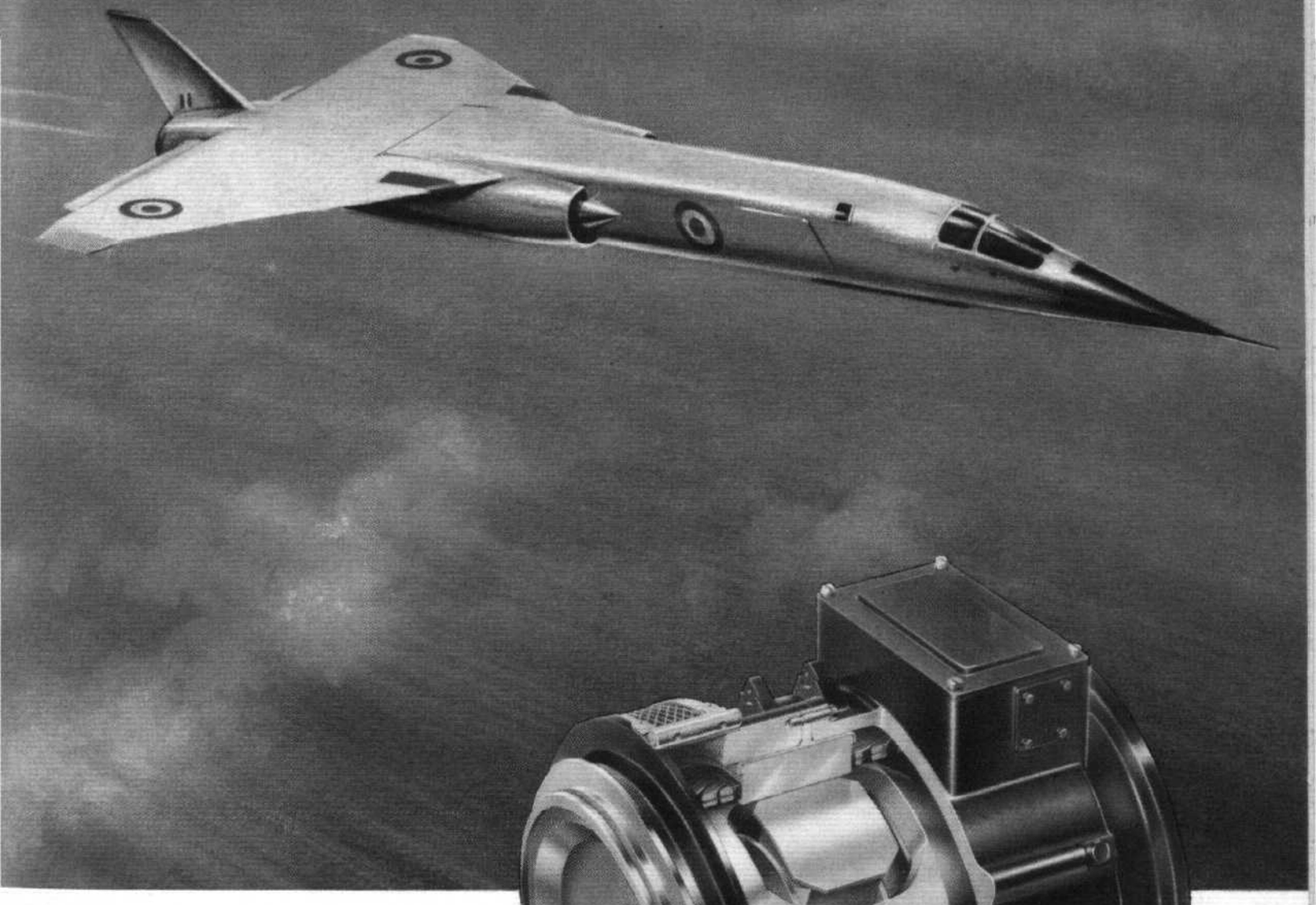
JANUARY 1965

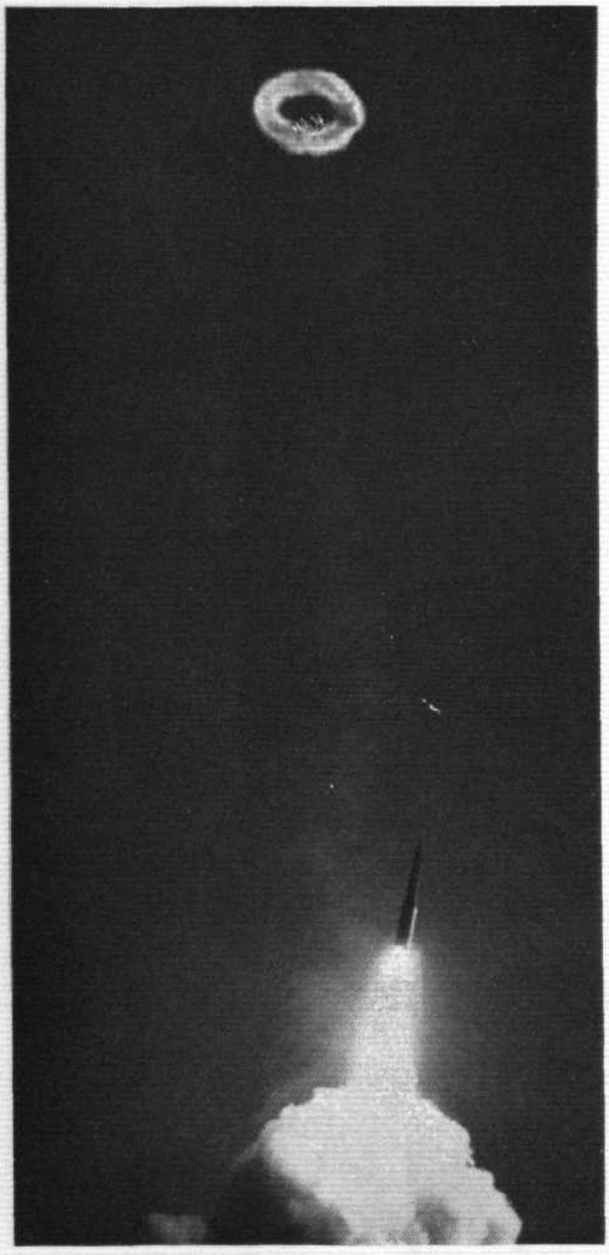
ONE SHILLING & SIXPENCE

FLIGHT

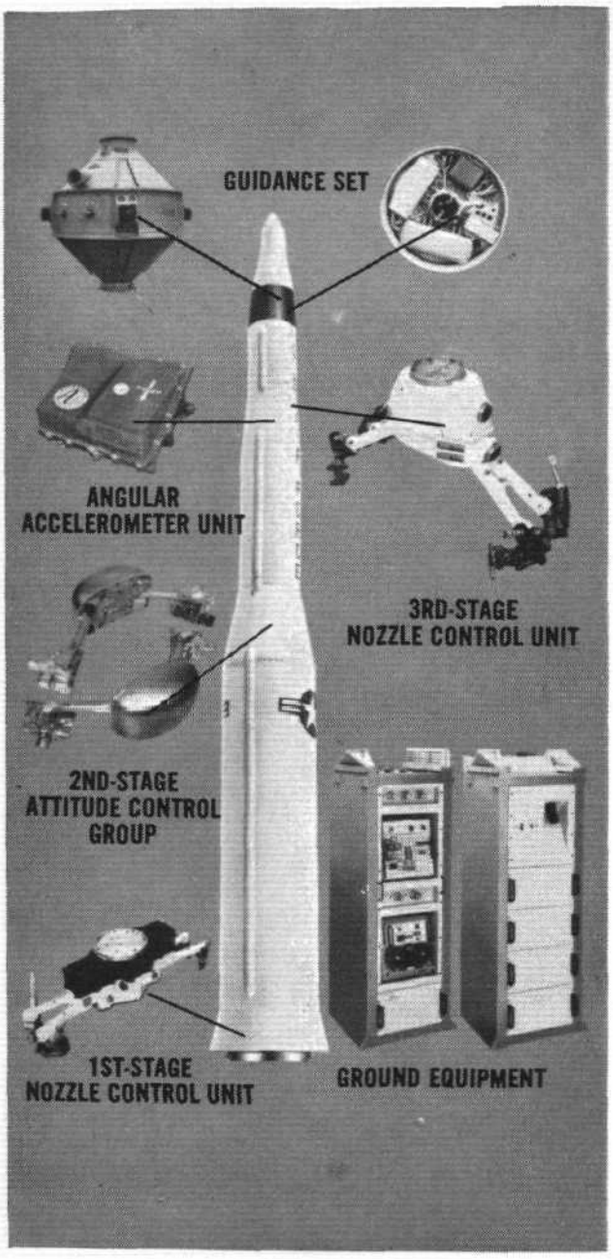
International



MINUTEMAN II SCORES COMPLETE SUCCESS ON 5000-MILE MAIDEN TEST FLIGHT



IT WAS THE FIRST MISSILE FLIGHT WITH FULLY-INTEGRATED MICROELECTRONICS SYSTEMS



The first flight of the Minuteman II represents a breakthrough in the application of microelectronics to military and space systems. The guidance, control, and checkout systems for the Minuteman II were designed, developed, and produced for the U. S. Air Force by NAA/Autonetics and its nationwide team of suppliers.

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FLIGHT International

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A Business Decision . . .

A DECISION on TSR.2 will be made by the Government shortly—probably before the end of this month. Let us look at the two big questions the decision-makers have been asking, and try to provide the answers. The questions are easy; the answers are difficult, because so few of the essential facts are available.

The questions are these: if TSR.2 is cancelled, what will be the advantage to the national economy, and what will be the effect on the national defence?

