Instruments Those comments from Sir George must have a familiar sound to all who try to persuade people that the new is better than the old. Mr Brown of Bendix put forward a most convincing case for the new vertical-tape flight instruments and vertical-scale engine instruments. His talk was reinforced by extensive quotations from US military evaluation reports on the equipment. He announced that the FAA has arranged to repeat some military experiments in which the

The much-travelled demonstration equipment for the Elliott head-up display which was shown at the BALPA symposium after being at the IFALPA all-weather meeting in Rotterdam



conclusion was reached that pilots using the instruments can manually flare and land aircraft under zero-zero conditions. Add to this the enormous amount of experience being gained by the USAF with the instruments in the C-141 transport aircraft which has now led to the deletion of conventional standby instruments and Mr Brown's apparent confidence in the products of his company appear to be well founded. He fielded very ably all the questions thrown at him and many in his audience must have left the meeting impressed by the equipment he had described. Certainly no one attempted to deny that the C-141 with Mr Brown's instruments is a good deal less cluttered in appearance than the C-130 Hercules fitted with conventional instruments.

Maps and Charts When MR BURTON of International Aeradio delivered his paper he gave a broad-brush treatment to the history and development of maps and charts and then went on to the difficulties encountered in attempting to supply the needs of modern air transport operations. He attempted to justify the separation of topographical and radio navigation information on to separate charts by stating that this procedure is recognised by ICAO in Annex 4. Capt T. St B. FREER of BALPA, who is something of an expert in these matters, attacked the philosophy and stated that the two types of information can be presented together if contour envelopes are used to depict high ground instead of using precise contour lines. Capt Freer showed that the use of selected spot heights

to show relief can be positively dangerous. When it was suggested to Capt Freer that his proposals for contour envelopes would involve the expense of colour printing, his quick riposte was that the airlines' give-aways to passengers already include expensive maps printed in at least four colours—and that was the end of the argument. Mr Burton's final point was that the future method of supplying information of this kind to pilots will probably be by the use of microfilm-projection techniques (see *Flight* for November 25, page 879).

Other Items Angle-of-attack indicators were mentioned by MR E. B. TRUBSHAW, BAC's manager, flight operations, who said that they are required when test flying to explore the complete performance envelope of aircraft. His suggestion that this instrument would be of great value to the airline pilot was quickly accepted by many of the pilots present. It was pointed out that the sensors for such instruments already exist on many aircraft for the purpose of stall-warning systems.

Moving-map displays were explained by MR L. R. MIEDZYBRODSKI of Ferranti, the Sud-Lear autoland system by a representative of Sud, and the merits of barometric and radio altimeters for all-weather operations were examined. There was a failure to agree as to the relative merit and roles of analogue versus digital readouts on displays. Throughout the three days of the meeting there was stimulating discussion on many related subjects; enthusiasm and interest was still in good supply even as time ran out.

BOAC RECRUITS MORE PILOTS

A DRIVE for pilots has been started by BOAC to support the supply of younger trainees from the College of Air Training, Hamble. Jobs are being offered to men in their 20s who already hold, or are training for, commercial pilots' licences. This campaign may seem, superficially, to be at variance with the fact that the corporation has now given "golden handshakes" to some 50 pilots, some of whom are now flying with the independent airlines. But the new pilots are to take the place of the first officers who, in their turn, will replace the present generation of captains as they reach retiring age during the next decade.

Almost all of BOAC's 380 captains are World War Two pilots who are now in their 40s and will be retiring at the age of 50-55—so that all but a few will have left the flight-decks by 1978. BOAC comments that, at present, in addition to the Hamble trainees, "we need young men who are already well on their way to qualifying as airline pilots and we believe there are plenty who will welcome the chance of a career with BOAC."

New BMA All-freight Service On December 1, British Midland Airways will start an all-freight service between the East Midlands Airport and the Channel Islands.

Caledonian Airways has applied to the ATLB for scheduled-service rights from Prestwick, Abbotsinch, or Renfrew to Palma, Barcelona, Ibiza, Alicante, Malaga, Genoa, Rimini and Perpignan. The flights would be made with Britannias at a frequency of up to seven a week. Caledonian has asked the Board for a ten-year licence from April 1, 1967.

Newest of the US third-level carriers, *Commuter Air Lines*, has started operations between Chicago O'Hare and points in Central Iowa with two Beech Queen Airliners. These are ten-passenger variants of the Queen Air B80 developed for third-level operations

Fire Prevention The National Fire Protection Association has issued its Fire Protection Publications List for 1966. It is available from the Association at 60 Batterymarch Street, Boston, Mass, 02110, USA.

Braniff in Europe Mr Robert T. Phinney has been appointed director of European sales for Braniff International. He will be based at the company's London office, Berkeley Square House, Berkeley Square, London W1.

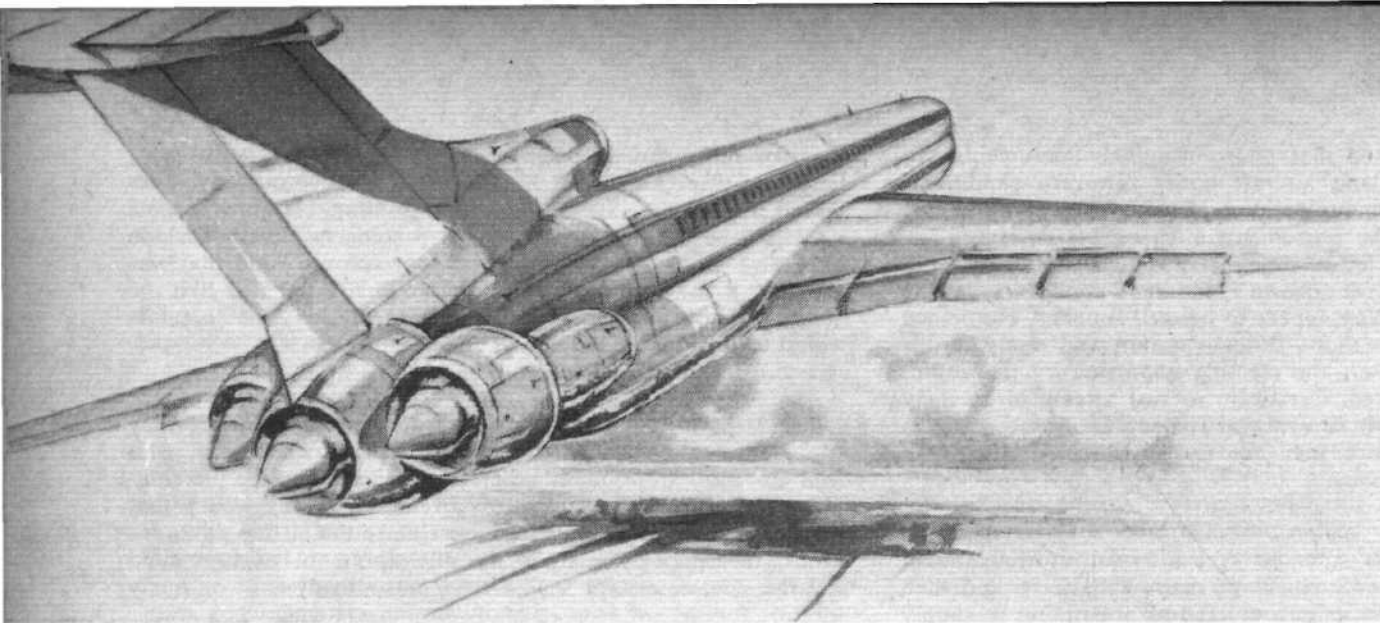
CATC Electronic News The latest edition of the Commonwealth Air Transport Council's Electronic News (August 1965) has recently been published and is available from the Council at Shell-Mex House, Strand, London WC2.

The Institute of Petroleum has produced part seven of the *Model Code of Safe Practice; Airfields, Part 7, 1965*. It is available from the Institute at 61 New Cavendish Street, London W1, price 35s post free.

Madagascar Crash An Air Madagascar aircraft crashed on November 15 on a scheduled flight between Sambaya and Vohemar. The pilot and one passenger were killed; two others are missing and two injured. The aircraft is named as a Broussard in *Lloyd's List*.

Flight Safety Foundation Award Mr Frank C. White has been presented with the Flight Safety Foundation's annual award for "distinguished service in achieving safer utilisation of aircraft." Mr White has been concerned with the development of airborne weather radar for commercial aircraft; he is communications and data-processing manager for the Air Transport Association of America.





THE CASE FOR HIGH BY-PASS

Heading this article is a "Flight" artist's impression of how a 265-seat super Super VC10 might appear with three 35,000lb-thrust high by-pass engines. The following article, by Mr J. Wotton of BAC, explains how the intake requirements and the comparatively cold efflux of high-by-pass (8:1) turbofan engines can be turned to advantage by integrated installation arrangements. These ideas are claimed to put a new complexion on the estimated installed weight and drag of such engines.*

The installed s.f.c. of 8:1 turbofans is alone estimated to cut long-haul direct operating costs by over 20 per cent off current levels without accounting for the depreciation—and maintenance—cost advantages of only three engines. Allied to a big payload capacity as proposed in the "Flight" sketch, the developed Super VC10 might have quite outstanding economics.

An aft-fan engine arrangement is considered best for internal mechanical reasons, but principally because it offers distinct installation advantages when both wing- and aft-fuselage-mounted. The high by-pass turbofan is claimed to match the thrust requirements of both long- and short-haul subsonic transports better than can any other kind of engine—though there are some engine manufacturers, notably Rolls-Royce, who would disagree. This whole issue is now developing into a technical controversy as great as that between jets and turboprops a decade ago.

THERE has always been a conflict between man's insatiable quest for adventure into the unknown and an equally strong inborn resistance to change. This is nowhere more clearly demonstrated than in the field of aeronautics, where the rate of progress is dictated by the "drag" or "restraint" of conservatism upon the enthusiasm of the pioneer, the term chosen being simply dependent upon point of view.

Because this is so the transition from piston engines to turboprops, and from turboprops to jet engines for use in civil aircraft was made to the accompaniment of much doubting and dire prediction of the eventual outcome in terms of economics and actual safety. So it is not surprising that the problems associated with supersonic transport have been used by some as a platform from which to aim prophetic mutterings of the unwisdom of adventure into this little charted sea of uncertainty. Almost as damaging has been the opposite argument that the 707/DC-8/VC10 type of aircraft would be outmoded by the SSTs.

*Mr J. Wotton, FRAES, project engineer, British Aircraft Corporation (Operating) Ltd, Weybridge.

What is now quite certain is that the SST will become a fact and that the economics of subsonic aircraft will be vastly improved to an extent which could ensure their continued dominance of the main air transportation field perhaps indefinitely. Such improvement will come about by more passengers than could be conceived of for SSTs and also by improvements in both propulsion and aerodynamics. There are gains to be had from drag reduction through improved surface finishes, boundary layer control and refinements in shape, but these are largely understood possibilities and the expected improvements modest. By far the most promising area of opportunity lies in propulsion advances and, in particular, the effect of higher by-pass ratio lightweight engines.

It is to the engine manufacturers therefore that we must look for spectacular gains and there is reason to believe that this will be forthcoming in the not too distant future.

Confusion regarding the potential and practical limitations of by-pass ratio can be avoided if the basic facts are not too freely mixed with assumptions. In particular a clear understanding of the effects of engine installation is of immense value in the final assessment.

Consider then the basic equation for propulsion efficiency:

$$\eta_p = \frac{2 V_o}{V_o + V_j}$$
 It is clear that jet velocity is a vital factor, and that by definition, large mass-flow and low unit-area thrust-loading go with high efficiency. Jet efflux velocity will be reduced and efficiency improved as by-pass ratio is increased. The thrust per pound of air passing through the propulsion unit as a whole is reduced as by-pass ratio is increased—likewise the quantity of air not by-passed, i.e., that going through the gas generator.

The work to be done per pound of air passing through the gas generator must then be increased, resulting in a higher turbine entry temperature under cruise conditions. There will therefore be an increase in the rate at which thrust is lost with altitude.

Aircraft thrust requirements decrease with altitude more rapidly than does the available thrust from the low or zero by-pass ratio engine, which is then not working at maximum efficiency under cruise conditions. In contrast, the turboprop power decay with altitude is such that the engine can be exactly matched to both take-off and cruise thrust requirements. Similar matching becomes more nearly possible with jet engines as by-pass ratio is increased. Increasing the permissible turbine entry temperature will increase the available work per pound of air, decrease engine weight, and/or extend the usable range of by-pass ratios. Increase in compression ratio will increase the available work per pound of air, and will also result in reduced fuel consumption.

From the foregoing it will be seen that, first, the overall engine diameter will increase with ascending by-pass ratio (for a given thrust rating); and the engine length will tend to

become less (neglecting thrust reverser provision). In fact the increase in diameter is not as great as might be expected due to reduction in gas generator size. An increase in turbine staging makes shortening negligible. This is shown diagrammatically in Fig 1.

Weight New techniques in engine component fabrication and increase in stage loading due to aerodynamic development have been responsible for significant reductions in engine weight. The reported specific weight of the P & W SJTF 14E engine for the C-5A is 0.167 for a 3.3:1 by-pass ratio and a compression ratio of 20:1. The GE 1/6 engine, which won the competition, has a specific weight of 0.179 but a by-pass ratio of 8:1 and compression ratio of 25:1. Contrary to previous expectations it is now expected that specific weight based on static thrust and a given compression ratio favours the higher by-pass.

Because thrust lapse-rates change with by-pass ratio, a static thrust comparison is meaningless—a specific weight based on about 125kt is more realistic. This is also a useful datum for aircraft performance calculations. Fig 2 indicates the trend for an uninstalled engine on this basis.

It appears that there is little weight penalty in going to a ratio of 8:1, the values shown being at a minimum at 4:1 for a front fan and 7:1 for an aft fan. The actual specific weights are about 20 per cent less than today's in-service engines, but closely agree with projected American engines referred to earlier.

Drag Most theoretical estimates of by-pass ratio efficiency assume an optimum pod-type installation, with a factor for possible aerodynamic interference effects from adjacent aircraft structure. This interference factor varies with location, being considerably less for a pod mounted below and well ahead of the wing leading edge than for a rear fuselage-side mounting.

The relationship between pod drag and intake momentum drag was discussed in an article published in *Flight* on January 7, 1965, by Mr L. G. Dawson, of Rolls-Royce, and for convenience his graph of propulsive efficiency against pod drag is repeated here as Fig 3, with approximate values of by-pass ratio added as a function of thrust momentum drag. The curves show the overall propulsive efficiency for a given standard of pod drag, and the dotted curve is the optimum line along which the efficiency is a maximum. The "probable" region of next generation long range engines shown on this curve lies well back from the worst drag ratio given and is already dated by the course of events. The fundamentals remain

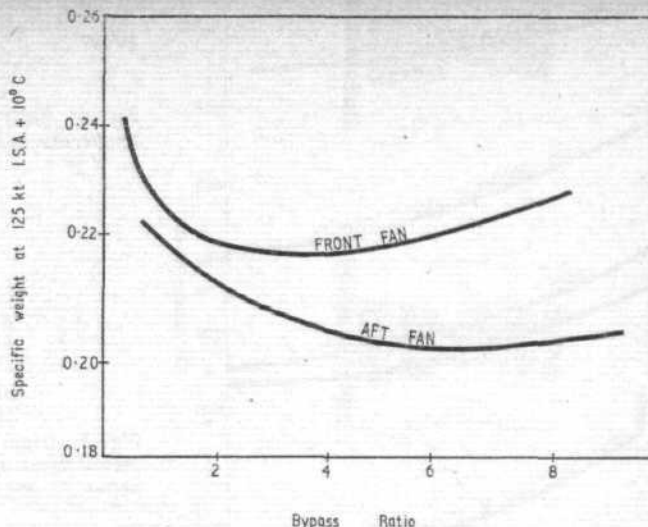


Fig 2 Variation of specific weight with by-pass ratio for the basic uninstalled engine

valid and the curves will remain substantially unaltered, indicating that if a pod/momentum drag of 0.04 can be achieved, a by-pass ratio of 8 is more nearly ideal than the 2 to 3 quoted.

Nevertheless, by-pass air must still go outside the tips of the turbine, the size of which is therefore restricted. Ideally it should approach or even exceed the diameter of the fan. The aft-fan invariably has a driving turbine near or in-plane with the fan and is similarly restricted. For a given component efficiency standard therefore, the choice of front- or aft-fan configuration has a negligible bearing on maximum diameter. In the case of the aft-fan, however, it is possible to reduce the gas-generator intake diameter, and hence the frontal-area and weight of that part of the power unit. In either arrangement there appears to be a turbine component efficiency penalty which rises with by-pass ratio. In spite of this and allowing for installation drag, it can be shown that the gain due to by-pass ratio continues even beyond a by-pass ratio of 8:1 at M 0.85.

As stated earlier, any improvement in gas-generator compression-ratio or r.p.m. will extend the benefits of high by-pass ratio, while higher turbine entry temperature development will increase thrust per sq ft, and therefore reduce drag penalty for a given installed thrust and by-pass ratio. In choosing by-pass ratio in this context, it is beneficial in the long term to lean towards the higher values. The fundamental principles point to a useful limit of opportunity at a by-pass ratio of 8:1 for a maximum cruise of M 0.9 at 36,000ft.

A further potential improvement in the case of the aft-fan lies in contra-rotation and interspacing of the fan and low-pressure compressor turbines. The fan turbine efficiency is then fully restored and the fan speed can be optimised for efficiency and/or minimum noise.

Thrust Reversal Any discussion on high by-pass ratio engines is incomplete without reference to thrust reversal, which becomes increasingly difficult as the fan mass-flow and

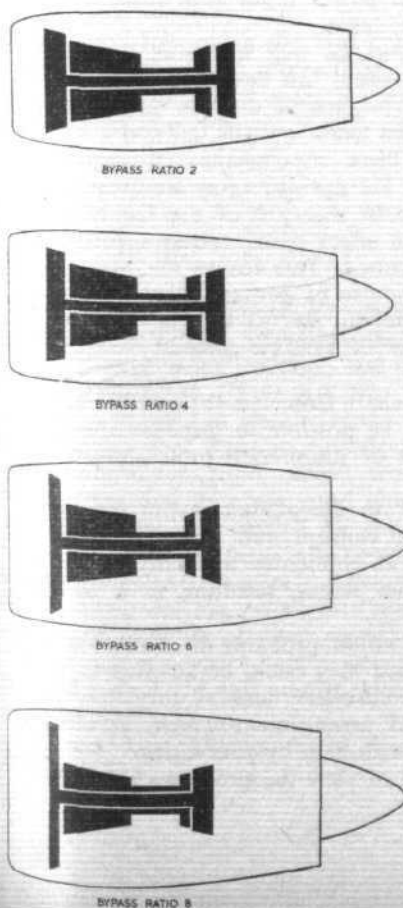
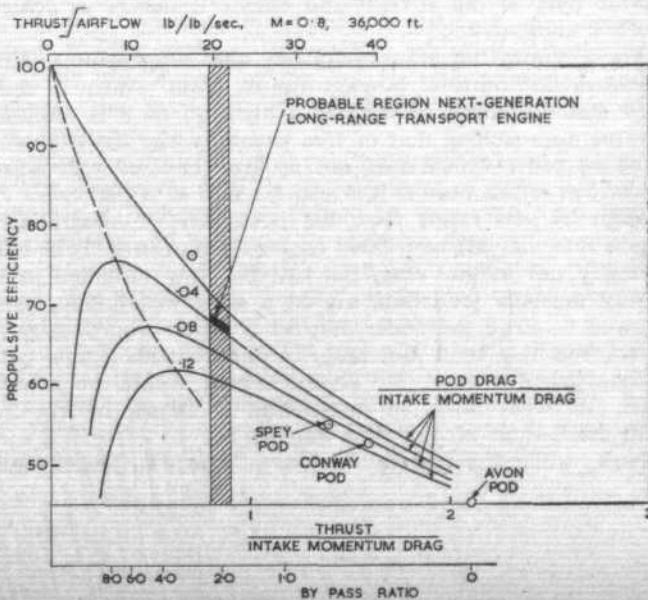


Fig 1 (left) Front-fan by-pass engines to scale

Fig 3 (right) Relationship of pod drag and intake momentum drag as first presented in "Flight" by Mr L. G. Dawson of Rolls-Royce in the January 7, 1965, issue. Approximate equivalent by-pass ratios have been superimposed by the author of this article



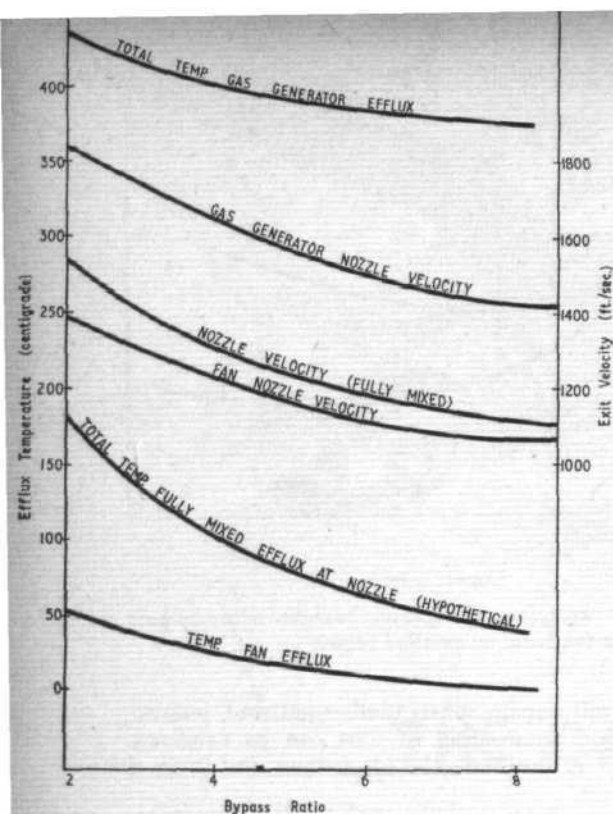


Fig 4 (left) Efflux velocities and temperatures for various by-pass ratios

Fig 5 (right) Proposed underwing installations of high by-pass engines: upper, front-fan; lower, aft-fan

THE CASE FOR HIGH BY-PASS ...

dimensions rise. Both the classical internal bucket and external clamshell type of reverser involve an ever increasing weight penalty, and alternatives such as annular cascades uncovered by fore and aft movement of the cowl must be considered. A possibility peculiar to the aft-fan is variable-pitch fan blades for thrust reversal and/or modulation, conferring useful benefits in terms of cowl size, reduction of internal and external cowl-drag, and fan speed control, together with considerable weight saving. It is probable that thrust reversal by this means is not applicable to by-pass ratios less than 8:1.