In round terms, about £190 million has been spent on research and development and on the construction of nine pre-production aircraft. As far as can be ascertained, a further £50m has been committed to sub-contractors and suppliers and to the purchase of materials and tooling for 30 production aircraft. Cancellation will therefore involve the writing-off of perhaps £250m, including compensation to contractors. The saving will amount to the cost of 140 aircraft—the RAF requirement—at £2½m each, or £3m each including introductory costs, spares and equipment such as automatic check-out systems and training simulators—a total of £420m over four years, or £105m a year.

This is a big saving. But what would be the cost of importing F-111As to meet the requirements of the national defence? Unit cost to the Australians is £2.2m, including spares. The cost of 140 at this price would therefore be £308m, plus at least £20m for equipment and more for any modifications from USAF standard. This total could easily reach £340m, compared with the £420m for TSR.2.

The figure could be reduced, or at least the balance of payments problem eased, by licence production in Britain, or if the Americans would be prepared to sell for less to the RAF than to the RAAF—customer discrimination that would not please the Australians. Re-engining with Rolls-Royce Speys would not reduce the cost to the taxpayer, even if General Dynamics were willing (which seems unlikely) to do the conversion engineering for nothing.

. . . and its Effects

As an exercise in straightforward economics, the cost-saving is relatively small; and four other items must be put in the balance. First would be the effect of cancellation on main and sub-contracting manufacturers, on both design and production staff. BAC might well dissolve into its original constituent parts. Second would be the loss to British technology as a whole of the "spearhead" electronics and systems work that TSR.2 has initiated. Third, and most important, the F-111 does not meet the operational requirements that TSR.2 will fulfil. The F-111 is a terrain-avoidance weapon, not a terrain-following one—and a few hundred feet in attack height above ground level can be decisive in terms of vulnerability. Lastly, the reconnaissance function that TSR.2 is designed to perform in addition to credible nuclear strikes is not provided by the F-111. There is no R in TFX as there is in TSR.2.

The balance of decision could well be tipped if the cost of the programme appears likely to exceed the above estimates, which total £670m. There are sceptics in the Government who are convinced that the total cost will escalate to £1,000m. If the contractors can minimize or cover escalation it is hard to see how, if £250m is already committed, cancellation of TSR.2 can significantly benefit the national economy; certainly it would curtail our defence capability.