Noise Whilst this is a subject not yet entirely understood, the probable contribution of by-pass ratios to noise levels can be stated qualitatively. Jet noise as such is a function of the eighth power of exit velocity (Lightfoot) and this is so much reduced at the higher ratios as to have no effect on the perceived noise. But turbine noise, and so-called machinery noise, will be greater than at present, due to the large mechanical power input to the fan. Fan noise is likely to predominate and may prove a greater nuisance than present-day jets unless dealt with as far as possible in the design stage. High tip-speed, close tolerances and numerous stators or struts are known causes of noise generation, and therefore to be avoided.

The aft-fan associated with contra-rotation appears to show considerable promise in terms of tip-speed reduction whilst the numbers of guide vanes can be reduced as the ratio is increased and the pressure rise across the fan falls. There may well be some ratio in the higher orders at which the noise level with this arrangement begins to fall off.

It is clear that installation drag is of paramount importance and that considerable scope exists for co-operative ingenuity on the part of the aircraft and engine designers in achieving the best combination.

Fig 4 shows the efflux velocities and temperatures (mixing assumed) for various by-pass ratios, from which it can be seen that the efflux velocity at a tip ratio of 8 is reduced to a value approaching that of free stream, while the temperature is of an order which does not prohibit contact with adjacent aircraft structure, even if it is also the wall of a fuel cell.

High by-pass ratios raise the possibility of integrating the engine into the structure. Such engines cannot possibly be buried, certainly not in the wing, but can be close mounted in such a way that the jet efflux, say in a wing installation, can be allowed to scrub the underwing for a lower drag penalty than is incurred by a strut mounting. In this example a flow pattern is established around the engine which would be smoother than otherwise. Such an installation is shown in Fig 5 for both front- and aft-fan type engines.

Now, while the high by-pass-ratio front-fan engine cannot

readily be buried in the rear fuselage, the aft-fan type of engine is amenable to this kind of treatment. The fan intake can form an annulus around the fuselage, and a separate gas generator intake in the fin root, where free stream air is reached. The ingestion of fuselage boundary layer air by the fan actually improves the overall propulsion efficiency (and, hence, s.f.c.) by reason of the lowered momentum drag into the fan and better energy exchange through the fan/turbine system.

As the aft-fan engine can equally well be integrated under the wing, it is seen that this engine layout can be used with any odd or even number of engines. An interesting possibility is the optimised three-engine layout shown in Fig 6, where the two rear side-mounted engines have their fan cowls integrated with the centre one described above. This arrangement produces a low-disturbance flow-pattern and good drag characteristics similar to the underwing installation shown in Fig 5.

Returning now to the engine, a front-fan layout appears to permit considerable freedom in respect of turbine size, but the actual minimum fan diameter is determined by the hub/tip ratio (about 0.35 for good efficiency) and this largely decides the frontal area of the gas generator.

Engineering The engineering of two-shaft engines increases in complexity as the compression ratio per spool rises, notably because of the need for variable-geometry stator blades. However, the latter are already widely used so the higher compression-ratio engine would merely be an extension of current practice in this respect. A simplifying factor is that the relative number of compressor stages is tending to get less due to improved aerodynamic and mechanical techniques. High by-pass fans do require a large power input and hence a larger number of associated turbine stages.

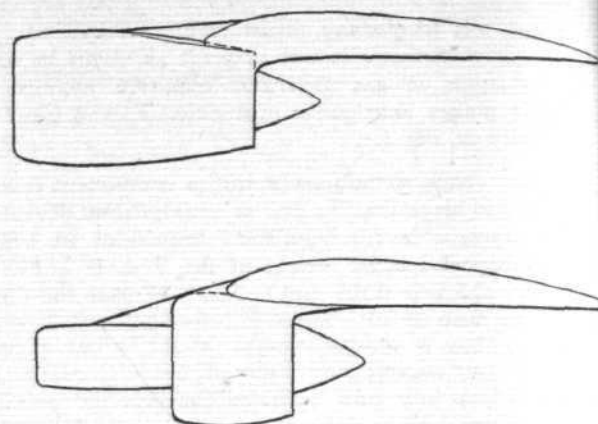
For reasons of power input, as well as noise, tip-speed is a controlling parameter in overall fan design. With increasing by-pass ratio the pressure rise across the fan falls and the optimum number of fan stages tends towards unity at a by-pass ratio of around 4. Under these circumstances it seems best to disassociate the fan from the gas generator compressor and to arrange a separate drive. In the case of the front-fan the arrangement would have the effect of a modest supercharger on the gas generator compressor. This leaves the main compressor to achieve a pressure rise of perhaps 20:1 in a single spool in the conventional layout at (a) in Fig 7, and this could lead to a large number of variable-geometry stages and complex control.

Alternatives are the three-shaft front-fan (b) and the aft-fan (c) in each of which it may be possible to dispense altogether with variable stators because of the modest total pressure rise per spool.

Contra-rotation is peculiar to the aft-fan layout (d) and is essentially more complex in concept and assembly, but not necessarily in manufacture. It eliminates as many stators as there are interspersed turbine stages, resulting in a smaller, lighter power unit.

Variable-pitch fan blades would probably be limited to the aft-fan arrangement. If adopted they could be adapted to work as speed and acceleration controllers, and as thrust-reversers in place of the conventional arrangement which, as already mentioned, becomes difficult with high by-pass ratios.

From the installation point of view the problems get increas-



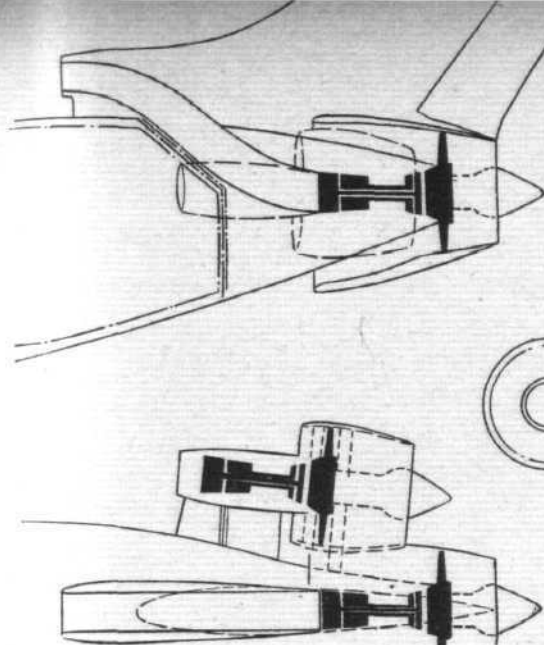


Fig 6 Three aft-fan high by-pass turbofans could be rear-fuselage-mounted as shown left. The centre-engine fan-intake forms an annulus around the fuselage and the gas generator intake is in the base of the fin. Reversible-pitch fan-blades, and deflectors in the efflux centre bullet, is a likely reverse-thrust arrangement

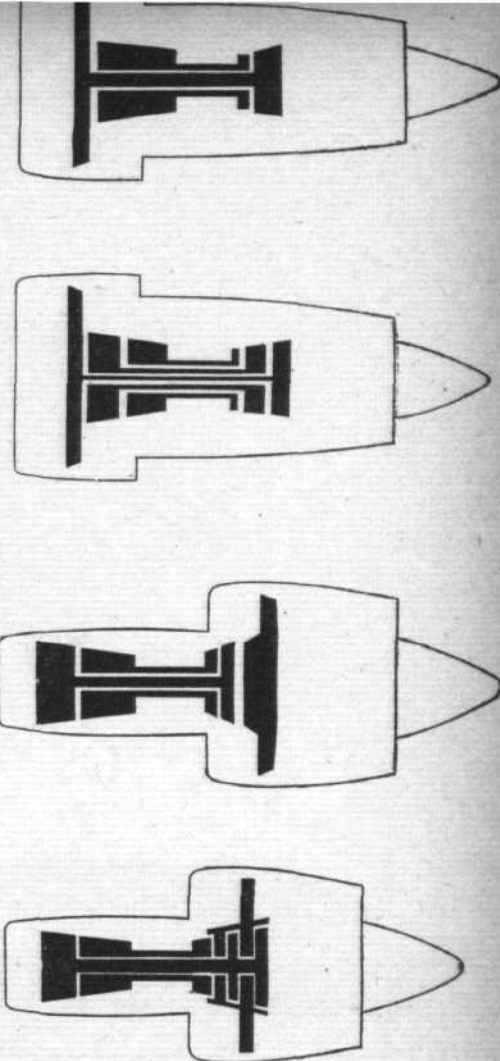


Fig 7 Diagrammatic arrangement of gas-generator and fan turbine rotating assemblies

ingly difficult with ascending by-pass ratios until integration can be introduced, whereupon both problems become easier and installed weight becomes acceptable.

Performance Under static conditions, thrust augmentation of the basic engine is 2:1 for a by-pass ratio of 4, and 2.6:1 for a by-pass ratio of 8. These quantities are reduced by about 60 per cent at 36,000ft and M 0.85. Specific fuel consumption improvement is, therefore, a reflection of the thrust augmentation (neglecting drag).

The fundamental altitude thrust-lapse of the by-pass engine can be turned to advantage when it comes to airframe matching. It is fortuitous that the thrust requirements for take-off and high-altitude cruise in a long-range high-subsonic aircraft approximate to the thrust available under those conditions from an 8:1 by-pass ratio engine running at its design point. For this reason such an engine would have an s.f.c. representing a lower ton-mile fuel cost than can be obtained with any other form of transport aircraft, regardless of speed.

Over short ranges (500 miles or so) high-by-pass-ratio engines must be matched to cruise—the thrust-lapse then provides a useful margin for take-off and climb. Any additional engine weight is balanced by reduced fuel consumption and the smaller wing area, at a by-pass ratio of around 5. Choice of a common ratio of 8:1 for both long- and short-range aircraft would incur a negligible weight penalty on the latter.

Economics Improving the fuel consumption of a long-range (3,000 miles or more) aircraft by 1 per cent is reflected in a similar drop in direct operating cost. But at 500 miles or so a 5 per cent improvement is still only worth 1 per cent d.o.c.

The installed fuel consumption of an engine with an 8:1 by-pass ratio and a 25:1 compression ratio is likely to be only 0.6lb/lb or 25 per cent better than present day engines. The actual gain in d.o.c. will appear to be even larger by reason of the increased passenger accommodation now being projected, itself made largely possible by the smaller aircraft resulting from the reduced fuel requirement.

From work already done there is little doubt that by careful installation, and possible integration of the engine and airframe, by-pass ratios of up to 8:1 can be used for high-subsonic transport aircraft. The development of such engines in America may well set a trend that will make low-ratio engines obsolete, and produce an economic revolution in air transport. It is also possible that these engines may go a long way to easing the noise problem. It is to be hoped that Britain will not lag too far behind America in the development and application of high-by-pass ratio engines to civil transports.

"JANE'S" 1965-66

THE largest yet number of editorial pages (533, including 1,200 illustrations, of which nearly 650 are new this year), plus a 25-page index covering the last ten editions, mark the 1965-66 edition of *Jane's All The World's Aircraft** (briefly referred to in our last week's issue). *Jane's* has long been noted for its coverage of Russian aircraft and missiles, and this year much information from official Russian sources is included. Seen for the first time are good photographs of the "Kennel" anti-shiping missile carried by the Tu-16, and a helicopter-borne missile. In all, there is information on nearly 40 different Soviet missiles and spacecraft, much of it never before published. Not forgotten are the spacecraft (both manned and unmanned) and missile activities of other countries; and this section, which includes comprehensive tables detailing US and Soviet space launchings since the last edition, is larger than before.

Hovercraft are well represented, and the predominance of Britain's lead in this field is reflected in the large proportion (well over 50 per cent) of this section which is devoted to British ACVs. The engine section, too, is well supported, and demonstrates the great interest which this active section of industry commands.

This edition again highlights the increasing effort which many nations are channelling into the development of drone aircraft for a number of purposes, and reflects the importance ascribed to these versatile and relatively inexpensive devices. As usual, the work is a mine of information on military and civil aircraft in general. Not surprisingly, the section devoted to the known airships of the world occupies less than a page.

Many joint design, development and production programmes are being undertaken by West European manufacturers; in reviewing them in his preface the editor, Mr John W. R. Taylor, warns that co-operation is beneficial only if projects are completely acceptable to all the parties concerned.

*Sampson Low, Marston & Co, Great Missenden, Bucks. Price £8 8s.



Which Hawker Siddeley Dynamics equipment

The equipment is T.R.A.C.E. — Hawker Siddeley Dynamics' Tape-controlled Recording Automatic Check-out-Equipment — and this is how it can halve an airline's spares.

In a typical airline, the maintenance staff will remove about two suspect autopilot computers (for example) from aircraft every week. They are not necessarily *both* unserviceable; in fact experience shows that usually only one is. The removed units then are subjected to testing, diagnosis, repair and re-testing.

Meanwhile two spare units have replaced them in the aircraft. Testing, repair and checking takes an average of three weeks, so that to cover every contingency the airline must have *six* spare units available. If, instead, the suspected units are checked immediately by a T.R.A.C.E. adjacent to the

aircraft, the faulty unit is readily identified and sent for repair, whilst the other suspect unit is cleared for service in less than thirty minutes and returned to the aircraft. Only one unit need be replaced and so spares are cut by half.

T.R.A.C.E. has many other benefits. As well as diagnosing a fault it can indicate exactly where the fault is and eliminate unnecessary circuit testing. Testing time is drastically reduced. So is repair time. And T.R.A.C.E. has a built-in safety-factor; before the machine tests anything, it tests itself and it does so again after it has tested the equipment.

Every day we discover a new application for Automatic Testing. Tomorrow we could have one for you. Why not contact us and find out?



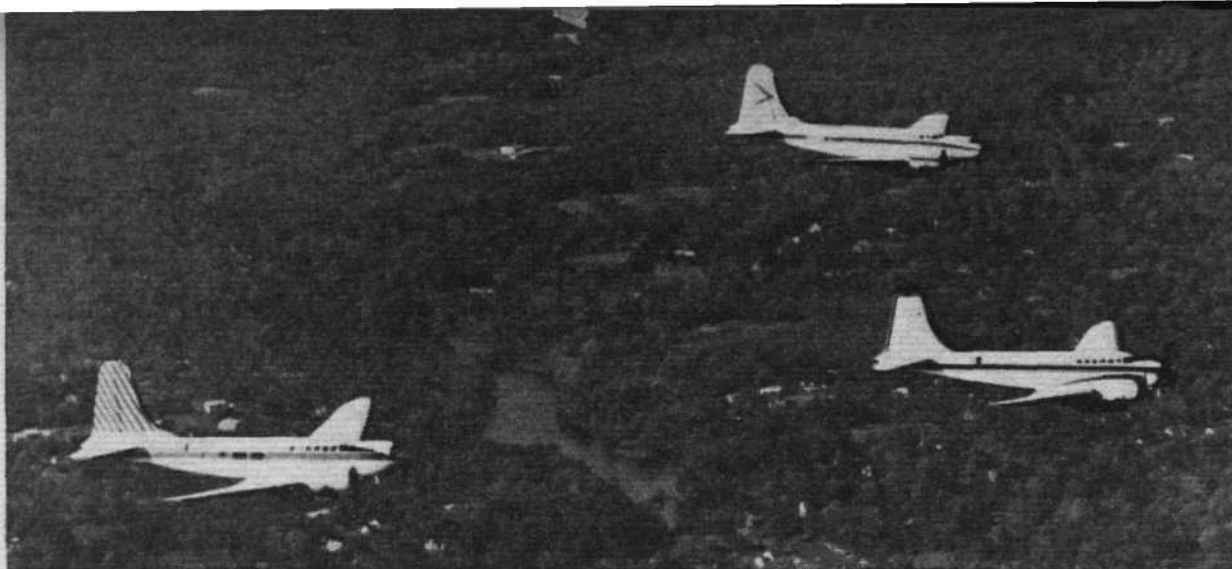
an cut an airline's spares by half?

HAWKER SIDDELEY DYNAMICS LIMITED

THE BIG NAME IN AEROSPACE



HAWKER SIDDELEY DYNAMICS LTD. Manor Road, Hatfield, Herts. Tel: Hatfield 2300. Manufacturers of missiles, rockets, a wide range of aerospace equipment and electronics. Other Hawker Siddeley companies supply aircraft, electrical power generation and distribution, locomotives, marine and industrial diesel engines, gyros and platforms for sea, land and air navigation, light alloys, agricultural equipment, tankers and refuellers and other general engineering products.



Three Douglas B-23 bombers, converted many years ago for business operations, recently formed for a last flight—from Westchester County Airport, New York, to East Hampton Airport, Long Island, flown by Starflite Inc ferry pilots. Mr Juan Trippe, president of Pan American, occasionally still uses a converted B-23

The Beech Boom In its thirty-third financial year, which ended on September 30, Beech Aircraft Corporation increased earnings 61 per cent over the previous year to over \$5.5 million (£1.95 million) on sales of \$122.5 million (£43.8 million). Although spaceflight and defence are rapidly expanding aspects of Beech activities, light aircraft still predominate in the company's affairs (\$74.3 million sales in the Fiscal Year 1965—an increase of 37 per cent over 1964; the \$20 million increase actually equals Beech total commercial sales in 1954).

Looking ahead, the company predicts total sales in all fields of \$140 million (£50 million) in the current year and a growth to \$200 million (£71.5 million) by 1970. A key factor in the increased tempo during 1965 was the benefit from the first full year of King Air selling. Production of this \$410,000 (£146,000) turboprop is running at 100 aircraft per year—over 90 have been delivered. This year's sales of the various models in the range break down as follows: Bonanza/Debonair and Musketeer, \$15 million (£5.4 million); Baron and Travel Air \$13 million (£4.65 million); Super H18, \$5 million (£1.8 million); Queen Air, \$12 million (£4.3 million). There are now 15 basically different types in the Beech range, from the new two-seat Sport 3 Musketeer through to the ten-seat King Air, compared with four in 1959. Beech export sales totalled \$17 million (£6.1 million) in 1965.

Piper's Profit Total Piper sales in the fiscal year which ended on September 30, 1965, reached \$69.1 million (£24.6 million)—a 27 per cent increase on the 1963-64 figure. The strike which began at Lock Haven on September 10 and continued until October 31 is estimated to have reduced the 1965 sales figure by \$2 million (£715,000).

Last month Piper were awarded a "Presidential E" for an outstanding contribution to the American exports drive. Since 1934—when Mr William T. Piper, 84-year-old founder-chairman of the company, sold four Cubs to Brazil—over 9,000 aircraft have been sent overseas. Export sales since 1960 have realised \$55 million (£19.7 million). In the year just ended, Piper exported 906 aircraft to a total of 91 countries for \$14.9 million (£5.3 million) together with spare parts worth \$1.4 million (£500,000).

Business Weather The FAA proposes to reduce landing minima for general-aviation jet aircraft, and others of over 12,500lb gross weight, to equal the lowest conditions permitted to commercial operators (Category 2). Provisos would be that airborne electronics built and serviced to Category 2 standards are carried and that pilots would hold a special rating. Requirements for the latter might include the demonstration of 90 per cent acceptable accuracy during 50 ILS approaches down to 100ft.

SPORT

AND

BUSINESS

If You Fly, Don't Drink The FAA is proposing to make it an offence for any pilot to operate an aircraft within eight hours of drinking alcoholic beverages. Measurable blood alcohol has been found during several autopsies performed on general-aviation pilots killed in flying accidents. FAA experience indicates that current rules, prohibiting the operation of aircraft by pilots under the influence of drink, are inadequate and difficult to enforce.

Better Bar and Briefing The Yorkshire Aeroplane Club has just opened a new £15,000 clubhouse at Leeds and Bradford Airport. The new premises house the pilot training section of Yorkshire Flying Services Ltd, and stand in the southern corner of the airfield. Facilities also include a large lounge and bar, a flight briefing room, and a Link trainer.

Britain's painfully inadequate arrangements for seaplanes were again highlighted on November 22 when Dr J. Gaston arrived from America in his Piper Cub floatplane. Attempting to find suitable water near Torquay, the doctor eventually landed on the Exeter Ship Canal at Topsham; the canal superintendent has ordered the removal of the aircraft. The journey from Maine was via New Brunswick, Quebec, Labrador, Greenland, Iceland and Holland



IN THE AIR

By Neil Harrison: Number 201 of the series

CESSNA SKYKNIGHT

(Two 285 h.p. Continental TSIO-520-B turbo-supercharged piston engines)

Span, 36ft 11in; length, 29ft 6in; wing area, 175 sq ft; fuel capacity, 85 Imp gal (standard) or 119 Imp gal (optional); basic empty weight, 3,220lb; empty weight as tested, 3,590lb; gross weight, 5,200lb; wing loading, 29.7lb/sq ft; power loading, 9.13lb/h.p.

Performance (owner's manual figures except where indicated) Maximum speed, 276 m.p.h. at 16,000ft; best 75 per cent cruising speed (at 20,000ft), 259 m.p.h. (254 m.p.h. observed); best 55 per cent cruising speed (at 25,000ft),

243 m.p.h. (225 m.p.h. observed at 20,000ft compared with a book figure of 231 m.p.h. at that height); stalling speed (clean), 86 m.p.h. (IAS); stalling speed (gear and flaps down), 76 m.p.h. (IAS); single-engine climb (gross weight ISA s.l.), 500ft/min; single-engine service ceiling (gross weight), 19,000ft; twin-engine service ceiling, 29,000ft; take-off to 50ft (gross weight, ISA, s.l.), 1,800ft; accelerate-stop distance (ISA, s.l., gross weight, engine failure at normal unstuck speed), 2,500ft; landing from 50ft (gross weight, ISA, s.l.), 1,710ft; maximum range (45 per cent power at 25,000ft, 221 m.p.h. TAS), 1,119 miles (std fuel), 1,570 miles (opt fuel).

CESSNA SKYKNIGHT

CAPABLE of cruising at over four miles a minute more than four miles high, Cessna's turbo-supercharged 1966 Executive Skyknight sets a challenging new peak of performance in the light-twin class. Most six-seaters in this category are clearly in line for turbine propulsion; but the development of such highly refined turbo-supercharged piston-engined aircraft as the latest Skyknight is making such changes ever more difficult to justify. From performance to comfort this last word from Wichita spans the gap between turbine- and normal piston-powered private and business light aircraft. Yet in price there remains a significant advantage for the reciprocator.

Two changes distinguish Cessna's 1966 Executive Skyknight from its outwardly similar predecessor: the installation of 285 h.p. TSIO-520-B Continentals in place of 260 h.p. TSIO-470-Ds; and the use of a new turbo-supercharger control unit designed to guard against inadvertent overboosting in any flight situation. Aircraft handling has come in for some attention too: elevator control circuit friction is halved; a bigger elevator trim-tab cuts the minimum trim speed; rudder travel is increased from 29° to 34° either side of neutral to improve engine-out control; and the engine thrust-line is 4° more nose-down to minimise trim changes with power variation.

Every Skyknight now has an automatic propeller synchroniser. Cabin silence and smoothness, already good, have been made outstanding by fitting double panes in the back three windows, and by the use of soft rubber engine-mounts together with sleek new cowlings built up from stretch-formed aluminium skins stabilised by bonded aluminium honeycomb blocks smoothed-off inside by glass-fibre panels. Other changes introduced with the new model include 50A alternators (in place of 13lb-heavier 25A generators); better oil filler and oil cooler locations; 16 Imp gal more fuel capacity, and improved fuel venting; slimmer window pillars; and entirely new styling inside and out. Empty weight of the basic 1966 Skyknight is actually 40lb less than before, despite the addition of even more standard equipment. Gross weight remains unchanged.

Ex-factory, the basic executive Skyknight costs \$79,950 (£28,550); the fully equipped factory demonstrator (N4102T), the subject of this evaluation, had about the equipment specification one would choose for an aircraft of this performance and, delivered in Britain new with the 14 per cent import tax and 10 per cent temporary import surcharge included, it would cost £49,000.

N4102T's £13,600-worth of extras weighed some 370lb. Electronics comprised a Nav-O-Matic 800 autopilot and a full complement of "Cessna-crafted" 500-series radio units. The latter included a 360-channel VHF transceiver, a VHF nav/com unit with built-in marker beacon receiver, a VHF nav/omni unit with glideslope, and an ADF (total 135lb).

A rubber-boot de-icing system was fitted to the wing and tailplane leading edges (42lb including detector light), and there were electric mats on the propeller blades (28lb). For

the ultimate in icing protection an electrically heated windscreen with gold filaments is on the list of options—this luxury costs £850 and, together with the thicker windscreen, adds 16lb to the empty weight. The three-bladed propellers on N4102T—alternatives to the normal two-bladers (33.9lb total weight increase)—give 1½in more ground clearance and are claimed to run more quietly; unfeathering accumulators (12lb) were also fitted. Two 33 Imp gal auxiliary fuel tanks (20lb total), an oxygen bottle (32lb) and a sixth seat completed the list of extras on this particular Skyknight.

My flight was from a very overcast and rainy Cranfield, whence Mr Jim Dale (Cessna's European twin-engine sales manager, based in Brussels) had brought the demonstrator for Rogers Aviation to show to potential customers in Britain.

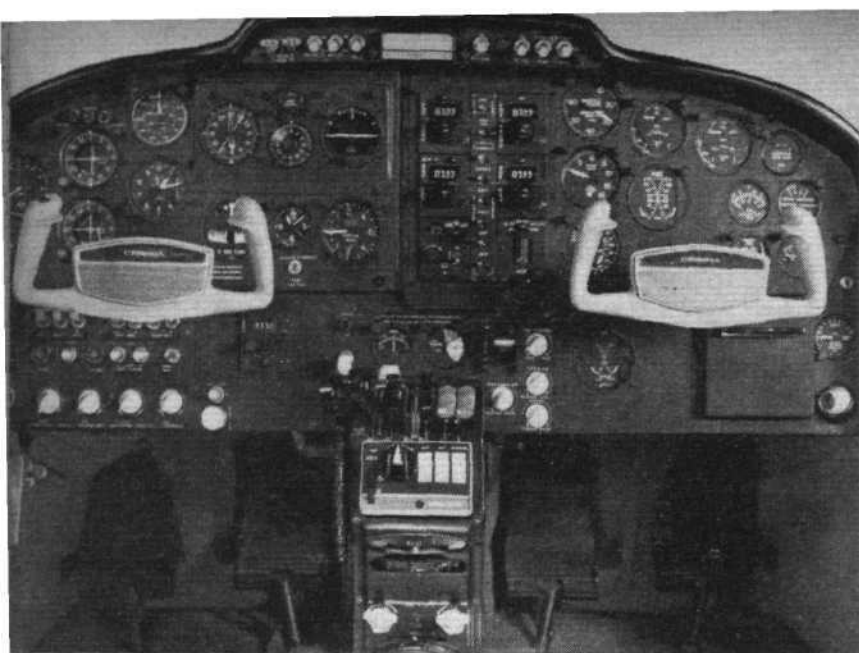
The aircraft stands quite high off the ground and the wing walkway is gained via an automatically retractable step; the single cabin door is quite long and the generous seat pitch makes it comparatively easy to reach the rear two rows. A baggage area right aft in the cabin is reached through a side hatch and by tipping forward the optional sixth seat. The convenient engine-cowling baggage nacelles are each big enough to take a full-length hanging suitcase in the opened-out position.

The fuel injection engines started easily from cold and 700 r.p.m. gave sufficient thrust for taxiing without recourse to frequent braking. Ground manoeuvring is greatly simplified when there is no need to worry about maintaining at least 1,000 r.p.m. or so for electrical power—at 700 r.p.m. the alternators provide power for electronics and services without any load on the batteries. The Skyknight rides smoothly and quietly on the ground and the nosewheel steering is light and precise.

"It's a bold new breed," the brochure reads, "... like a great jungle cat, all balance, beauty, grace and power." To see the Skyknight really perform one must jump high; to fly around

Three- instead of two-bladed propellers are optional on the 1966 Skyknight





Although this is not the instrument panel of the aircraft flown for this report the various equipment locations are the same. Radio controllers are central; the autopilot heading selector is between the artificial horizon and the RMI. A DME indicator dial is to the left of the ILS presentations. Engine and systems indicators are on the far right

CESSNA SKYKNIGHT in the Air...

at low altitude is as cruel as keeping a jaguar in London—and this certainly is no rooftop moggie. I was glad of the chance to try the lightweight oxygen system; the clear polythene-bag masks are increasingly common items of equipment in today's high-flying light aircraft. Until a low-cost pressurisation system comes along, face masks are going to be used a lot with turbo-supercharging now spreading right through to the four-seat single engined class. Pre-flight checks on the oxygen system consist of connecting all the masks into the overhead plugs and, with the master selector "on," ascertaining an oxygen flow indication by the coloured valves in the connectors. Other pre-flight actions on the Skyknight are similar to those for a normal twin.

The TSIO-520-Bs deliver their 285 h.p. all the way up to around 16,000ft or thereabouts, depending on ambient density, whereupon the new automatic ratio controller takes over and maintains a boost pressure of $2.2 \times$ ambient by controlling the exhaust waste gate to the compressor turbine. Overboosting at lower levels is prevented by an absolute controller set to work

"The high-flying Skyknight has a way of going almost like a jet..."



at 32in manifold pressure (previously 34in on the TSIO-470-D). A rate controller provides protection against slam accelerations.

According to Mr Bob Alter, Cessna's wholesale service manager in Europe, reliability of the turbo-charger automatic controller has been found excellent on this aircraft and on the similarly equipped Cessna 411. Heart of the controller is a simple spring-loaded servo working off pressures sensed in the inlet manifold.

A full run-up of the engines before take-off is not recommended by Cessna—only an intermediate r.p.m. magneto check. Oil temperature should be over 70°F for proper actuation of the exhaust waste gate controller. In very cold conditions, therefore, care must be exercised not to overboost the engine soon after starting. At our intermediate weight (two-thirds fuel and two-up), N4102T accelerated quickly, the recommended 90 m.p.h. rotation speed and 105 m.p.h. unstuck coming within a very few seconds of each other.

With only a moderate backward pull the Skyknight flew off easily and cleanly. We were cleared by Cranfield radar all the way to FL200 on a northerly heading, and the aircraft just felt as though it just could not help going up. With a comfortable 75 per cent power (2,350 r.p.m. and 29in, both maintained by the automatics without any need for progressive adjustment) the VSI showed over 1,300ft/min at 145 m.p.h. IAS—some 20 m.p.h. less would have produced nearly 2,000ft/min, according to the book figures for best rate of climb. With even the propeller synchroniser doing its stuff I was able to concentrate exclusively on hand-flying through the overcast.

Conditions generally were smooth. Without previous experience of Cessna 310s or Skyknights I would not care to comment on the relative stability and control characteristics of the latest aircraft. Yaw disturbances produced by prodding the rudder did reveal neutral stability, and the powerful rudder and high yaw inertia due to the tip-tank layout combined to give a lively response. Roll and pitch control are nicely harmonised, light and powerful.

As we donned our face masks at 10,000ft the Skyknight was still furiously climbing—20,000ft was reached without any special effort in hardly more than 16min from brakes-off. The only engine adjustments needed during the climb are to trim the fuel flow and to adjust the cowl flaps (just visible) to maintain cylinder temperatures.

Level at FL200 and 75 per cent power (max cruise conditions) produced 189 m.p.h. IAS to give a fully corrected TAS of 254 m.p.h. This observed performance compares with a book figure of 259 m.p.h.—a figure which, given enough time to accelerate, might have been achieved. A 55 per cent power setting gave 165 m.p.h. IAS (225 m.p.h. TAS)—compared with a book TAS of 231 m.p.h. The owner's manual for the aircraft contains nicely arranged cruise performance tables. For three r.p.m. settings and five manifold readings in each case, and for every 5,000ft up to 25,000ft, they give TAS, total endurance and range with full fuel in still air and standard atmospheric conditions. To achieve maximum range the Skyknight is flown at 25,000ft and 45 per cent power; even so, the TAS is no less than 221 m.p.h. The aircraft has an absolute range of over 1,500 miles, subject to oxygen capacity—a factor which is discussed later in this report. With Cranfield chivying us because it was getting near their lunch hour, one became conscious of the time needed to achieve pre-determined engine settings. There is a certain lag while things balance out in the supercharging cycle—the propeller synchroniser is a real boon to quiet operation.

With ten minutes to closing time and N4102T still at 20,000ft there was no opportunity for single-engined or low-speed handling. In view of Cessna's efforts to improve the type in these respects I was sorry to be cheated of a chance to see how effective things had been. According to the book performance figures the stall occurs at 76 m.p.h. IAS at gross weight with the gear and split flaps fully lowered. Clean, the figure is 86 m.p.h. Single-engine book performance tables quote a very creditable best sea-level rate of climb, at gross weight, of 500ft/min, and a single-engine ceiling of no less than 19,000ft. With both engines going the Skyknight has a 29,000ft-plus service ceiling.

One advantage of the circumstances was that I was able to see how quickly the Skyknight goes downhill—even faster

Concluded on page 1017

IN THE AIR *Number 202 of the series*

SIAI-MARCHETTI S.205

This "In the Air," and the assessment of the Partenavia Oscar overleaf, also constitute Parts 3 and 4 of Neil Harrison's "Made in Italy" series of articles; Parts 1 and 2 appeared in the issues of November 11 and 18. The fifth article appears on pages 1013-1014

A COMPANY with one of the oldest names in Italian aviation, SIAI-Marchetti, has ambitious plans for starting a sizeable light aircraft manufacturing adjunct to its existing diverse aeronautical and general-engineering activities. Under Dr Ing Paolo Barbaro, the company has built two prototypes of an all-metal four-seater, the 180 h.p. S.205, which is to form the basis for a range of single-engined types with more powerful engines and retractable undercarriages. There are also plans for a light twin-engined version to be known as the S.210.

For many years SIAI-Marchetti has been a subcontractor to Fiat, making parts for G.91s and F.104s, while the big hangars at Vergiate (built in the 1930s to house seaplane and bomber production) have been filled with Fairchild C-119s undergoing overhaul for the Italian Air Force. Light aircraft activities started several years ago when a licence to build the Riviera amphibian was signed with Nardi, but that programme has slowed with the need for more powerful engines. This is a difficult market to establish and it is not certain whether demand for the improved amphibian would be worth the expense of a re-engining. The second light aircraft venture was the building of an all-metal three-seat fully aerobatic version of Stelio Frati's beautiful Falco design. This latter aircraft, the SF.250, is being put into limited production for the highly specialised market that puts a premium on fighter-like qualities and which also buys Ferrari motor cars. The SF.250 sells for £8,400 ex-works.

Having thus played with two specialised aircraft, SIAI-Marchetti last year turned to something with a little bit more of a bread-and-butter flavour. The S.205, of which the prototype flew earlier this year, is a bold attempt to win a share of the lucrative low-price single-engine four-seat market, of which Piper with the Cherokee and Cessna with the Reims-built F.172 are capturing the lion's share in Europe. Production jigs are largely completed and components for the first 12 aircraft are well under way; materials and engines have been ordered for 50 aircraft. Initial production will be concentrated on the 180 h.p. Lycoming O-360 version with fixed undercarriage, which is being offered at the very competitive price of £4,800 ex-works. When *Flight* visited Vergiate at the end of September we were told that ten S.205s would be delivered this year and 40 by next April; by September 1966 the production rate is expected to be 18 aircraft per month. A 210 h.p. Rolls-Royce

With planned versions of the S.205 having up to 285 h.p., six seats and retractable undercarriages, the basic 180 h.p. aircraft has one of the widest cabins for its size. There is ample panel space for IFR equipment, and a deep interior permits two stretchers to be carried one above the other. The interior has been styled by Pinin Farina



Italy's challenge to American domination of the European market for popular four-seaters is the SIAI-Marchetti S.205. Powered in initial form by a 180 h.p. Lycoming O-360, the spacious S.205 cruises at 134 m.p.h. on 75 per cent power

Continental IO-360 version is to be flight tested this autumn together with the retractable undercarriage modification. There are plans for a version with a 285 h.p. Rolls-Royce Continental IO-520 engine.

SIAI-Marchetti's approach to the problem of keeping down the cost of the S.205/S.210 range has been to keep the number of structural components to a minimum and to arrange the maximum degree of interchangeability between the versions. The wing is a semi-monocoque structure with the honeycomb-stabilised skin panels taking a large proportion of the end loads due to bending. There are only five ribs in each half-wing and the three spars are virtually only shear-webs. The laminar section straight-tapered wing has 2° of washout and the problem of two-dimensional skin curvature has been avoided by employing eight panels per side. The half-inch-thick honeycomb is bonded to the panels before assembly to give a very smooth, stiff skin. Wings for all versions incorporate the cut-outs and attachment points for a retractable undercarriage, which can be incorporated retrospectively for £700. The fuselage is a simple frame and stringer box structure with single-curvature panels. Empennage components are of conventional design and fully interchangeable (fin-tailplane and rudder-elevators). There are fewer than 1,200 different parts making up the aircraft and less than 1,000 man hours per aircraft is the production target.

The S.205 has just about the biggest cabin of any aircraft in its class. The width is enough for three adults to sit side-by-side on the rear bench seat and one can actually squeeze through the space between the front seats. Headroom too is, if anything, over-generous and gives the impression that the aircraft must carry a lot of unnecessary drag. A lengthened version with another row of seats and, say, a 285 h.p. engine could easily carry seven people.

Climbing on to the wing of the second prototype (I-SIAA) to go aboard produced a strange squeaking from the honeycomb panels as though SIAI had left all the bees inside; production models will be foam stabilised in this region. The sill is quite low and the aircraft was found to be easy to enter. A number of small items such as the control wheels, throttle knob and door handle, are standard Beechcraft parts, otherwise the interior style and finish is not up to the usual Pinin Farina standard. It struck me as an excellent principle to employ a leading motor industry coachbuilder to style the interior, since they generally know a good deal more about aesthetics, ergonomics and so forth than do most aeronautical engineers; but one expects to see something a little more advanced on production S.205s.

As expected, the S.205 proved to have a cruising speed somewhat below average for the power; 2,400 r.p.m. and 24in (75 per cent power) gave only 125 m.p.h. IAS at 2,000ft. However, stability and control are nicely harmonised for what is essentially a touring aircraft; the ailerons are pleasantly light and powerful without adverse yaw, and heading stability is positive. The all-round visibility is excellent and the cabin noise level at normal power setting is pleasantly average.