WORLD NEWS

MOMENT OF TRUTH?

Following a confidential—yet widely reported—briefing on January 8, Mr Denis Healey, Secretary of State for Defence, is reported to have said that it was "not the duty of the defence forces to act as wet nurse for overgrown and mentally retarded children in our economy." This implied that, in preparing the forthcoming Defence White Paper he wished to take account only of the strict defence requirements of the country and to obtain the necessary equipment as cheaply as possible wherever it might be found. BAC reacted within 36 hours by requesting interviews with the Government and ultimately with the Prime Minister. (On Monday night, as this news went to press, BAC's Sir George Edwards—just back from a Paris talk on the Concorde with Sud's Gen Puget—was meeting the Minister of Aviation in company with Lord Portal, BAC chairman.) Hawker Siddeley, similarly threatened, were not placed in such jeopardy by the implications of Mr Healey's reported words.

It now remains to be seen whether the many other factors will outweigh Mr Healey's apparent intention to get the most for the least, regardless of the consequences.

On the same day the MoD announced that a study to determine the most efficient and economical organization for the control and employment of air power in support of national defence policy is under way, and is being made by Field Marshal Sir Gerald Templer, Admiral of the Fleet Sir Caspar John and Air Chief Marshal Sir Denis Barnett.

The object is to ensure that there is no duplication or overlapping between the Services in such fields as organization and equipment and to rationalize the control and employment of aircraft for all three Services to the greatest possible extent.

CONCORDE COST

The Minister of Aviation, Mr Roy Jenkins, said in the Commons on November 5, that the cost of the Concorde was "at least £280m." In *Flight* of December 31 we said that the latest Concorde cost estimate, up to certification stage, had increased from £280m to £350m.

The British Aircraft Corporation says that the cost of the Concorde up to certification stage still stands at £280m.

CONCORDE GO-AHEAD?
page 43

EUROPE'S COMSAT PLANS DISCLOSED
page 57

BRITISH BUILD-UP IN MALAYSIA
page 76

TSR.2 TEST PROGRESS

The TSR.2 made its fourth flight from Boscombe Down on January 8. It was airborne for 20min, and Mr R. P. Beamont, the pilot, said it was "making extremely good progress in normal development flight testing." Mr J. L. Dell would probably take over for the next flight.

SA 330 BENCH TESTING

Sud-Aviation have begun running a full powerplant, transmission and rotor rig for the SA 330 combat helicopter, which is to fly "during the first half of 1965." Other static tests have been in hand since August and the first airframe is nearing completion. The SA 330 is to meet French Army tactical requirements for the next ten years.

MORE HS.125 SALES

Hawker Siddeley's best-selling HS.125 continues to net business in North America. By the end of 1964 four more were ordered, bringing North American firm sales to 26, and the grand total to 57.

NOVEMBER'S EXPORTS

British aero exports last November continued at their depressed level, totalling only £6,407,388 against £9,025,659 for the same month the year before. Aircraft and parts accounted for £2,771,898 of the total (complete aircraft contributing only £548,749 and parts sales being worth over £2.2m). Engines and parts to the total value of £3,358,643 were made up by sales of 125 new engines, 47 other than new engines, and parts worth £1,784,968. Instrument sales were worth £184,516 and tyres £92,331.

The cumulative export total for January - November, 1964, was £83,519,148, a poor showing against the total for the corresponding period in 1963, which was £104,988,660.

Industry manpower has recently increased as its export achievements fall. In October last 265,500 people were employed in aircraft manufacture and repair, according to Ministry of Labour returns; this was 500 more than in September and a surprising 3,100 more than in October 1963.

US AWARDS FOR WHITTLE . . .

A significant award has been made to gas-turbine pioneer Air Commodore Sir Frank Whittle by the American Institute of Aeronautics and Astronautics. The AIAA has selected Sir Frank as the first recipient of the Goddard Award—a gold medal and a $10,000 honorarium—which is made "for imagination, skill, persistence and courage in pioneering the gas turbine as a jet-propulsion aircraft engine, thus revolutionizing military and commercial aviation for all time."