The slotted flaps, though small in chord, are quite powerful and cause quite a marked trim change. From a full flap, power-off, glide situation to a full-power overshoot without retrimming, the pilot must exert quite a hefty forward push on the control wheel to maintain airspeed. The flap lever is also quite heavy to operate in an age when most manufacturers

Concluded on page 1017



Of conventional appearance and construction, the Partenavia Oscar nevertheless combines good performance and low price; but the accommodation is fairly tight

IN THE AIR *Number 203 of the series*

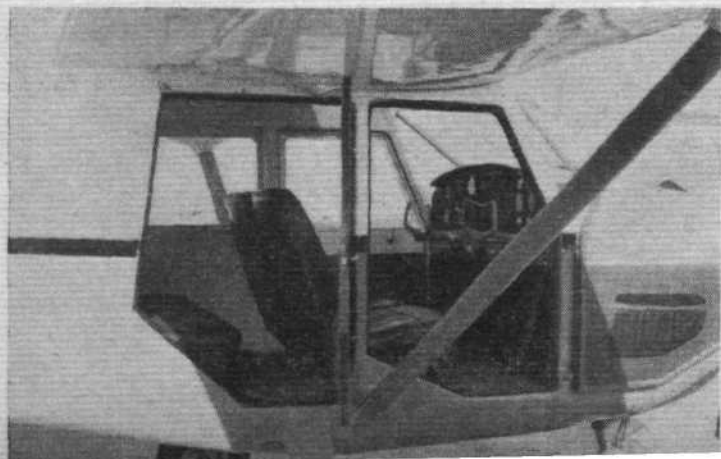
PARTENAVIA P.64 OSCAR

OVER the last two years the tiny Naples company Partenavia has built some 40 P.57 Fachiro III high-wing touring four-seaters. Most of these clean little aircraft were sold to Italian aero clubs and so the company's products are not widely known outside Italy. However, with a new and improved version of the Fachiro III known as the P.64 Oscar, Luigi Pascale, chief designer and director of the company, hopes to start making export sales. In common with all sections of the Italian aircraft industry, Partenavia looks south of Europe to Africa for the biggest export possibilities.

Apart from the Fachiro III—which, incidentally, achieved fame by coming second in the Tour of Sicily Air Race on several occasions—and the P.59 two-seat Jolly, the Partenavia factory's main source of income has been in the design and construction of mechanical handling equipment for brick works. Signor Pascale, who is also a lecturer in aeronautics at Naples University, first built an aircraft (a modest two-seater rather like an early Cub) just after the war. His other ventures have ranged from a hot little two-seat racer which did over 200 m.p.h. on 150 h.p., to the Sea-sky sailplane designed for towing behind a speedboat. This latter device ended its days powered by a Citroën Ami-six engine.

The main features of the P.64 Oscar are a good performance (over 150 m.p.h. cruise) at a reasonable price (£4,870 ex-works), and a simple structure designed for cheap and easy repair. The comparatively good performance for such a

An unusual feature for an aircraft of this size is the generous number of access doors—two to starboard and one, for the pilot, to port. Although the cabin is narrow there is enough panel space for full IFR instrumentation



general arrangement results from much care in achieving a clean external finish. The laminar-flow wing has an accurately formed single-piece glass-fibre leading edge, with integrally moulded ribs in the same material, back to 35 per cent chord, where it bolts on to a light-alloy torsion box. The slim mild-steel tube fuselage has a hard smooth covering of glass-fibre fabric treated with butyrate paint in accordance with the Razorbach technique. Interior accommodation of the Oscar is a little tight with four grown men aboard, but a generous number of doors make for easy access; an enlarged cargo door will be offered on production aircraft. Also planned to fly next summer is the P.65 Oscar Six, with a longer fuselage, an additional row of seats, and a 230 h.p. Rolls-Royce Continental O-470-R.

An initial production run of ten Oscars powered by 180 h.p. Lycoming O-360s is being laid down. Airworthiness certification by the Italian Aeronautical Registry is expected early next year when a demonstration tour of Africa will be made to appoint agents. The aircraft may also visit Britain in the spring for the same purpose.

In a short flight from Naples' Capodichino Airport, where Partenavia assembles aircraft in a nearby factory, I found the Oscar quite fast for its power within the limitations of its overall shape. Handling at normal speeds is pleasant; the aircraft has a good rate of roll for a moderate effort and neutral heading stability. However, the all-flying tailplane transmits quite large out-of-trim forces over the range of flap and power settings at low speeds, and trimmer gearing is such as to require quite a lot of tweaking on the wheel to take-up the load on, say, a full-flap overshoot. Another feature which made me think that this was a man's aircraft was the barbaric strength needed to pull the flaps down and to twist the handle to latch; we all had one heartstopping moment during stalls when the catch slipped and the flaps flew up with a tremendous bang. The prototype also displayed quite a severe wing drop at the stall; the designer assured me that plans were in hand for these shortcomings to be rectified on production aircraft.

PARTENAVIA P.64 OSCAR

(One 180 h.p. Lycoming O-360-A1A driving a Hartzell constant-speed propeller)

Span, 33ft; length, 23.4ft; wing area, 144sq ft; fuel tank capacity, 44 Imp gal; basic empty weight, 1,430lb; gross weight, 2,420lb; wing loading, 16.8lb/sq ft; power loading, 13.45lb/h.p.

Performance (claimed) Maximum speed, 168 m.p.h.; cruising speed (75 per cent power) 155 m.p.h. TAS at 7,000ft and 8.6 Imp gal/hr; cruising speed (65 per cent power), 145 m.p.h. TAS at 11,000ft and 7.5 Imp gal/hr; stalling speed flaps down, 64 m.p.h. IAS; take-off ground run, 850ft; landing ground run, 500ft

With a structure designed for cheapness and simplicity (glass-fibre and mild-steel are not the best materials from the strength-to-weight point of view) the useful load naturally suffers somewhat. When I flew the prototype there were four people on board (730lb) and half fuel (22 Imp gal, 160lb) leaving enough disposable load for 100lb of luggage, fuel or extra equipment. Following take-off at 100lb under gross, the Oscar climbed at almost 1,000ft/min on full power and at a forward speed of 165km/hr (103 m.p.h.)—quite spritely considering the highish span- and wing-loading. Full-power in level flight gave a good 253km/hr. IAS at 1,500ft (over 160 m.p.h. TAS). A typical cruise setting of 2,400 r.p.m. and 24in (approximately 75 per cent power) returned 142 m.p.h. TAS; nearer the engine's full throttle height this power setting is claimed to give 155 m.p.h. At the best-range setting of 65 per cent power the Oscar is claimed to cruise at 145 m.p.h. at 11,000ft and this would give a dry-tanks range, starting with full fuel, of 900 miles (fuel consumption 7 Imp gal/hr).

Good big slotted flaps give the Oscar a potentially steep approach gradient. Power off and with full deflection, I-LRAS went downhill at 1,800ft/min at the recommended approach speed of 130km/hr (81 m.p.h.). The stalling speed in this condition was 80km/hr IAS (50 m.p.h.) with quite a sharp wing drop of about 40°. The brochure claims 64 m.p.h. in this condition, which would appear to be unduly pessimistic even allowing for the known big position error. In any case the stalling speed is comparatively high. The aircraft has been spun during the course of development trials but it is not planned to have this ability written into the initial C of A: Signor Pascale said that it would be if flying clubs demanded it for training.

NEIL HARRISON

Made in Italy—Part 5

AERONAUTICA MACCHI MB.335A

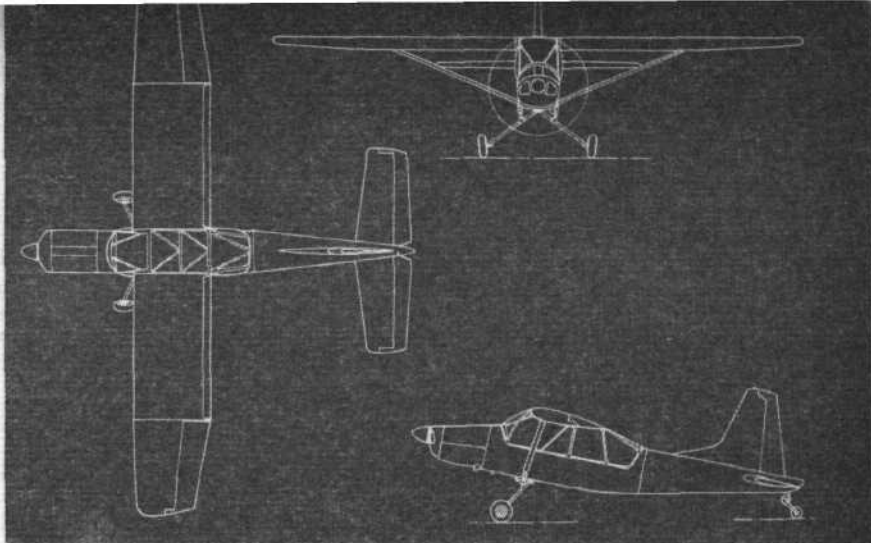
By NEIL HARRISON

NOW being built, and to fly in the spring, is the first prototype of the Aeronautica Macchi MB.335A (previously referred to as the AM-3) STOL aircraft for battlefield surveillance. Forming its basis are the wings, tailplane and fin of the six-seat AL-60 Santa Maria, of which the company has just completed building 100 under licence from Lockheed. The MB.335A will have more power than was ever applied to production Santa Marias—namely, a turbo-supercharged 340 h.p. Rolls-Royce Continental GTSIO-520-C. An entirely new three-seats-in-tandem fuselage with large upward-opening side doors has been carefully proportioned to be just big enough for a wide range of military applications. Advantages of the narrow fuselage include the best possible downward view and the lowest aerodynamic drag.

The MB.335A is being proposed to the Italian Army; and Aeronautica Macchi are working in close collaboration with the Government-owned Aefer organisation, who will build fuselages if the type is ordered into production. In view of current American interest in this kind of aircraft for the MAP in various parts of the world, the MB.335A will have a good claim to consideration.

It has three external load-attachment points: outboard of the strut attachment beneath each wing, and also under the fuselage centre-section. The very wide range of loads envisaged are listed in the diagram on page 1014.

Excellent airfield performance throughout a wide range of climatic conditions is a feature. The geared and turbo-supercharged 340 h.p. engine, turning a three-bladed propeller, will deliver its rated power up to 16,000ft. With large-area Fowler flaps the take-off distance to 50ft at 10,000ft airfield altitude

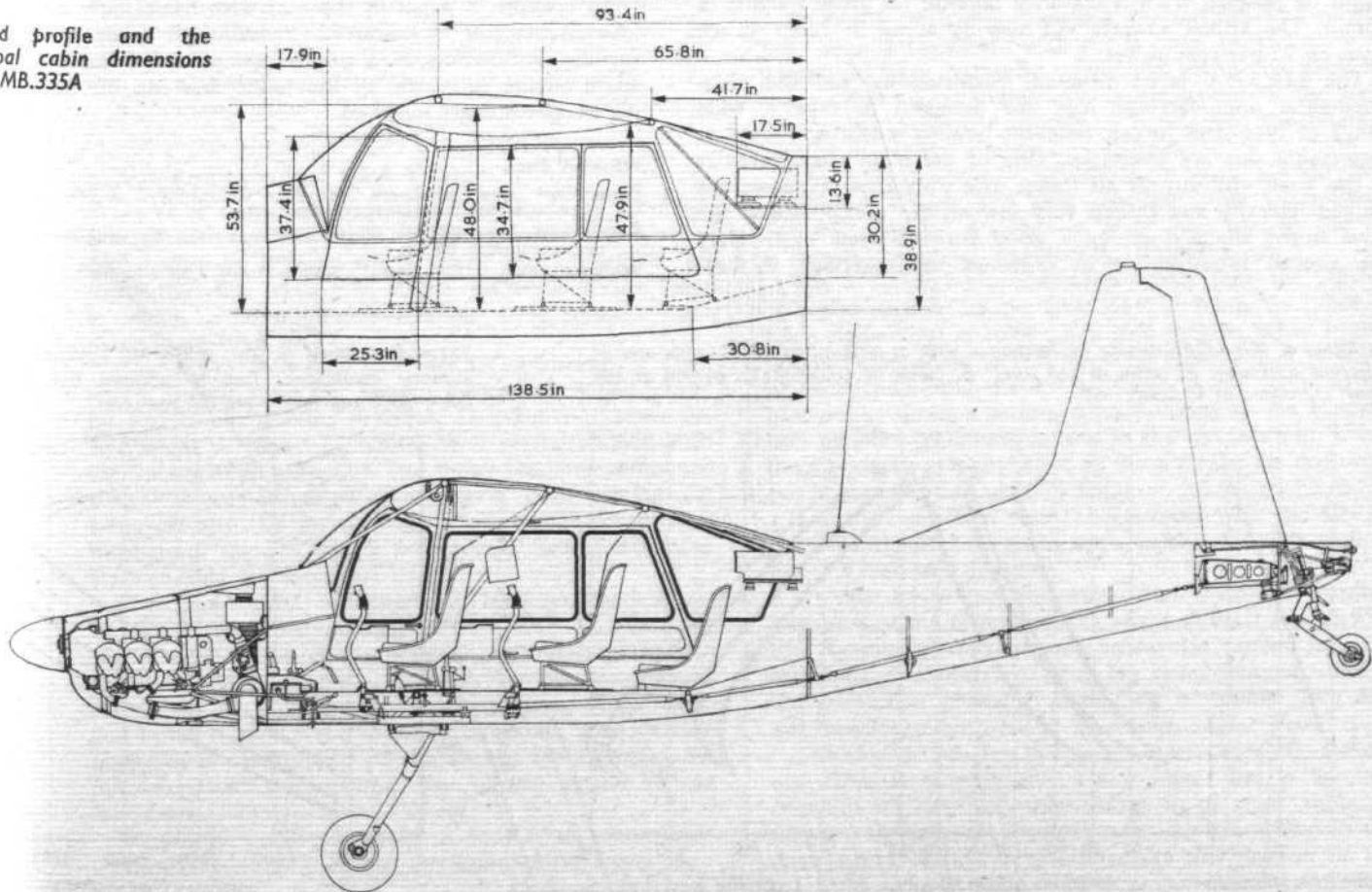


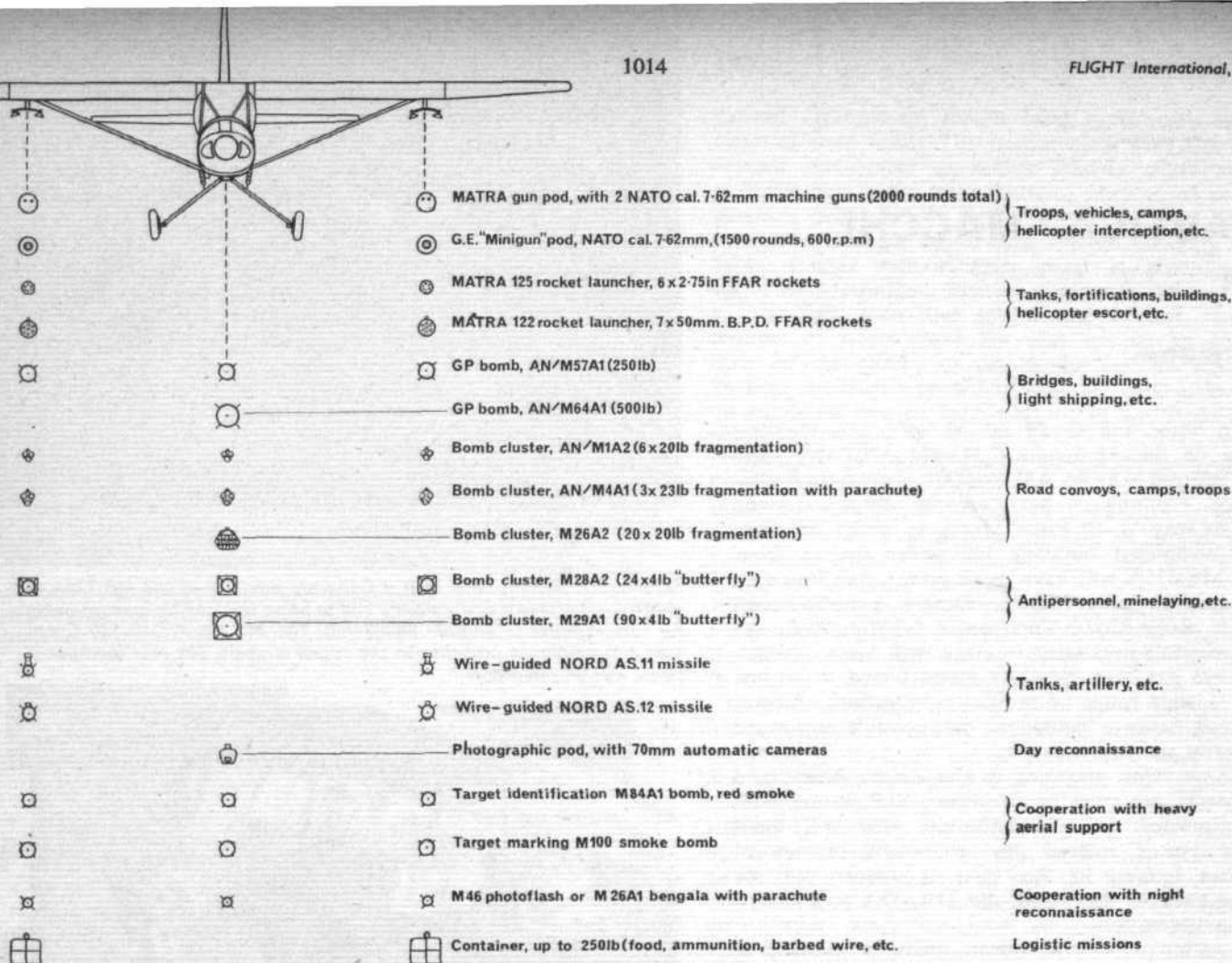
MB.335A general arrangement drawing

Aeronautica Macchi have built a full-scale mock-up of the MB.335A to check cockpit layout and visibility and to prove the loading arrangements for various items of military equipment. The 340 h.p. GTSIO-520-C will turn a three-bladed propeller on the actual aircraft. The rear instrument panel will be removable



Inboard profile and the principal cabin dimensions of the MB.335A





A wide range and combination of military loads are planned for the three external load-points on the MB.335A

MADE IN ITALY . . .

is less than 250yd (at sea level it is under 200yd). Climb performance is equally good; with any of the external load combinations the service ceiling is no less than 26,900ft—which could be reached from a sea-level take-off (at gross weight) in 35min. The armed aircraft will also fly at up to 120kt at sea level on 75 per cent power.

The MB.335A is of all-metal construction, and the oleo-pneumatic undercarriage legs are designed to take a wide range of tyre sizes to suit different landing surfaces. Floats or retractable skis are envisaged. One of the main characteristics is the good visibility at all times. The Plexiglass windows are bulged laterally and extend very low on the cockpit sides; the nose slopes sharply, giving a good forward view even when the aircraft is sitting on its tailwheel undercarriage. A full-

scale mock-up has been built at Varese to check the installation of the planned military equipment, and also to prove the cockpit arrangement.

The three-seat cabin can be arranged to take a stretcher in place of the rear two seats. The main flight station is the front cockpit; a panel in the rear with basic flight and engine instruments can be removed. Provision is made in the floor for the installation of a photo-reconnaissance camera, and a spare engine is typical of the loads that can be carried with the two back seats removed.

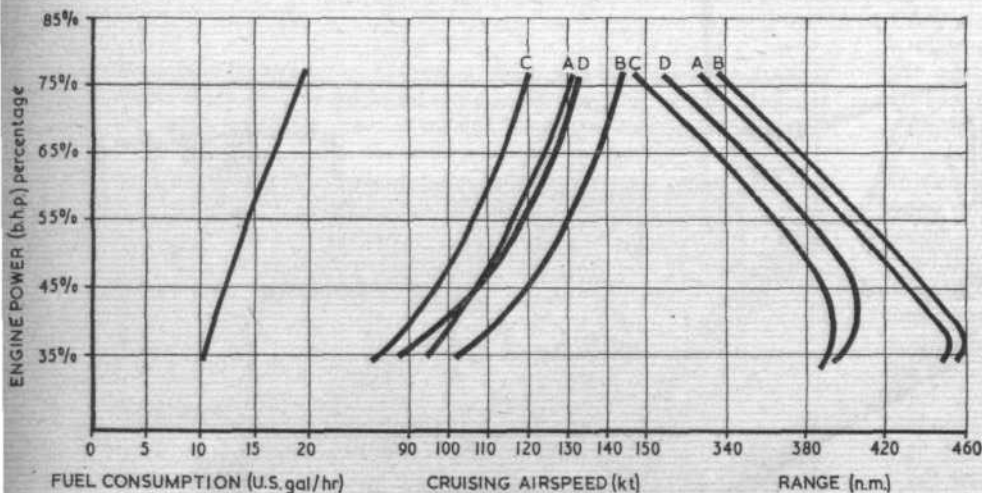
MB.335A Data

Powerplant One Rolls-Royce Continental GTS10-520-C of 340 h.p. driving a three-blade 88in diameter Hartzell propeller.

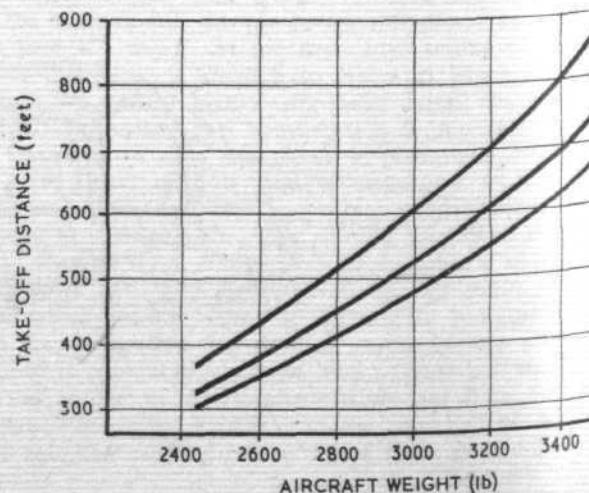
Dimensions Span, 38ft 6in; length, 28ft 8in; height, 9ft; wing area, 205 sq ft; mainwheel track, 8ft 7in.

Weights Empty, 2,050lb; gross, 2,976lb (normal), 3,307lb (armed).

Variation of MB.335A cruising performance with or without external loads and at different altitudes: A, clean at sea level; B, clean at 10,000ft; C, armed at sea level; D, armed at 10,000ft



Take-off distance to 50ft of the MB.335A under three climatic conditions: (top to bottom) ISA 10,000ft; ISA + 20°C sea level; and ISA sea level



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.

What the Industry Does—and How

SIR,—“All that's wrong with British aviation is that Parliament . . . has no effective say whatever in how the money is going to be spent.” (Straight and Level, in your issue of November 25.)

I am sure that Roger Bacon would not want such a sweeping statement to be taken too seriously; but, even so, there is a danger in making it. The danger is that it will prolong the day when one of the most fundamental problems of the aircraft industry will be generally recognised.

This problem is that few people, when talking about the aircraft industry, make a distinction between *what* work the industry does and *how* it does the work. An essential part of the solutions to the time-and-cost-control problems which exist will be a real enthusiasm for the best way of working, at all levels—an enthusiasm which is largely lacking at present. It will not come at the wave of a magic wand: a concentrated and well thought-out effort will be needed to produce it.

That there is less interest in Britain than in many other Western countries in the way of working is evidenced by the relatively small effort expended on business schools, management techniques and training, etc. Therefore the aircraft industry, being a “frontier” one, is feeling the draught harder than some others.

May I suggest that *Flight* could make a handsome contribution here by devoting some space on a regular basis to the problems and techniques of management, with particular reference to the world of aviation?

Walton-on-Thames, Surrey

D. C. MCDOUALL

British Equipment in FAA Trials

SIR,—Your news item reporting the award of an FAA contract to Lear Siegler for designing and testing a zero-zero automatic landing system (page 882, November 25) states that this work will be an extension of the trials in which 1,000 automatic landings have already been made in an FAA DC-7.

It is worth recording that this DC-7 aircraft is fitted with a British automatic landing system developed jointly by BLEU and Smiths Aviation Division and based on equipment produced by Smiths used in conjunction with the Sperry SP20 autopilot. The many landings completed with this single-channel system have been carried out using existing ILS installations at more than 50 airfields throughout the US, and it is reported that results have been entirely satisfactory.

The grand total of automatic landings carried out by Smiths-equipped aircraft is now well in excess of 15,000. Autoflares and autolandings completed in HS Trident G-ARPB as part of the development programme for the Smiths multiplex automatic landing system specified by BEA now run into many hundreds. The ultimate objective is certification of the system for Category III operation and introduction into airline service in the late 1960s.

Wembley,
Middx

S. SMITH & SONS (ENGLAND) LTD,
J. S. Rivaz, Divisional Sales Manager,
Aviation Division

Bristol Boxkites preserved

From Air Cdre A. H. Wheeler, CBE, MA(Cantab), FRAeS

SIR,—Those interested in aviation history, and particularly those who have seen the Twentieth Century Fox film *Those Magnificent Men in Their Flying Machines*, will be pleased to hear that through the generosity of the Bristol Aeroplane Co the two Bristol Boxkite replica aeroplanes which were used in the film will now be preserved in two British museums. One will appropriately go to the Bristol Museum; and the other one, still in full flying order, will go to the Shuttleworth Trust Collection on Old Warden Aerodrome.

Both these replicas were constructed accurately to the original design from records obtained from the Bristol Aeroplane Co. Only the engine installation in the flying Boxkite differs from the original: it is hoped to obtain a true period rotary engine for the Boxkite which will go into the Bristol Museum.

Twyford, Berks

ALLEN WHEELER

Jet Noise and Politics

SIR,—Reading Sensor's column for November 18, a thought occurred to me. Can Sensor be certain that the jet noise around Heathrow is not the reason for the marginal nature of the constituencies surrounding the airport? Incidentally, I have no axe to grind!

London N7

D. W. B. FAY

The Islander's Powerplant

SIR,—Among the various points brought out by the reports on progress with the Britten-Norman BN-2 Islander which appeared in the issues of *Flight* dated September 23 and 30 was the failure of the prototype aircraft to come up to expectations in respect of single-engined performance.

Although a drag problem was also involved, it was perhaps understandable that much early suspicion should fall upon the two Continental IO-360-A engines, particularly as they were apparently not achieving a manifold pressure of more than 27in Hg at the maximum crankshaft speed of 2,800 r.p.m. The IO-360's maximum power is developed at a manifold pressure of 28in Hg.

Rolls-Royce, having supplied the engines and having been closely associated with the Islander project since its inception, were naturally concerned about the problem and undertook an immediate investigation. In the light of the two published articles, it is felt that the findings will be of general interest to your readers.

The subject of the investigation was IO-360 No. 10418-4-A, which had been removed from the aircraft for the purpose. A series of tests were carried out on a dynamometer testbed under ARB observation.

The Continental specification states that the IO-360 will give within 2.5 per cent of 210 b.h.p. (i.e., 204.75 b.h.p. minimum) at 2,800 r.p.m. full throttle, when inspiring and exhausting at ISA sea-level conditions. Corrected to these conditions, the test engine gave 208 b.h.p. at the best power mixture setting corresponding to the metered fuel pressure recommendations in the specification. Using the air intake actually fitted to the aircraft, the corrected power was reduced to 206.5 b.h.p.

The next problem was to determine why the BN-2's instrumentation had given apparently unreliable indications of manifold pressure.

At 208 b.h.p. the corrected total manifold pressure measured at the same point as in the aircraft was 26.95in Hg. By probing the pressure sensor 1in farther into the manifold a reading of 28in Hg was obtained, and a 2in protrusion produced a reading of almost 29in Hg. All these readings were at maximum engine power.

The explanation for this range of readings taken from one external tapping at constant power lies in the fact that the IO-360 inlet manifold is, in plan, of W form, and the tapping was located under the apex. Due to the firing order, airflow reversals across this portion of the manifold occur at the rate of three per engine revolution,

LETTERS ...

resulting in local breakaway and a consequent low pressure in the region of the tapping.

Britten-Norman had two means of assessing engine power—crankshaft speed and manifold pressure. At maximum power, constant-speed propellers ensured that the specified 2,800 r.p.m. was readily maintained, so in practice only the manifold pressure reading was any real guide. The Rolls-Royce investigation has shown that the siting of the manifold pressure sensor was giving a false reading and, as a result, misled the BN-2 flight engineers. In fact, the engine was giving a power output well within the design specification.

Derby

A. I. FENWICK

Manager, Public Relations,
Aero Engine Division, Rolls-Royce Ltd.

SIR,—We are pleased that recent calibration by Rolls-Royce of one of the Continental IO-360s fitted to the prototype Islander has revealed that the unit produces its brochure power.

Our doubts concerning its power when used with our intake arrangement occurred because the standard manifold pressure tapping arrangement supplied produced an under-reading of 1 in Hg.

To complete the record, we would like to state that in the Islander the IO-360s performed very smoothly and completely reliably throughout many hours of full-throttle work and proved very easy starters both on the ground, hot or cold, and after unfeathering in the air.

The power-to-weight ratio of these engines is as good as that of any reciprocator in the business, and we hope that we shall in time be able to develop drag and weight reducing refinements to the airframe which will permit us to offer the machine fitted with the Rolls-Royce Continental IO-360 as originally planned.

Bembridge, IoW

N. D. NORMAN,

Director, Britten-Norman Ltd.

BIATA Non-scheduled Operations

SIR,—In your issue of November 18 you commented on the BIATA annual report for 1964-65 and referred to the absence from that report of the usual tables showing the non-scheduled operations (excluding inclusive-tour charters) of BIATA members. As you correctly surmised, the reason for the omission of this table was because to have published it in its usual form would have required so much qualification as to make its value doubtful. However, I have had a table prepared, which shows a comparison over a period of three years of the non-scheduled traffic carried by BIATA members, with the Air Holdings Group companies excluded and also Britannia Airways, which did not join the Association until 1964.

H. C. BRILLIANT,

London SW1

Secretary-general, British
Independent Air Transport Association

(The table is reproduced on page 1001 of this issue—Ed)

That Iced Trident

SIR,—Mr Robert Blackburn, who writes your column on the Press, regularly makes very obvious his dislike and contempt for most of the Press and for journalists and the way we work.

I was lucky enough, journalistically, to be on board the BEA Trident which was iced-up at Schiphol recently. It was undoubtedly my story to my news agency which was the cause of Mr Blackburn's biting comments in your issue of November 25 and I feel I must write to cross swords (or should it be pens?) with him.

Whatever Mr Blackburn may think, this was not an "everyday, unexciting event." A number of circumstances conspired to lift it out of the mundane—not merely the way I wrote it.

The weather conditions were appalling—exceptional for

DIARY

- Dec 9** RAeS: 54th Wilbur and Orville Wright Memorial Lecture, "The Well Balanced Structure," by Sir Alfred Pugsley, 6 p.m. (preceded by presentation of annual awards).
- Dec 9** RAeS Southend Branch: Film show, Aviation Traders (Engineering) Ltd, Southend Airport, 5.45 p.m.
- Dec 9** Institute of Transport (West Middlesex Group): "The Small Airline in International Air Transport," by W. J. Anson. BEA Training Centre, Southall Lane, Southall, 6.15 p.m.
- Dec 10** Society of Licensed Aircraft Engineers & Technologists: "The Development of Autoland Systems," Manchester.
- Dec 13** Institution of Electronic and Radio Engineers: a.g.m. 9 Bedford Square, London WC1, 6 p.m.
- Dec 13** RAeS Bedford Branch: a.g.m. and films. Bridge Hotel, 7.45 p.m.
- Dec 14** RAeS Air Law Group: "Practical Noise Control at International Airports, with Special Reference to Heathrow," by F. C. Petts, 6 p.m.
- Dec 14** RAeS Boscombe Down Branch: "The Channel Tunnel," by J. Hood. A & AEE Lecture Hall, 5.30 p.m.
- Dec 14** RAeS London Airport Branch: a.g.m. (6 p.m.), and Lecture, "Are Aircraft Electronics too Complicated?" by H. Zeffert. BOAC Mess, 6.15 p.m.
- Dec 14** RAeS Luton Branch: "Operation and Development of Luton Airport," by C. K. Cole. Ashcroft School, 5.30 p.m.
- Dec 15** Guild of Air Pilots and Air Navigators: Livery dinner. Apothecaries' Hall, London EC4, 7.45 p.m.
- Dec 15** Kronfeld Club: "Adventures Around the Dead Sea," by Romilly and Joanna Waite; 74 Eccleston Square, London SW1, 8 p.m.
- Dec 15** RAeS Graduates' and Students' Section: "Preserving Historic Aircraft," by P. M. Thomas, 7.30 p.m.
- Dec 15** RAeS Brough Branch: N. E. Rowe Medals competition papers. Flying Club Lecture Theatre, 5.30 p.m.
- Dec 16** RAeS Isle of Wight Branch: Branch prize lectures. Bugle Hotel, Newport, 6 p.m.
- Dec 16** RAeS Yeovil Branch: "Radio Astronomy," by D. Barber. Technical College, 6 p.m.
- Dec 17** RAeS Weybridge Branch: Annual dance.
- Note:** RAeS lectures other than those given at branches take place in the Society's lecture theatre at 4 Hamilton Place, London W1.

the time of year and unusually bad for any time of the year in Amsterdam. There was the attitude of the Schiphol harbour authorities, who refused permission for de-icing equipment to go on to the runway. Then there was the topicality of icing-up problems—the Munich disaster inquiry in Germany. And finally there was what the pilot, Capt Wilson, actually told us over the public-address system in the Trident. His words, his tone, his phrasing, all confirmed to me that here was a good news story.

Mr Blackburn says he deplores "this kind of newspaper presentation of air transport." He is, of course, entitled to his opinions. BEA, whose Trident it was, are entitled to theirs. And their opinion is that this was a "good" story from the airline's point of view. It showed BEA's, and their captain's, paramount regard for safety—and, incidentally, resulted very quickly in changes for the better in the Schiphol authorities' de-icing regulations.

Copthorne, Sussex

JOHN MANN,

(Brenard Press News Service)

SIR,—It was interesting and revealing to read Mr Robert Blackburn's comments in your "Press" column for November 25 on the newspaper and TV coverage given to the Trident icing incident at Schiphol. They clearly show how a normal occurrence in unusual circumstances can be made to appear sensational by the use of particular words to describe it; and that aviation is still considered a suitable subject for treatment of this kind.

In deciding not to take off in freezing rain without having the aircraft properly de-iced, Capt Wilson was acting as any responsible airline captain would have done in the same conditions. Although freezing rain is, fortunately, comparatively rare in Europe, when it does occur it produces hazardous conditions for all forms of surface transport; and it is by far the most dangerous icing condition with which pilots have to contend. Pilots are trained to be vigilant to recognise the weather conditions in which it occurs and to take the necessary precautions to deal with it.

Continued on page 1017

LETTERS...

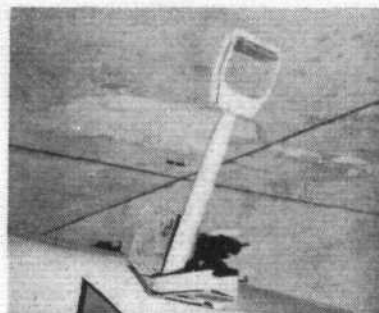
Quite apart from the safe airmanship aspect, however, the captain is legally responsible for operating his aircraft in accordance with the procedures in the operations manual, which in turn are based on the ARB flight manual. In the case of a BEA aircraft the captain is required to ensure that it is completely free of all forms of ice or snow before take-off. He is given no discretion to deviate from these procedures, and Capt Wilson is to be commended on complying with them in a responsible manner.

In the context of the re-opened inquiry into the Munich accident it would have made a more interesting, if less dramatic, news item if the Press had reported the number of aircraft which took off from the many airports in North-West Europe that night without either the airport authorities taking action to deal with icy taxiways or the captains' ensuring that their aircraft were adequately de-iced. Responsible reporting of such irresponsible actions would be more useful than the sensational reporting of responsible actions.

London Heathrow
Airport

D. S. KIRKLAND,
Captain, Trident Flight, BEA

You can call a spade a spade, or you can turn it right way up (as "Flight" ought to have done on page 943, November 25) and call it a retractable step. Apologies to Mr J. P. Tiplady (letter below) and other readers who have written



Putting a Foot in it

SIR,—In the A7A Corsair feature (issue of November 25) a number of salient features were picked out in the Howard Levy photographs. You covered the armaments, the array of flaps and even one of the machines in the air—but you appear to have missed one obviously advanced feature, i.e., its ability to land upside down on ceilings (Photo 5). Is the pilot to be issued with suction pads in order to make his way to the stirrup? With refinements like this, orders should pour in from every air force!

Salisbury, Wilts

JOHN P. TIPLADY

CESSNA SKYKNIGHT (continued from page 1010)

than it goes up. Usefully, up to 15° of flap can be lowered at 180 m.p.h. IAS (just below maximum cruising speed) and with 2,100 r.p.m. and 17in set on the engines this gave a 1,200ft/min rate of descent and no sign of overcooling the engines. With the 40° flap and the gear down at 140 m.p.h. well over —2,000ft/min is possible.

There was a little twitching and tweaking as the gear came down with hands off the stick, but nothing to worry about. Back in the blackness from the bright blue heavens, and with eyes on the panel, I hit upon what is perhaps the only disappointing feature of this otherwise exciting creation—the panel layout. The artificial horizon is offset far to the right, a long way from the ILS presentation. The twin-needle engine instruments, too, are way over on the right, surrounded by a haphazard profusion of arc-type indications showing fuel contents, engine temperature and pressures, OAT, gyro suction, and so forth. The knobs and switches are clearly marked and work well; and the control wheels have a convenient map light which shines down on to the knees.

Following the unfamiliar let-down procedure and on to the ILS the Skyknight was pleasant and light—the only proviso being a brief impression that directionally it is very light, so that the unfamiliar driver tends to overcorrect. The elevators gave nice control for the touchdown, and the selected seating position gave a commanding view.

As already noted, the Skyknight really stands apart from its normally aspirated contemporaries in terms of speed and range only when flown high—20,000ft for maximum speed and up to 30,000ft for best range. The high-altitude range performance is way ahead of the normal one-bottle oxygen system, but an additional bottle can be fitted in the nose compartment if desired (about 32lb). Based on the altitude-oxygen consumption rate chart in the owner's manual, flight above 20,000ft is limited to 2hr 26min with six occupants and only one oxygen bottle on board. Hence the best still-air no-reserves range with this payload (and, say, 200lb of baggage) would be around 620 miles at an average TAS of around 220 m.p.h. As passengers are exchanged for fuel the oxygen capacity becomes ever more limiting on the use of altitude performance. Even with only two-up the aircraft could go on flying above 22,000ft when the oxygen was finished. A solo pilot could achieve the ultimate range conferred by the altitude performance. With four-up the 25,000ft endurance is around 3hr. The point of mentioning these facts is to draw attention to the importance of considering oxygen availability in determining what the aircraft will do. Most airfields served by commercial aircraft

now have oxygen-replenishing facilities; the cost is around £2 a bottle and the process is performed quickly through a simple bayonet-type connection in the nose-leg bay.

Despite the provisos with regard to oxygen supply (there is up to 150 miles and around 37 m.p.h. difference in range and speed between 25,000ft and 10,000ft cruising altitudes) much more important to the owner is the versatility of operation which the performance confers. In many parts of the world the excellent hot-and-high airfield performance will be the most important feature. For ultimate range, oxygen is limiting—but something has to be. For leaping mountains, for bad-weather work, for hitching a ride from a high-altitude tailwind, or for just getting there really fast the high-flying Skyknight is not, in my experience, surpassed in its class. It has a way of going almost like a jet; yet it is quite at home off short grass strips and is still very much in the piston-engined price bracket.

SIAI-MARCHETTI S.205

(continued from page 1011)

supply electric motors to do that job. The stalling characteristics are quite normal with a minimum speed of 50 m.p.h. achieved during my flight at light weight. The recommended approach speed is 85 m.p.h. at high weight and with full flap; this speed gives a moderate approach gradient and ample elevator power for the less marked rotation during round-out.

It is hard to summarise one's feelings about the S.205. The aircraft handles perfectly satisfactorily both in the air and on the ground yet the performance seems to be compromised by, among other things, the enormous cabin which cannot be used to the full because of the performance limitations. Nevertheless the more powerful single and twin derivatives will undoubtedly prove to have a much better combination of features. On the manufacturing and commercial side only time will tell whether SIAI will find the right sort of outlets to the market, to back up its bold enterprise in getting on with the job of production.

SIAI-MARCHETTI S.205

(One 180 h.p. Lycoming O-360A1A piston engine driving a Hartzell constant-speed propeller)

Span, 34ft 10in; length, 26ft 3in; wing area, 173 sq ft; fuel capacity, 44 Imp gal; basic empty weight, 1,500lb; gross weight, 2,645lb; wing loading, 15.3lb/sq ft; power loading, 14.7lb/h.p.

Performance (claimed): Maximum speed, 147 m.p.h.; 75 per cent power cruising, 134 m.p.h. TAS at 6,500ft and 8.6 Imp gal/hr; 65 per cent cruising, 127 m.p.h. TAS at 10,000ft and 7.5 Imp gal/hr; stalling speed, flaps down, 52 m.p.h. IAS; take-off distance to 50ft, 1,360ft; landing distance from 50ft, 1,260ft; sea level rate of climb, 790ft/min; service ceiling, 17,200ft.

INDUSTRY International

Products

Company News

Great Britain

RAF buys TRACE An order has been placed with Hawker Siddeley Dynamics (32 Duke Street, London SW1) on behalf of RAF Transport Command for two TRACE (Tape-controlled Recording Automatic Test Equipment) units. They will be used for general-purpose testing of VC10 and Belfast electronic equipment. BOAC has so far found TRACE very successful in service. As it makes fault-finding much quicker, less spare equipment needs to be kept in store, with a resultant saving in capital cost.