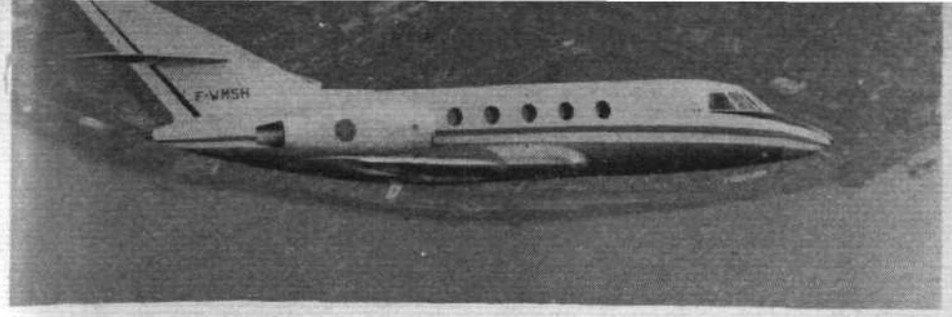
The Goddard Award is named after US rocket scientist Dr Robert H. Goddard and is presented for a brilliant discovery, or a series of outstanding contributions over a period of time, in the engineering science of propulsion or energy conversion.

. . . AND TRUBSHAW

The Wings Club announced in New York last week that the 1964 Richard Hansford Burroughs award, for significant contributions to safety and efficiency of flight by a test pilot, has been awarded to Mr Brian Trubshaw, chief test pilot of BAC (Weybridge).

FURNISHING AND FINISHING . . .
. . . of aircraft interiors will be the subject of special features in next week's issue of *Flight*, dated January 21.

24 Days Ahead of Schedule, *the General Dynamics F-111A moved its wings through the full sweep range during its second flight, on January 6. Take-off was at 63,000lb, and 460 m.p.h. and 27,000ft were reached. Roll-out had been 16 days ahead of schedule and first flight ten days ahead. Pilot sensations of wing-sweeping were reported to be pleasant, with no difficulties and no surprises*



Fan Jet Falcon Aloft *The first production Mystère 20, in the colours of Pan American Business Jets, made its maiden flight from Bordeaux-Merignac on January 1 in the hands of René Bigand and Max Rastel. The flight lasted 1hr 10min; 30,000ft, 350kt and Mach 0.83 were reached. By January 6 five flights had been made, totalling 10hr 20min. The second production machine will fly at the end of this month; the third is destined for the powerplant manufacturer, General Electric, and will be supplied through Business Jets*

TIME TO THE SCILLIES

A United Aircraft International (S-61N) advertisement in *Flight* for December 3 said: "Getting to the Isles of Scilly, 28 miles south-west of Land's End, England, requires more than four hours by boat. By a British European Airways Sikorsky S-61N it takes 15 minutes."

The Isles of Scilly Steamship Co Ltd describe this statement as "completely untrue," and say that "in fact, the average time for the boat journey for the past eight years has been 2hr 45min."

United Aircraft International "regret exceedingly the misstatement" and the Editor is glad of this opportunity to put the record straight.

BS DIRECTORS RETIRE

Air Chief Marshal Sir Alec Coryton, KCB, KBE, MVO, DFC, and Mr H. T. Chapman, OBE, FRAeS, MIMechE, have retired from the Bristol Siddeley board.

Sir Alec Coryton

Mr Chapman

Sir Alec joined the Engine Division of the Bristol Aeroplane Company as managing director in 1951. He became a director and deputy chairman of Bristol Siddeley on the formation of the company in 1959.

Mr Chapman became a designer with Armstrong Siddeley Motors in 1926. In 1951 he was appointed managing director and on the formation of Bristol Siddeley was appointed a director and deputy chairman. He relinquished his deputy chairmanship in 1961 when he became chairman of Hawker Siddeley Industries.

AN AMERICAN FARNBOROUGH?