The MoA Contract for Standard Telephones and Cables, STR.70-P radio altimeters for the RAF version of the C-130 Hercules will amount to approximately £100,000. The STR.70-P is the latest of the company's FM radio altimeters; it will be manufactured at Southgate, installed in the Hercules at Marietta, Georgia, and flight-tested at Dayton, Ohio.

FieldTech Ltd, of London (Heathrow) Airport, Hounslow, Middlesex, is now handling the MKS Baratron electronic pressure/vacuum gauge, made by MKS Instruments Inc, of Burlington Mass. This high-precision tensioned diaphragm gauge is claimed to measure vacuum and gas pressures from 10^{-5} mm Hg to 1,000 mm Hg to an accuracy of 0.03 per cent or better. FieldTech are in a position to give demonstrations.

BAC Opens Paris Office British Aircraft Corporation is to establish a Paris office to handle matters arising from the company's joint Anglo-French projects. The resident representative will be Mr

Allan W. Millson, formerly managing director of British Aircraft Corporation (Australia) Pty Ltd. The joint projects with which he will be concerned include the Concorde, Jaguar and the joint variable-geometry aircraft as well as studies for high-density transports and other possible areas of civil and military Anglo-French collaboration. Mr Millson's duties in Australia are being taken over by Gp Capt C. W. K. Nicholls, who now becomes general manager of BAC (Australia) Pty Ltd.

The New Mullard Electronics Centre in Mullard House, Torrington Place, London WC1, was opened by the Minister of Aviation, Mr Roy Jenkins, on December 2. Intended as a showcase for the company's products and as a venue for conferences and exhibitions, the centre incorporates a number of imaginative works of art. These include a sculpture in brass by Barbara Hepworth entitled *Theme on Electronics*; a 50ft mural in etched aluminium by Stanislaw Niczewski; and a sculpture in steel by Andrew Bobrowski entitled *Nucleus*. The centre was designed by John Jedwab.

Mr Michael Jolley has been appointed deputy public relations manager at Bristol Siddeley Engines Ltd. He succeeds Mr K. T. Fulton, who is starting a PR service for Capper-Neill Ltd, an engineering group.

Mr Jolley graduated from the DH Aeronautical Technical School in 1956, and after service as an RAF pilot joined the PR department of Armstrong Siddeley. From 1959 he held PR appointments at Hawker Siddeley, Beagle, and the London Press Exchange. He has also acted as technical consultant for the ATV serial *The Planemakers*. He will be based at Bristol Siddeley's London HQ.

IN BRIEF

Extensive use is made of Belfort wood laminates (**Bonded Laminates Ltd**, Chisenhale Road, London E3) in the BAC executive One-Eleven. The wood is bonded to melamine sheet in order to combine pleasing appearance with hard wearing qualities.

The Melabs CPA-3 pulse polarographic analyser, now available in the UK from **Techmation Ltd**, of 19 Carlisle Road, Colindale, London NW9, is claimed to combine the advantages of conventional polarography with the additional sensitivity and resolution of pulse techniques.

The activities of **Danquigny**—manufacturers of micro-miniature connectors—have been taken over by Souriau et Cie, whose British concessionaires, **Lectrotron Ltd**, Kinbex House, Wellington Street, Slough, Bucks, are now selling Danquigny connectors.

Wayne Kerr Laboratories Ltd, Sycamore Grove, New Malden, Surrey, are offering a new LF filter with two identical channels usable in cascade, independently or in band-pass arrangement; a single tuning control operates over 28 ranges to permit both sections to be set anywhere between 0.1592 c.p.s. and 1,592 c.p.s.

France

PT6 in Europe United Aircraft of Canada Ltd has appointed REVIMA (Société pour la Revision et l'Entretien du Matériel Aéronautique) as the first European distributor for UAC's PT6 gas turbines. REVIMA will undertake the distribution of spare engines and parts in France, and establish repairs and maintenance facilities at Caudebec-en-Caux, Seine Maritime, France.

USA

Sea Legs Goodyear Aerospace Corp, under contract to General Dynamics, is developing inflatable vertical "legs" to assist flying-boats to ride rough water. From 17ft to 35ft long, the legs will be designed to retract into the fuselage and wings of the aircraft. They are to be tested on a Martin Marlin P5A, on which trials have already been completed with rigid vertical floats.

At least one American aircraft constructor has been doing considerable research in this field: Boeing's Vertol Division recently disclosed a design for a tilt-float helicopter.



Sir George Gardner (centre), RAeS president, recently visited Smiths Aviation Division at Cheltenham in order to present prizes to the apprentices. He also toured the works, and is here seen studying a master gyro in company with Mr A. M. A. Majendie, managing director (left) and Mr A. Hirst, training executive (right). Ten of the 278 apprentices have gained university degrees in electrical or mechanical engineering during the year

Spaceflight

TWO-WEEK ORBITAL FLIGHT BEGINS

The first part of the double Gemini manned orbital mission planned by NASA following the abortive Gemini 6 rendezvous flight of October 25 began well at 7.30 p.m. GMT on Saturday last, December 4, with the successful orbiting of astronauts Frank Borman and James Lovell aboard the Gemini 7 spacecraft, launched from Cape Kennedy by a Titan 2 vehicle. If all goes well they should set up a new endurance record by remaining in orbit up to 14 days (Gordon Cooper and Charles Conrad logged 7 days 22hr 56min in Gemini 5).

The second part of the double mission will be the launch of the Gemini 6 craft crewed by Walter Schirra and Thomas Stafford, who will attempt to rendezvous close to Gemini 7 during their two-day flight. The Gemini 6 flight, scheduled to begin on Monday next, December 13, will follow essentially the same programme as planned for October 25 except that the rendezvous target will be the Gemini 7 craft and not an Agena stage, and no physical connection between the two craft will be made. The scheduled flight plan is as follows:—

Gemini 7 was to be launched from Cape Kennedy into an elliptical orbit (100-210 miles) inclined at 28.87° to the equator. After separation of the spacecraft from the booster (30sec after sustainer engine cut-off) the craft was to turn until its heatshield was facing forward and was to begin station-keeping on the second stage of the Titan. This was to continue until 25min after lift-off. Celestial radiometry experiments were to be conducted during the first period of darkness.

At 3hr 50min after lift-off, as the spacecraft was at its third apogee, thrusters were to be fired to accelerate the craft to raise its perigee to 124 miles—ensuring an orbital lifetime of 15 days. The next several days were to be devoted to a variety of experiments.

After about five days in orbit the crew were to manoeuvre Gemini 7 into a circular orbit in preparation for its target role in the rendezvous with Gemini 6. The exact manoeuvres needed will depend on the rate of decay of the Gemini 7 orbit and the expected lift-off time of Gemini 6 (originally planned to be 8 days 19hr 4min after Gemini 7). The resulting orbit for Gemini 7 will be at a height of 185 miles.

Gemini 6 is scheduled to be launched on December 13 into an elliptical orbit at 100-168 miles. Second-stage yaw steering will be used to place the spacecraft into the same orbital plane as Gemini 7; this technique can make a change of up to 0.55° in orbital inclination. At orbital insertion Gemini 6 will be approximately 1,200 miles behind Gemini 7.

If lift-off is on time rendezvous is planned for the fourth orbit of Gemini 6. If delayed, there are seven further launch opportunities over the next four days. During the first 35min of each launch window each 100sec delay in lift-off will delay rendezvous by one spacecraft orbit. If the lift-off is delayed more than 300sec rendezvous will be postponed until the next day. Should lift-off occur during the last 12min of the maximum 47min window the spacecraft will be placed into a lower orbit (100-138 miles) so that it will catch up with Gemini 7 at a higher rate.

Following a successful, on-time lift-off and insertion into orbit, a small acceleration may be needed at first perigee to obtain the required 168-mile apogee. Near second apogee a further acceleration will raise the perigee to 134 miles. This will reduce the catch-up rate from 6.7° to 4.5° /orbit. If the two spacecraft are in different planes an angular adjustment will then be made by Gemini 6 at the common node, i.e. where the two orbits intersect. At third apogee a further acceleration will make the orbit circular at 146 miles.

At that time Gemini 6 should be about 184 miles behind Gemini 7. This is within range of the on-board radar and Gemini 6 should have locked on to the other spacecraft. Two further accelerations by the Gemini 6 thrusters should bring the two craft close together in the same orbit.

Gemini 6 re-entry will begin 46hr 10min after lift-off, during the 29th revolution, with landing in the West Atlantic

recovery area. The Gemini 7 crew will continue with their other experiments after the rendezvous phase, and will begin their re-entry near the end of their 206th revolution.

Experiments Twenty experiments are scheduled for Gemini 7, of which 14 are continuing studies begun on previous Gemini flights. These comprise cardiovascular conditioning, in-flight exerciser, in-flight phonocardiogram, bone demineralisation, human otolith (orientation) function, proton/electron spectrometer, tri-axis magnetometer, celestial and space object radiometry, simple navigation, synoptic terrain photography, synoptic weather photography, visual acuity and astronaut visibility.

Experiments to be flown for the first time on Gemini 7 comprise an analysis of body fluids to study astronauts' reaction to stress; calcium balance study; in-flight sleep analysis using electroencephalograph; optical communication using laser beams; landmark contrast measurements; and star occultation navigation.

Three experiments will be performed by Schirra and Stafford during the flight of Gemini 6: synoptic weather photography; synoptic terrain photography; and radiation measurement inside the spacecraft. The first two are repeats of those flown on all previous Gemini flights; the third was flown on Gemini 4.

LUNA 8 LAUNCHED

A further attempt to send a spacecraft to the Moon and to "further refine the elements of a soft lunar landing" was announced by Tass news agency on December 3. The communique stated:—

"The Soviet Union launched an automatic lunar probe, Luna 8, today. The main purposes of the launching are the further refinement of the elements of a soft lunar landing and scientific studies. The probe weighs 1,522kg.

"The last probe, Luna 7, was launched on October 4, 1965. When the probe was near the Moon, most of the operations needed to achieve a soft landing on the lunar surface were carried out. Some operations, however, were not performed and need additional refinement. The Luna 7 flight supplied much practical material for further work.

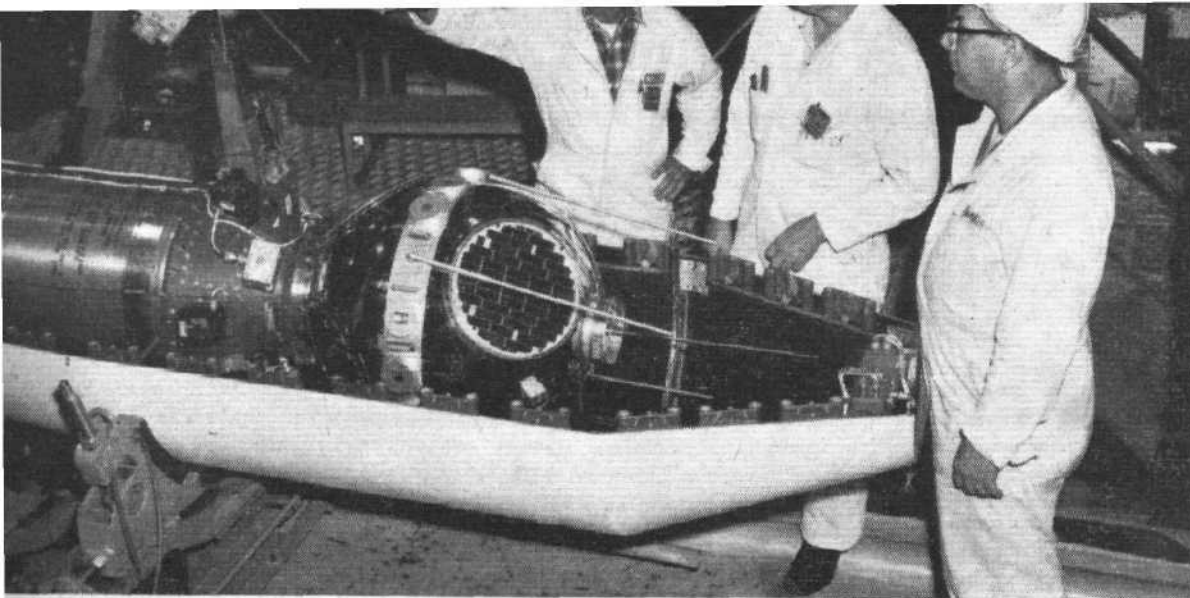
"Luna 8 carries scientific, telemetric and other measuring equipment which is automatically switched on according to the flight programme and also on commands from the Earth. Preliminary measurements show that the probe is moving on a trajectory close to the prescribed. All the equipment aboard the station is functioning normally. The flight is being tracked by a special ground measuring complex. All incoming data are being processed by the co-ordination and computing centre . . ."

FRENCH SATELLITE, US LAUNCHER

The French FR-1 scientific satellite was scheduled to be launched aboard a NASA Scout vehicle from Vandenberg Air Force Base, California, on Monday last, December 6. Designed to study very-low-frequency radio propagation through the ionosphere, the 132lb spacecraft was expected to achieve a circular, near-polar orbit at a height of approximately 500 miles.

This project represents the first joint US/French satellite launching. NASA has provided the launch vehicle and the services of STADAN (space tracking and data acquisition network) ground stations; the French Centre National d'Etudes Spatiales (CNES) has directed the development of the satellite; and the Centre National d'Etudes de Télécommunications (CNET) is responsible for the scientific experiments. The satellite structure was built by Nord Aviation.

The first French spacecraft to achieve orbit was the A-1 test capsule launched by Diamant from Hammaguir on November 26 (see page 1021).



NASA's Explorer 30 IQSY satellite was orbited by Scout from Wallops Island on November 18. Engineering personnel Jim Bynum (NASA), J. Herrick (Ling-Temco-Vought), and Roy Harding (Naval Research Laboratory) checked the satellite prior to launch

Spaceflight

LAST BLACK KNIGHT FIRED

The 22nd Black Knight rocket was launched on November 25 from Woomera in the final firing in the Dazzle programme of re-entry research. It reached a height of about 400 miles before the second stage fired to give re-entry acceleration, and was tracked through the flight by a team of scientists at the Research Establishment operating the Woomera instrumented staff operating the Woomera project Britain which has contributed most of the instrumentation for observing the re-entry phenomena; and with facilities. The programme was described in detail in the issue of July 23, 1964.

Originally designed to obtain re-entry data needed in the development of the ICBM, Black Knight was subsequently adopted for a series of investigations into the physics of the re-entry of vehicles into the Earth's atmosphere. The first Black Knight was launched from Woomera just over seven years ago and the subsequent launches have all been successful.

Black Knight has been manufactured by the Ministry of Defence in association with Bristol Aeroplane Company for the main propulsion system. The Research Establishment has provided the equipment, data-recording system, and the missile firing team has been provided by the Royal Aircraft Establishment (Australia). The direction of the whole programme is under the leadership of the Royal Aircraft Establishment.

Although not yet off the drawing boards, re-entry research in Australia is expected to continue with Redstone vehicles at Woomera launching and track again be used.

SOVIET/FRENCH

A successful experiment was conducted in Moscow to Paris by means of a satellite. A Tass news item under a Franco-Soviet television, and it was reported that the satellite was transmitted to the Molniya orbit.

From the Molniya orbit, the satellite was transmitted to the Molniya orbit.

picked up by a ground station in France, whence it was directed via a relay line to Paris and relayed by the Butte-Chaumont colour-television transmitter.

TOWARDS VENUS

The two Soviet spacecraft Venus 2 and Venus 3 are expected to pass close to the planet Venus from different sides and to explore different regions of the planet. This was stated recently in Izvestiya by a Soviet official who confirmed that the two spacecraft had different scientific objectives. He said that, at this initial stage in the mission, the spacecraft were carrying out preliminary scientific reconnaissance of Venus from two different orbital stations.

The spacecraft are expected to increase the amount of information about the planet Venus which would be obtained by the group of spacecraft. The flights of the spacecraft are not too distant from Earth, and supply the ground, Prof Ivanov said. "The simultaneous operation of the spacecraft is very useful."

MAS

The tests into the Pacific is now expected to end on December 25. The completion of other tests, on November 24:—

The carrier rockets into an area in the Pacific in the Soviet Union in accordance with the space programme. The operation of the rockets passed normally and the penultimate stage hit the planned target position. The tests planned for this stage of the programme have thus been successfully fulfilled.

It is stated that the area of the Pacific circle of 40 n.m. radius, 35° N, 163° 43' E, announced by the Soviet government.

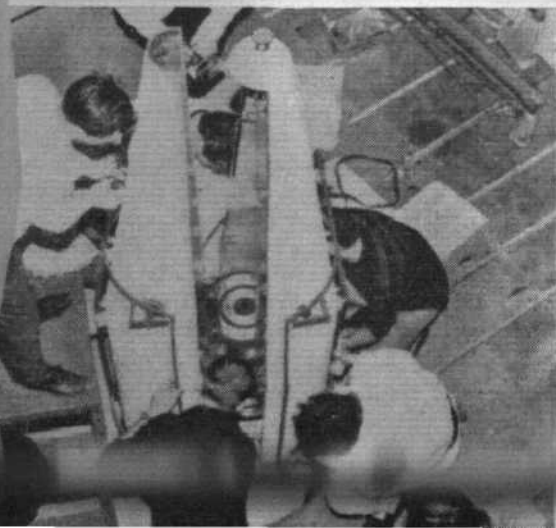
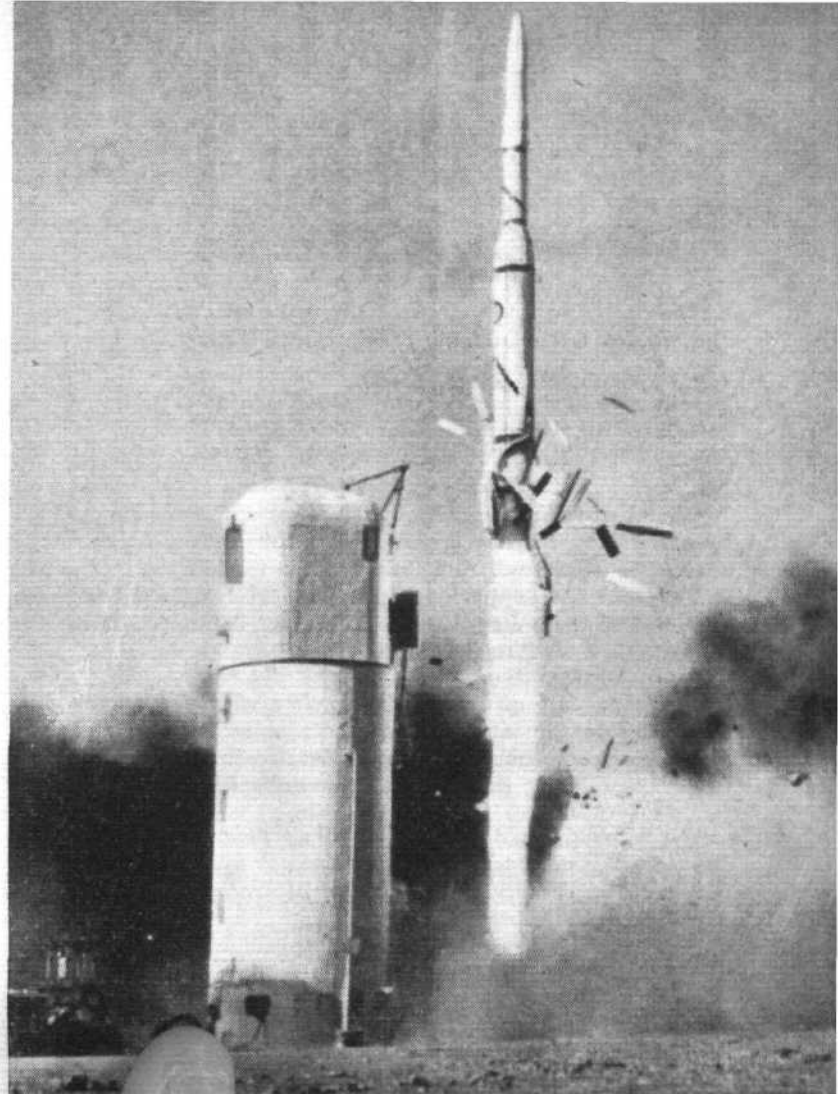
From November 25 to November 29, the central Pacific will be closed to ensure safety the Soviet government of other countries using the air routes in the Pacific to instruct the ships and planes not to enter the space of this area from noon to midnight every day.

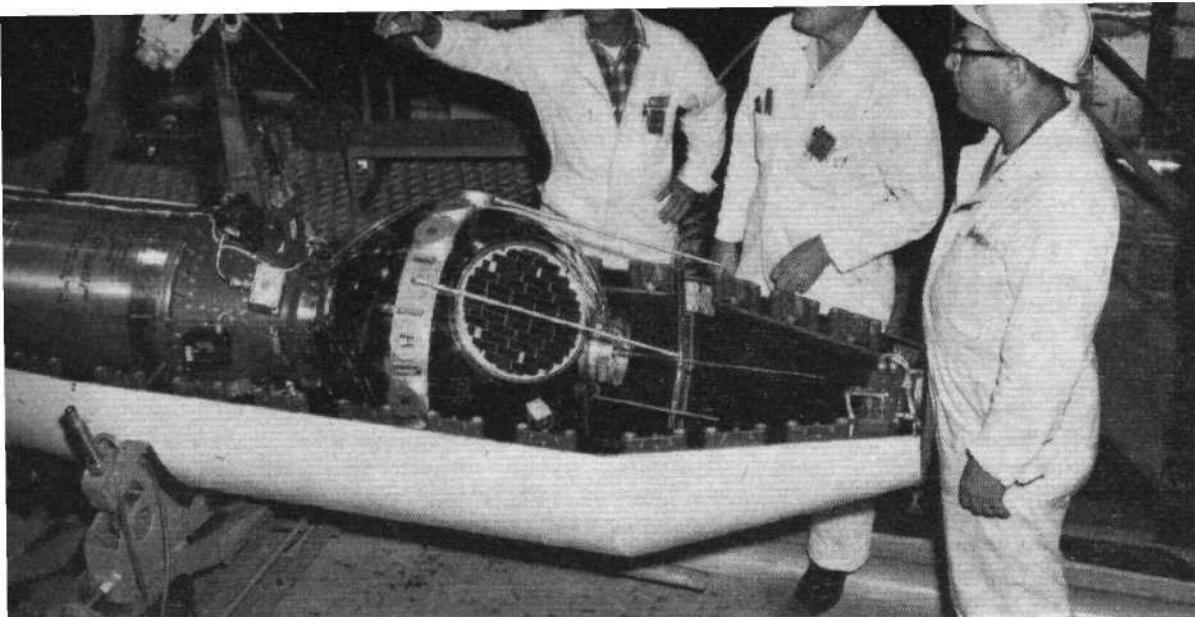
FRANCE'S ORBITAL LAUNCH

The French A-1 test capsule launched into orbit from Hammaguir on November 26 ceased transmitting beacon signals two days later, according to an announcement by the Armed Forces Ministry. It was reported that the signals became weak on November 27 and that the spacecraft's aerial had probably been damaged during the launch. Developed by Engins Matra, the craft carried no scientific instrumentation but was intended solely to verify the performance of the rocket.

The launch vehicle which has enabled France to become the first nation other than the Soviet Union and the USA capable of orbiting a satellite is the three-stage Diamant. The first stage, tested as the Emeraude, was built by Nord Aviation, who also adapted the Vexin motor developed by LRBA/SNECMA. Structure and stage junctions of the second stage, tested as the Topaze, was also built by Nord Aviation. In addition, this company is responsible for the integration of the first two stages and the launching on board of the REB.

First two to the
Second to the
Poudres to the
Equipement to the
structure to the
thrust to the
and the to the





NASA's Explorer 30 IQSY satellite was orbited by Scout from Wallops Island on November 18. Engineering personnel Jim Bynum (NASA), J. Herrick (Ling-Temco-Vought), and Roy Harding (Naval Research Laboratory) checked the satellite prior to launch

Spaceflight

LAST BLACK KNIGHT FIRED

The 22nd Black Knight rocket was launched on November 25 from Woomera in the final firing in the Dazzle programme of re-entry research. It reached a height of about 400 miles before the second stage fired to give the re-entry acceleration, and was tracked through the flight by Weapons Research Establishment staff operating the Woomera range instrumentation. In the Dazzle project Britain has co-operated with the USA, which has contributed most of the special ground-based instrumentation for observing the re-entry phenomena; and with Australia, which has provided the range facilities. The programme was described in detail in our issue of July 23, 1964.

Originally designed to obtain warhead re-entry data needed in the development of the Blue Streak missile, Black Knight was subsequently adopted for a wider series of investigations into the physics of the re-entry of vehicles into the Earth's atmosphere. The first Black Knight was launched from Woomera just over seven years ago and the subsequent launchings have all been successful.

Black Knight has been developed and manufactured in Britain for the Ministry of Aviation by Westland Aircraft Co in association with Bristol Siddeley Engines who are responsible to the Rocket Propulsion Establishment, Westcott, for the main propulsion system. In Australia the Weapons Research Establishment has been responsible for all the range equipment, data-recording instrumentation and data analysis; the missile firing team has been supplied by Hawker Siddeley Dynamics (Australia). The co-ordination of the design and direction of the whole project has been carried out by the Royal Aircraft Establishment, Farnborough.

Although not yet officially announced, a further programme of re-entry research involving Britain, the USA, and Australia is expected to follow project Dazzle. For this series Redstone vehicles are to be provided by the USA, and the launching and tracking facilities of the Woomera range will again be used.

SOVIET/FRENCH TV LINK

A successful experimental colour-television broadcast from Moscow to Paris was carried out for the first time on November 29 by means of the Soviet Molniya 1 communication satellite. A Tass report stated that the telecast was carried out under a Franco-Soviet agreement on co-operation in colour television, and that the Secam system was used.

From the Moscow television station the programme was transmitted to a satellite ground station in the USSR and then to the Molniya spacecraft. From the satellite the signal was

picked up by a ground station in France, whence it was directed via a relay line to Paris and relayed by the Butte-chaumont colour-television transmitter.

TOWARDS VENUS

The two Soviet spacecraft Venus 2 and Venus 3 are expected to pass close to the planet Venus from different sides and to explore different regions of the planet. This was stated recently in *Izvestia* by Prof Ivanchenko, who confirmed that the two spacecraft carried different payloads and had different scientific programmes. He pointed out that, at this initial stage in the study of Venus (that of preliminary scientific reconnaissance) it was logical to send two automatic stations separated by a relatively short distance and time interval.

The launching of two probes to Venus would increase the chances of obtaining authentic information about the planet. In addition the double flight would help in developing the techniques of controlling flights involving a group of spacecraft. Work on this problem began with the flights of Nikolayev and Popovich in August 1962. "In the not-too-distant future, space stations will appear near the Earth, and supply spaceships will ply between them and the ground," Prof Ivanchenko added. "The experience of simultaneous operation of several spaceships . . . will be very useful."

ROCKET TESTS FOR CHRISTMAS

A further series of Soviet rocket tests into the Pacific is now taking place and is scheduled to end on December 25. Announcing this together with the completion of other tests, the Tass news agency stated on November 24:—

"New launchings of carrier rockets into an area in the Pacific have been carried out in the Soviet Union in accordance with the USSR's space programme. The operation of all systems and the flight of the rockets passed normally and the mock-ups of the penultimate stage hit the planned target area with great precision. The tests planned for this stage of the programme have thus been successfully fulfilled.

"Tass is authorised to state that the area of the Pacific Ocean within a circle of 40 n.m. radius with a centre 35° 05' N and 175° 43' E, announced on October 31, will be fully free for shipping and aircraft from November 25.

"In connection with the extension of the programme of scientific research aimed at further studying outer space, the Soviet Union will fire rocket boosters from November 25 to December 25 into a circular target area in the central Pacific with a radius of 40 n.m. with a centre 0° 5' S and 163° 45' W. Tass is instructed to announce that to ensure safety the Soviet Government requests the governments of other countries using these sea lanes and air routes in the Pacific to instruct the appropriate bodies to advise ships and planes not to enter the sea and air space of this area from noon to midnight local time, every day."

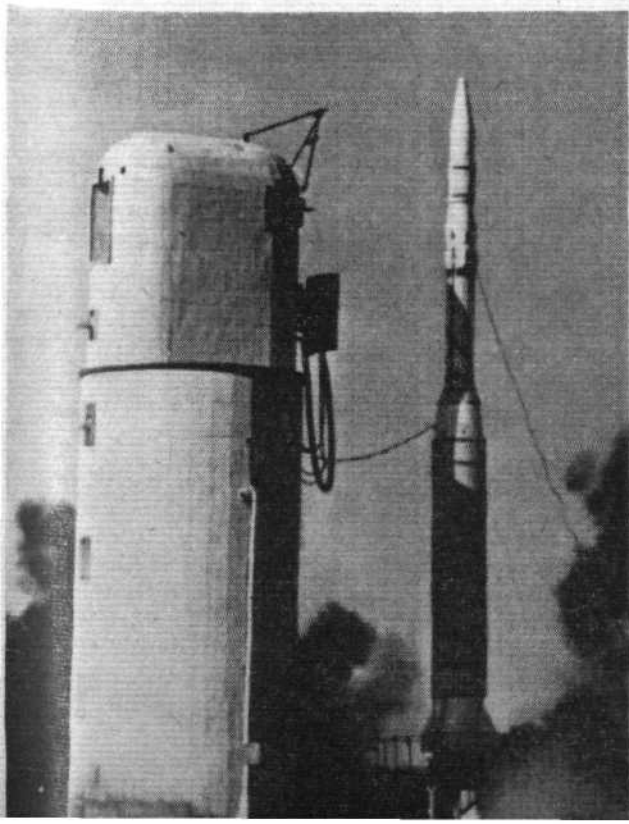
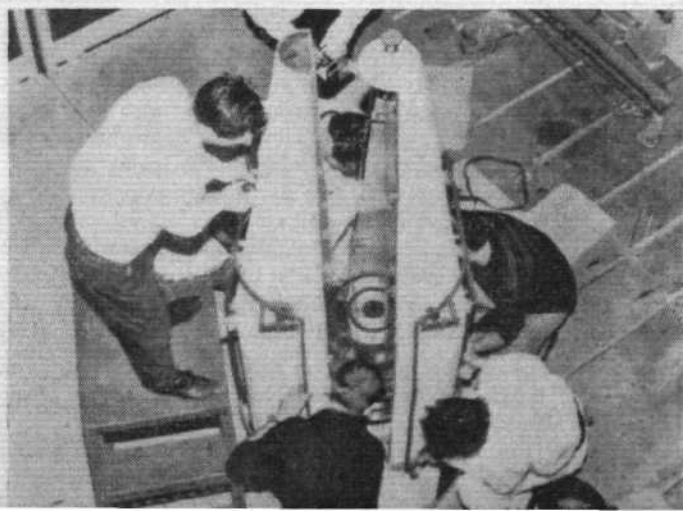
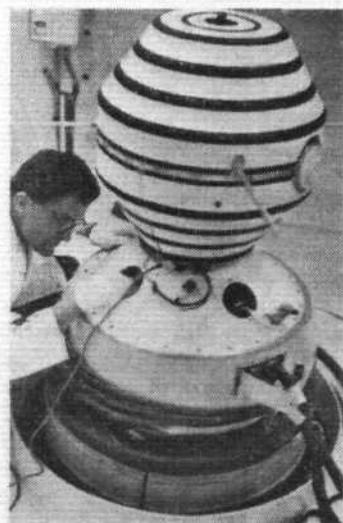
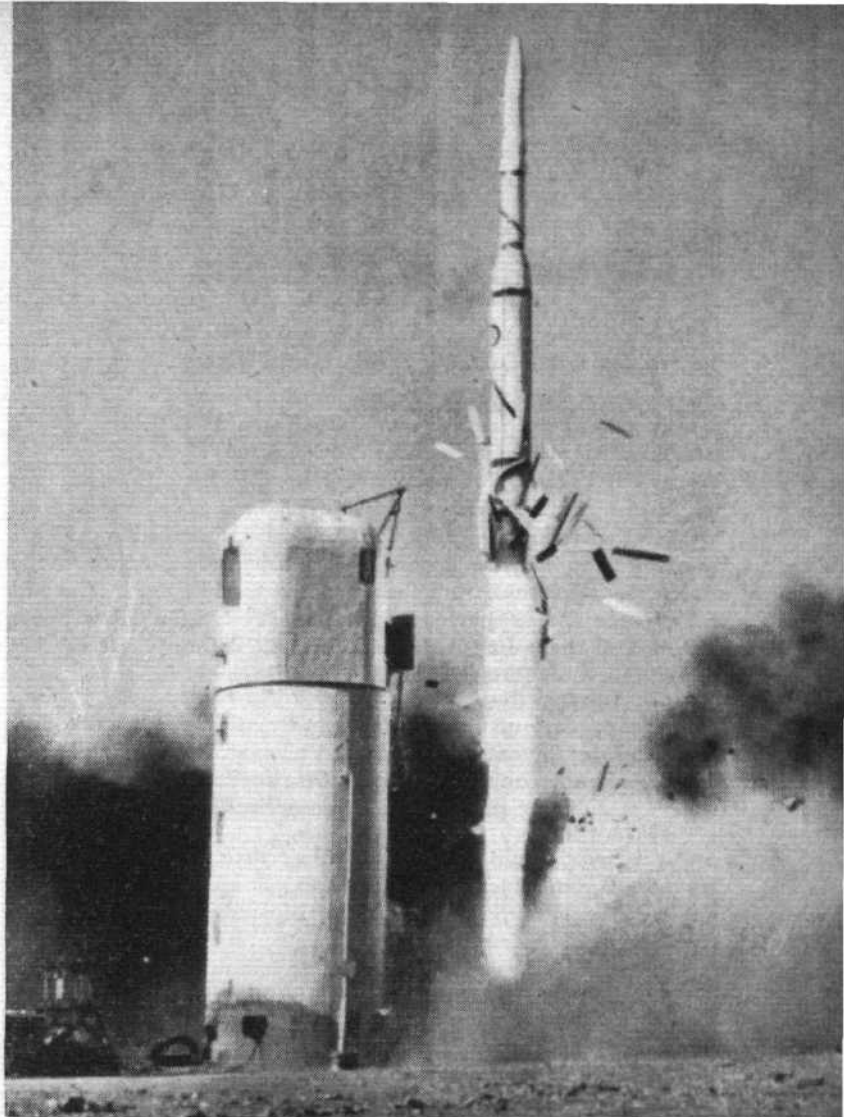
FRANCE'S ORBITAL LAUNCH

The French A-1 test capsule launched into orbit from Hammaguir on November 26 ceased transmitting beacon signals two days later, according to an announcement by the Armed Forces Ministry. It was reported that the signals became weak on November 27 and that the spacecraft's aerial had probably been damaged during the launch. Developed by Engins Matra, the craft carried no scientific instrumentation but was intended solely to verify the performance of the rocket.

The launch vehicle which has enabled France to become the first nation other than the Soviet Union and the USA capable of orbiting a satellite is the three-stage Diamant. The first stage, tested as the Emeraude, was built by Nord Aviation, who also adapted the Vexin motor developed by LRBA/SNECMA. Structure and stage junction for the second stage, tested as the Topaze, was also built by Nord Aviation. In addition, this company was responsible for the integration of each of the first two stages and their final testing on behalf of SEREB.

Second-stage propulsion is by the French "Direction des Poudres" and the thrust chambers by SEPR, actuators by Air-Equipement and programming equipment by SFENA. The structure of the third stage was built by Sud Aviation, the thrust chamber by SEPR, electronic equipment by Dassault and the altitude control computer by SAGEM.

Taken at Hammaguir on November 26, these photographs show the final pre-launch preparations and the lift-off of the French Diamant vehicle carrying the A-1 test capsule. Right, the 93lb satellite is attached to the third stage of the rocket and (below right) the nose fairing is fitted. The Diamant lift-off (below and above right) was made at 2.51 p.m. GMT



Proton Space Stations

By NAUM GRIGOROV, IVAN SAVENKO
AND GENNADY SKURIDIN*

THE heavyweight space station Proton 2 was placed into orbit on November 2, 1965. This was a new, important step in the realisation of a large-scale programme initiated by the Proton 1 space probe. Our country, the pioneer of the space era, is in possession today of the world's most powerful carrier rocket. The payloads put into orbit around the Earth by this rocket on July 16 and November 2 this year were the heaviest in the entire history of space research.

As is known, the payload of the Proton 2 space station, similarly to that of Proton 1, together with the control and measuring equipment, totals about 12.2 tons. The possibility of putting scientific objects with such a tremendous payload into orbit around the Earth opens up unheard-of prospects for space exploration.

The scientific stations Proton 1 and Proton 2 are designed for an all-round investigation of cosmic rays with a view to obtaining answers to quite a number of problems in the physics of elementary particles, astrophysics, physics of the Sun, physics of cosmic rays, as well as spaceflight engineering.

To be able to solve numerous scientific problems, among them those related to the study of cosmic-ray particles of high and super-high energy, Proton 1 and Proton 2 were equipped with a unique apparatus—the ionisation calorimeter invented and designed by Soviet physicists.

This instrument is used to study the energy spectrum (i.e., energy distribution) of the primary particles of cosmic rays in the energy range from 10,000 to 100,000,000 million electron volts, as well as the chemical composition of primary particles in the same energy range. This instrument can also be used to study the processes in the collisions of protons and atomic nuclei at particle energies ranging from ten thousand to several million MeV, with the birth of secondary particles. Such collisions are referred to as inelastic.

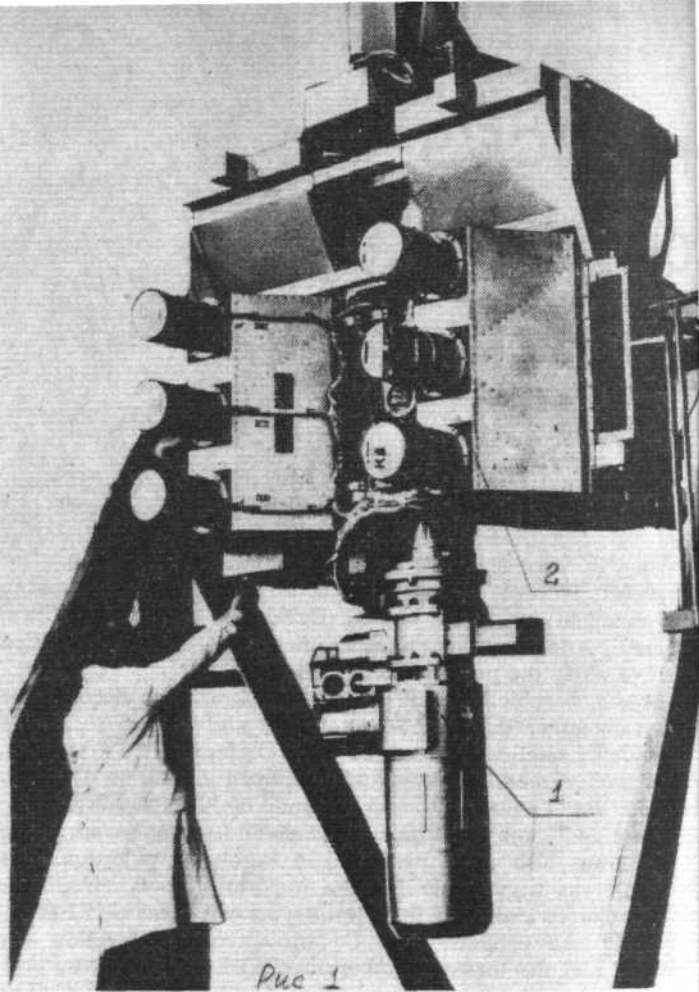
A special instrument, SEZ-12 type, has been developed to study high-energy electrons. This is a sophisticated and rather heavy instrument incorporating modern principles of nuclear physics which are used for mass separation of elementary particles.

The SEZ-1 charge spectrometer was used to study cosmic rays with energies within 30,000 MeV, among them those which are sometimes emitted by the Sun. The essential difference of this instrument from similar ones, particularly those formerly used by Soviet scientists on board spaceships and space rockets, lies in its high transmission, i.e., sensitivity over a wide range of particle separation. This range embraces the atomic nuclei of elements ranging from hydrogen to tin nuclei, i.e., nearly half the elements existing in nature. This instrument's high sensitivity enables it reliably to record the insignificant variations in cosmic-ray intensity which are due to solar activity.

The study of high-energy electromagnetic radiation (gamma quanta) was made possible by the special gamma-telescopes, GG-1 type, installed on board Proton 1 and Proton 2. These instruments are intended to obtain the sky's "photograph," but not in the range of wavelengths (visual light) usually associated with this notion, but in wavelengths which are hundreds of millions of times less. Such a "photograph" provides information on the degree of uniformity in the distribution of cosmic rays and interstellar matter in the galaxy.

All these instruments were so designed as to form a single unit, as shown in the photograph. This unit of scientific equipment was installed inside the Proton space probes.

Here are some figures that will give you an idea of the scale



The scale of the scientific equipment aboard the Proton spacecraft is shown for the first time in this Novosti Press Agency photograph. The numbered equipment comprises: 1, electron spectrometer SEZ-12; 2, ionisation calorimeter; 3, gamma telescope GG-1; and 4, low-charge particles spectrometer SEZ-1

of the experiment and the complexity of the scientific equipment involved. The scientific instruments on board the Proton 1 space probe were recording more than 180 parameters. Among the various electronic units in this equipment there were more than 4,100 transistors and over 4,500 crystal diodes, and about 9,000 semiconductor elements in all.