A proposal for an "American Farnborough" in 1966 has been made to President Johnson by Mr Najeeb Halaby, Administrator of the FAA. He told a news conference at Johnson City, Texas, that it could be held at Dulles International Airport, Washington, and would lay emphasis on American advances in aviation.

WHIRLWINDS FOR BRUNEI

The Sultan of Brunei, ruler of the small oil-rich state in Malaysian Borneo, signed an order for three Westland Whirlwind Series 3 Gnome-powered helicopters before returning home from a two-months visit to Britain last week. The Whirlwinds will be used in general police and internal security work in Brunei, where an Indonesian-inspired insurrection occurred shortly before the Indonesian "confrontation" with Malaysia began.

SOVIET DESIGNER'S DEATH

Simon Kosberg, the Soviet aero-engine designer, died at the age of 61 in a car accident on January 3.

PARIS PROGRAMME

Well over 400 exhibitors of 15 nationalities have now contracted to exhibit at the Paris Aerospace Show at Le Bourget from June 11 to 20.

Main events of the period will be: Official inauguration, Friday, June 11; official missions day, Friday, 18th; international flying demonstration, Saturday, 19th; and "international air parade," Sunday, 20th. The show is to remain open for an extra day—Monday, 21st—for the benefit of technicians. Various categories of aircraft and equipment will be specially demonstrated on particular days yet to be announced.

The show will be open to the public, from 9 a.m. to 8 p.m., every day except June 21st.

IN THE HONOURS LIST

In these pages last week we mentioned some names of aviation people in the New Year Honours. It is now possible to give more detailed extracts, as follows, from the civil sections of the list:—

Knighthoods *KCB:* M. T. Flett, Second Permanent Under-Secretary of State, RAF, Ministry of Defence.*Knight Bachelor*: J. L. S. Steel, chairman, Triplex Holdings Ltd.

CB F. J. Doggett, Under-Secretary (Establishments and organization), Ministry of Aviation.

CMG Ewen Broadbent, formerly Assistant Secretary, Sovereign Base Areas Administration, Cyprus, MoA.

CBE G. H. Hough, technical director, Hawker Siddeley Dynamics Ltd; F. J. E. Tearle, managing director, Associated Electrical Industries (Overseas) Ltd, for services to

(Continued overleaf)

SENSOR

Next week a meeting of Ministers of the ELDO countries will decide how much money Europe will spend on building future space launch vehicles. Last month three top men from the United States' NASA Headquarters spent three hectic, unpublicized weeks in Europe offering a prodigious amount of free payload space aboard large US spacecraft.

If British Eagle buy BAC One-Elevens and put them on to their domestic trunk routes, BEA will respond with Comet 4Bs. This will upset the present Britannia *v* Vanguard competitive balance, and will undoubtedly lead to higher costs.

Hawker Siddeley's 136 small jet airliner project is believed to have de Havilland good looks and style, but it is still as far from being launched as it was in 1961 (when it was the DH 126). The main doubts centre on the cost, possibly as much as £15m, of designing, developing and tooling the aircraft and the engine (Rolls-Royce RB.172 or a Bristol Siddeley product); on the difficulty which small local-service airlines might find generating £½m per aircraft; on competition from the Dart Convair and downgraded Viscounts and Electras; on the need to be small—i.e., 30 seats—and at the same time offer very low seat-mile costs; and on Hawker Siddeley's need to win more orders for the Trident, Argosy and 748 before launching on a new civil programme.

Will Mr Roy Jenkins be the last Minister of Aviation? This question is in the Minister's mind, though his decision will depend on the Plowden committee report which he expects early in the autumn.

Details of the association between Hawker Siddeley Dynamics and TRW Space Technology Laboratories on the forthcoming ESRO 2 satellite are expected to be made known within the next two weeks. This could indicate the pattern for future collaboration between US and European companies in Europe's growing space activity.

Air Racing in the UK should be more interesting this year, thanks largely to the efforts of Mr Norman Ryder, Royal Aero Club Secretary-General. A thousand-guinea race meeting based on the Isle of Man was reported last week; pilots will learn further details of the race calendar at the club's air-racing dinner later this month.