The scientific equipment well withstood the severe test on board the Proton 1 space probe. A great amount of information covering all the parameters involved was obtained during the flight. This information was continuously supplied from the numerous scientific instruments and various inboard systems to be "memorised" by special devices on board and periodically transmitted to the Earth in response to commands.

A preliminary analysis of the energy spectrum of primary cosmic rays from the data obtained at Proton 1 has shown that the earlier conceptions derived from indirect data are not supported by direct measurements. These results are of extreme scientific importance. They may justify a revision of the mechanism by which high-energy secondary cosmic particles originate in collisions between primary cosmic rays and atomic nuclei of the matter, including the atmosphere, as well as bring forth new concepts on the mechanism of the formation of extended air showers. They call for an explanation why the results obtained by indirect methods are so much different from direct measurements.

The experiments on board Proton 1 for the first time afforded the opportunity to subject to experimental verification some highly important theoretical predictions, i.e., to measure the probability of inelastic collisions of protons and carbon atomic nuclei for different proton energies. The fact that effective cross-section has been found to depend on the energy nearly as much as predicted by the theory is highly important for the theory of elementary particles.

The measurements of high-energy electrons outside the atmo-

*Condensed from an article published in "Pravda" on November 16, 1965.

sphere conducted by Proton 1 were first experiments of this kind. They detected an unexpectedly large flux of electrons with energies in excess of 300MeV. Its intensity was found to be nearly identical at any point in the circumterrestrial space, except for polar regions which were by-passed by the space station. Its intensity is nearly ten times as great as could be expected from the earlier measurements of high-energy electrons in the stratosphere.

The fact that the intensity of electrons is independent of the latitude of the observation place is a proof that nearly all of them are of secondary, rather than galactic origin. However, the mechanism of the formation of such an intense flux of secondary high-energy electrons outside the atmosphere is still not clear.

OVER-WEATHER TRACKING

THE development of a lightweight, airborne missile tracking system which may reduce launch delays due to bad weather has been announced by Northrop Corporation. The device is mounted externally in a streamlined pod on the forward fuselage of a Boeing KC-135 tanker, and consists of a 200in. f.l telescope; a 70mm camera operating at 80 frames/sec; and two vidicon sensors for tracking. The aircraft contains a manual tracking station for initial target acquisition and a control console with television monitor.

From a height of 40,000ft, the system will photograph missiles during early launch, stage-separation and re-entry. The missile is acquired visually by an airborne operator using a modified gun sight, after which tracking and photography is carried out automatically whilst the operator watches the missile on the television monitor. The system is expected to be flown from Cape Kennedy before the end of the year.

Full Flight Duration of 2½min was achieved during static firing of a ground-test Saturn S-IC-T stage at NASA's Marshall Space Flight Center, Huntsville, on November 24. Full thrust of 7,500,000lb was achieved during the run, which is the 13th since the static firings began in April 1965.

Direct-broadcast satellites capable of transmitting directly to conventional home FM and/or shortwave radio sets are the subject of feasibility studies to be carried out for NASA. Proposals from industry have been requested for two alternative types of spacecraft, which would transmit in the HF and FM bands respectively.

Space Congress The 17th congress of the International Astronautical Federation will be held in Madrid during October 9-15, 1966. General sessions will be devoted to propulsion; astrodynamics; guidance, control and tracking; physical problems of re-entry; systems design; application-type satellites; and bio-astronautics.

Upgraded H-1 Engines The first two Rockdyne H-1 engines upgraded to 205,000lb thrust have been delivered to NASA's Michoud Assembly Facility, New Orleans. First flight using eight of these improved engines as the booster stage of the Saturn S-IB vehicle will be that of SA-206, the sixth flight vehicle. Originally tested at 165,000lb thrust, H-1 engines had earlier been successively upgraded to 188,000 and 200,000lb.

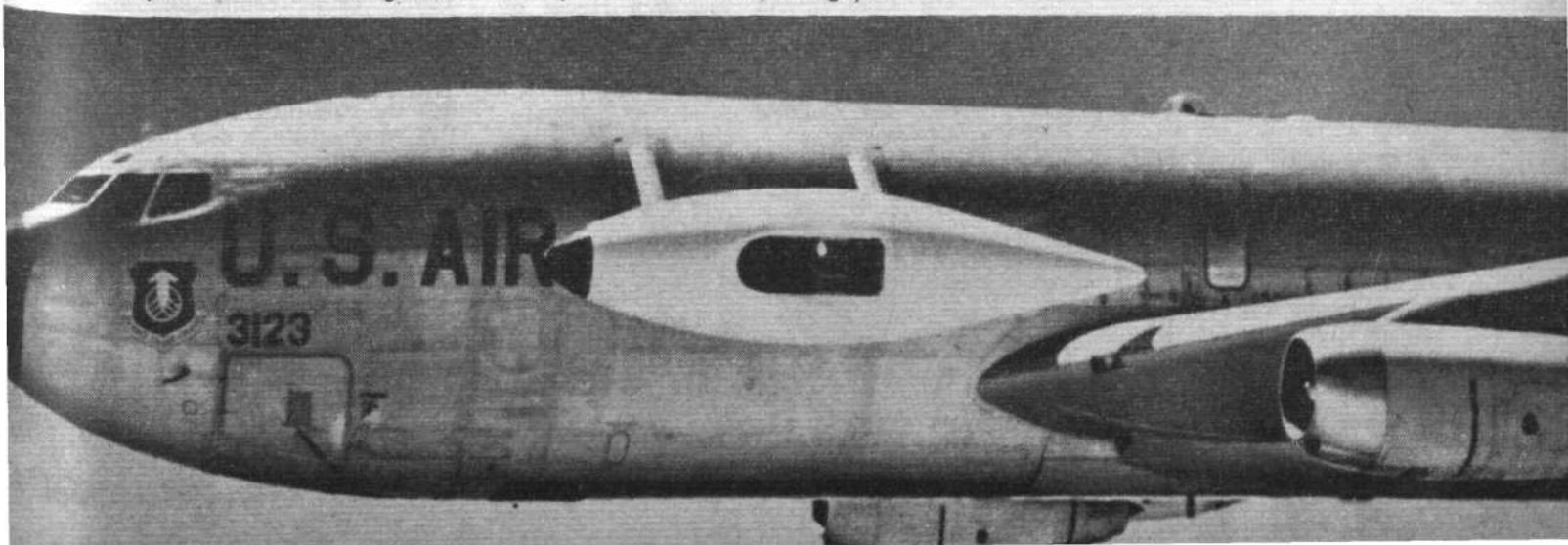
OSO 2 Switched Off After exceeding its expected operational life by 50 per cent, NASA's second Orbiting Solar Observatory (OSO 2) spacecraft has ceased regular operation. The gas supply for the pitch control in the stabilisation system of the satellite has become exhausted, and the craft is unable to maintain its required Sun-pointing accuracy. Before being switched off OSO 2 had completed more than 4,100 orbits since its launching on February 3, 1965, and had returned some 2,200,000 bits of scientific data per orbit.

Apollo Heatshields A follow-on contract for approximately \$22 million has been awarded by North American Aviation to the Research and Advanced Development Division of Avco Corporation for 13 ablative heat shields for Apollo command modules designed for test missions in lunar orbit. North American is principal contractor for the Apollo command and service modules to NASA's Manned Spacecraft Center. This follows a \$25 million contract for heatshields for Earth-orbiting Apollo spacecraft.

Cosmos 97 and 98 Two further satellites in the Soviet Cosmos series were launched on November 26 and 27, respectively. Cosmos 97, launched on November 26, was stated by Tass to have been placed into an orbit—with 220km perigee, 2,100km apogee, 49° inclination and 108.3min period—which was "close to the prescribed one." Cosmos 98, launched on November 27, was stated to have been placed into orbit at 216km perigee, 570km apogee, 65° inclination and 92min period, and to carry a radio transmitter operating on 19.996Mc/s. The equipment aboard both spacecraft was functioning normally, it was reported, and the telemetered information was being processed at the co-ordinating and computing centre.

A Space Science Division has been established by Computing Devices of Canada Ltd. Under Dr G. P. T. Wilenius the new division will handle a variety of programmes in applied physics, mechanical engineering, scientific analysis, high-g electronics and scientific services. Among the projects directed by the division are the company's aerophysics range near Ottawa, management of the High-Altitude Research Project (HARP) in Barbados under contract to the Space Research Institute of McGill University, operation of a satellite telemetry station at Shirley Bay for the Canadian Defence Research and Telecommunications Establishment, and a data processing centre for the RCAF Flight Evaluation Centre at Cold Lake.

Northrop has developed a lightweight, airborne missile-tracking system which, it is hoped, will reduce launch delays due to bad weather. It is carried in a streamlined pod mounted on a Boeing KC-135 tanker (see "Over-weather Tracking")





The nuclear-powered aircraft carrier USS "Enterprise" (75,700 tons) has joined the US Seventh Fleet off South Vietnam. She is expected to replace one of the conventional carriers which has been operating daily air strikes against North Vietnamese targets. "Enterprise" (CVAN-65) had previously been deployed with the Atlantic Fleet, and in this picture a Skywarrior, Skyraiders, Skyhawks, Crusaders and Vigilantes line the deck, with a Tracer AEW aircraft amidships. During operations last Thursday, December 2, two aircraft were lost, one to Viet Cong ground fire and the other after running out of fuel over the sea

DEFENCE

The Rhodesian Situation

THE PRIME MINISTER, Mr. Harold Wilson, announced in the House of Commons last Thursday that a force of RAF Javelins is to be sent to Ndola, in the Zambian copper belt. The aircraft are from 29 Sqn, equipped with Javelin FAW.9s, under the command of Wg Cdr K. Burge. The first aircraft of the squadron, which had originally been based in Cyprus, arrived on Wednesday, December 1, at Eastleigh Airport, Nairobi, in preparation for the move into Zambia.

This move follows Mr Wilson's talks with the President of Zambia, Mr Kaunda, over the possibility of a Rhodesian threat to cut off power to Zambia from the Kariba dam power station.

Airfield defence is being handled by 140 men of 51 Sqn, RAF Regiment, commanded by Sqn Ldr A. B. McGuire, who were flown out from Catterick and will provide defence for the airfields at Ndola, Lusaka and Livingstone.

At press time, Egypt was still refusing to allow RAF transports—supporting the force in Zambia—to overfly her territory. A request had been made by

Britain, through the embassy in Cairo, for permission to cross the country; but at the time of writing no affirmative statement had been issued by the Egyptian Government.

Four days before the RAF move the aircraft carrier HMS *Eagle*, unknown to the Rhodesians or the other African States, had in fact been off the coast of Tanzania following an alert to sail from Singapore on November 20—a timely illustration for the defence planners of the value and mobility of carriers in this kind of situation.

Eagle has Buccaneers (800 Sqn), Sea Vixens (899), flight-refuelling Scimitars, Gannets (848), and Wessexes of 820 Sqn.

The overall commander of the Zambian expedition is Air Cdre I. N. MacDougall, Senior Air Staff Officer, 38 Group, RAF, who has been nominated Air Defence Commander designate.

Australia Buys British

A SURPRISE ANNOUNCEMENT was made last week in the Australian House of Representatives by the Air Minister, Mr

Air Cdre I. N. MacDougall, Senior Air Staff Officer, 38 Group, RAF, who is appointed Air Defence Commander designate of the RAF in Zambia



Peter Howson, who revealed that the RAAF is to buy ten Hawker Siddeley HS.748s and two BAC One-Elevens. Coupled with this was the statement that three Fan Jet Falcons (alias Mystère 20s) would also be ordered. The value of the British aircraft is £10,440,000. Eight of the Series 2 HS.748s will be used for navigational training, in which role they will replace DC-3s. The other two 748s will be equipped with movable bulkheads and used for either VIP or personnel transport. The BAC One-Elevens, Series 200 aircraft, will be used mainly as VIP transports.

Mr Howson's announcement took both BAC and Hawker Siddeley by surprise; it was known that the RAAF was close to buying (see *Sensor*, *Flight*, November 25) but how close was not known.

A spokesman for the SBAC commented: "This is a highly encouraging export achievement for the British aircraft industry in this area. It was won against strong competition and proves that this country is holding its own for export orders. This is further underlined by our 1965 January-October air export figures, published today [December 1, Ed] which show a £30 million increase on the same period last year."

Australian Manpower Shortage

THE RAAF has an urgent need for 5,000 more men in order to operate at peak efficiency. Logistic support would be increased by at least 50 per cent, a spokesman said, if this requirement were met. If it were not, the Air Force would not be able to keep more than 100 of its 400 aircraft in service, because

of lack of ground crews. The RAAF is already involved in heavy expense by contracting to private firms servicing work which it would normally handle itself. The shortage could threaten the Government's plan to build up the RAAF over the next few years.

More Lightnings for Germany

A SECOND RAF LIGHTNING squadron will be transferred to Geilenkirchen at the end of this month. The squadron is No 92, based at present at RAF Leconfield, Yorks, and equipped with the Lightning F.2 under the command of Wg Cdr J. A. Gilbert. The squadron will replace the Javelins of 11 Sqn.

The first squadron to be transferred to Germany was 19 Sqn, in September. It is based at Gutersloh.



One of the force of ten Javelins of 29 Sqn landing at Lusaka last week (see first news item, opposite page)

CAN BRITAIN AFFORD CARRIERS?

RECENT ARTICLES and correspondence in *Flight* about carriers largely miss the point of the current debate (writes Air Marshal Sir Maurice Heath, KBE, CB, RAF ret'd). The point is not whether strike carriers *per se* are desirable (few airmen would dispute this provided one can afford them) but is whether it makes any sense for this country to retain them when defence cuts are to be imposed.

The facts would seem to be that we cannot afford more than three carriers. In this context "afford" is a curious word as it seems that carriers could only be "afforded" at the expense of the other Services. If we can only afford three carriers is it sensible in either military or economic terms to maintain this particular capability?

A force of three carriers can at best only give us two at sea, often only one. These one or two carriers would, in comparison with those of the USN, be relatively small ships. Additionally, out of a necessarily small total complement of embarked aircraft, the fighters, the AEW aircraft, the ASW helicopters and some of the strike aircraft would be concerned with the carrier's own defence, leaving only the remaining handful of strike aircraft to be legitimately counted as the carriers' contribution to air power. This handful of aircraft—perhaps the equivalent of one or two land-based squadrons—could not in the very nature of things be counted on to be in the right place at the right time and would, during the lifetime of the carrier, have cost us thousands of millions of pounds.

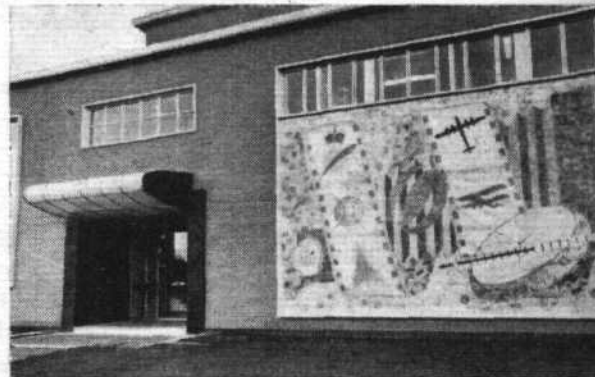
This sort of expenditure could only be justified if there was some role which was literally vital to this country's security which could only be performed by carriers. Such is not the case. The days of Fleet actions—the special justification for the carriers—are past. The Royal Navy and the RAF are capable of handling any surface or submarine threat which could be mounted against our shipping by any power, other than Russia, without recourse to carriers. Similarly, any air threat could be con-

tained by the next generation of RAF tactical aircraft. These will be of much increased performance—particularly in range—and will be far less demanding in their airfield criteria. Suitable airfields already exist in all likely areas.

There are two other points which are relevant. First, carriers are dependent on airfields and other land-based facilities overseas; it is significant that the vast majority of naval flying takes place from land airfields. Second, newspaper reports in recent years have provided evidence of how frequently defects can remove a carrier from the scene of operation.

The carrier must, therefore, stand or fall by its role as a conspicuously vulnerable "floating airfield" which, if and when it arrives where it is needed, can deploy air power no different in kind from that which can be provided at a fraction of the cost by land-based aircraft. By this criterion it is a luxury which this country can no longer afford.

A new facility for the RAF School of Photography was opened at RAF Cosford, Staffs last week. Formed during the First World War, the school moved from Farnborough to Heath End in 1947. It is responsible for the training of apprentice and other RAF photographers and has technical equipment capable of processing 9in-wide films at the rate of 40ft/minute. Beside the entrance, seen here, is a 23ft x 16ft terrazzo mural tracing the history and development of the school.



First photograph showing F-5As in service in Vietnam. The picture agency caption states that the aircraft were returning from bombing Viet Cong positions at the Michelin rubber plantation 45 miles north-east of Saigon. These two aircraft, part of a USAF evaluation batch of 12, are based at Bien Hoa





Straight and Level



EACH year the Royal Society's research professors give an account of their work in an appendix to the Society's annual report. This year's includes one by Prof M. J. Lighthill, FRS, formerly Director of the Royal Aircraft Establishment. It is remarkable not only for the wide scope of the work—from solar physics to the flow of blood in human arteries—but for this choice passage:—

"... I carried out a study of the detailed implications of Whitham's theory [on non-linear effects of dispersive wave propagation] in the one-dimensional case.

"This brought to light a strong interaction between non-linear effects and dispersive effects, which can take two rather different forms according as the phase velocity of periodic waves changes with increasing amplitude in the same or the opposite sense as the group velocity changes with increasing wavelength. (This criterion causes a certain governing equation to be of elliptic or hyperbolic type.)

"I visited the headquarters of the Siberian Department of the Academy of Sciences of the USSR near Novosibirsk in June 1965 and gave three lectures in Russian on this work."

All I can contribute are the italics in that last sentence.

● "I want to emphasise," says Mr Roy Jenkins, Minister of Aviation, to an independent-airline audience, "that Government policy in relation to air services is one of expansion and not restriction."

Well, thank heavens for that. For a few ghastly months I've thought it was a policy of restriction.

● Our Neddle does say the oddest things. "No part of the benefit of the BOAC write-off will find its way into the pockets of Cunard shareholders," he declares in Parliament.

Mr Jenkins knows as well as I do that



Starting can be quite difficult these cold mornings

Gnat being moved at RAFA display, North Weald

this is humbug. In the past decade BOAC has lost at least £25 million developing its western routes. This £25 million is a quarter of the BOAC write-off—and Cunard have benefited from it since the day BOAC-Cunard started operations on June 24, 1962.

In fact, BOAC-Cunard's managing director, Mr Ross Stainton, asked whether Cunard was making a retrospective contribution to BOAC's losses, said in *Flight* for March 26 last year:

"Cunard entered the agreement looking forwards and not backwards and they are not responsible for any of our past losses. . . ."

How is it possible for Mr Jenkins to say that no part of the BOAC write-off will benefit Cunard?

● Sir Arthur Vere Harvey (Con, Macclesfield):

"What are we coming to in this country, with suggestions that we have failed, when, in fact, we have one of the great successes of all time? The VC10

is probably the best aircraft in the world today.

"The Minister spoke of a load factor of up to 85 per cent. I was told the other day that Sir George Edwards, leader of the design team, wanted to fly to New York recently and he could not get a seat on a VC10. It is invariably full, and he had to fly on a Boeing. How degrading for him!"

● Just before his recent retirement Mr P. C. Garratt, president of the de Havilland Canadian company, was still flying his Beaver to and from the Downsview plant in Toronto. Mr Garratt, 72, has held a pilot's licence for nearly 50 years and commuted to and from de Havilland since 1928. His Beaver, a bright yellow amphibian, was the 1,000th and was presented to him by his employees.

One of them, Mr William Brown, an aircraft fitter, lived near Mr Garratt, who gave him a lift to the plant each morning. Last August, when the United Automobile Workers went on strike against de Havilland, Mr Brown had to picket the plant. Mr Garratt, company president, continued to fly Mr Brown, striker, into the plant each morning.

● From the *Isle of Wight County Press*:

"While walking on the cliff path towards Sandown on Wednesday week, Mr and Mrs G. H. Cooper, of Sandown, saw a mysterious object in the sky over Lake. It hovered for a while and then shot upwards at a terrific pace and disappeared into cloud. Mr Cooper described it as having a white centre surrounded by a glowing blue ring."

All the lines were out of order when I tried to ring a Westland hovercraft spokesman. I hope they're all right down there.

● "These aircraft deals with the Americans are like borrowing a shilling off your neighbour to gas yourself with."

ROGER BACON

It'll never sell



Paulhan's triplane, 1911