BOAC are really developing their *scheduled* inclusive-tour business, but they may have made a policy mistake in deciding to oppose Caledonian inclusive-tour charter services across the Atlantic. European-style inclusive-tour traffic between Europe and the USA is going to be very big business in a few years' time, when the charter companies and tour operators start mass-marketing £100 all-in ten-day holidays to the USA. Mr Alan Boyd, chairman of the CAB, is known to favour inclusive tours as the next new major promotional development in air transport.

Getting its Feet Wet: *The Turbo Commander, with two 575 s.h.p. AiResearch TPE331s, completing its 15min first flight at Norman, Oklahoma, on December 31. Forty production-line positions are reserved for it and deliveries will begin in June. Details appeared in "Flight" for November 19*

WORLD NEWS . . .

export; A. H. Watson, formerly Chief Statistician, MoA.

OBE A. V. Cleaver, chief engineer (rocket propulsion), Rolls-Royce Ltd; J. E. Gabb, MO (Research), Institute of Aviation Medicine; N. L. Gibbs, chairman, No 1 Welsh Wing, Air Training Corps; K. G. Groves, for services to the RAF; Capt J. R. Jeffrey, chairman, British Air Line Pilots' Association; W. J. Johnson, training manager, flight operations, BEA; J. R. Karran, deputy director (operations), Directorate of Flight Safety, MoA; R. F. W. Keay, director of production engineering, Vickers-Armstrongs (Engineers) Ltd; N. H. Mason, principal scientific officer, Directorate of Materials and Structures R & D, MoA; P. C. Price, Wg Cdr (Trg), HQ Air Cadets, White Waltham; R. H. Sandifer, assistant chief designer (structures), Handley Page Ltd.

MBE R. Archer, higher executive officer, MoD (Air); F. D. Atkinson, superintendent of inspection, MoD (Air); S. G. Bishop, senior experimental officer, Signals Research and Development Establishment, MoA; C. G. Butler, tech Grade 1 (inspection), RAE Farnborough; Wg Cdr H. J. Cowley, lately admin. officer, HQ Middlesex Wing, ATC; V. J. Cox, chief development engineer, Aviation Division, Ekco Electronics Ltd; H. E. Devlin, personnel adviser to chief engineer, BEA; T. J. Lindsay, Controller, Civil Air Services, Hong Kong; Obs Cdr J. P. Pickford, Group Commandant, No 13 Gp, ROC; F. J. F. Properjohns, engineer II, Directorate of Electrical Inspection, MoA; F. C. Seager, chairman No 135 (Reigate and Redhill) Squadron Committee, ATC; Sqn Ldr R. C. Smith, engineer tech Grade I, MoA; A. J. Woodward, works manager, Electronics Department, Ferranti Ltd; S. W. W. Wright, secior security officer (investigation), MoA.

Queen's Commendation for Valuable Service in the Air Capt P. N. Daymon, senior captain, BUA; R. Dickinson, chief test pilot, Flight Refuelling Ltd; Capt H. V. Hubbard, senior captain, 1st class, BEA; R. M. Oliver, chief test pilot, Hawker Blackburn Division (Gnat Section), Hawker Siddeley Aviation Ltd; Sqn Ldr L. V. Worsdell, chief pilot and aerodrome manager, Marshalls of Cambridge; Capt E. R. Wright, senior captain, 1st class, BEA.

FOR THE MOTORISTS . . .

. . . two special numbers of *Autocar*: Tomorrow, January 15—"Holidays Abroad" (and Monte Carlo Rally Guide); January 22—"Racing Car Show Guide" (and Monte Carlo interim report).

press

ROBERT BLACKBURN

"There is deep bitterness among the French people," wrote Clare Hollingworth in *The Guardian* on December 30, "about Britain's reported intention to abandon the Concorde project." Miss Hollingworth's use of the word "reported" was correct because, despite all the stories to the contrary, the Government had not committed itself to anything more than a review of the project. By New Year's day most London papers were agreed, as *The Times's* Diplomatic Correspondent put it, that "the Anglo-French dialogue . . . appears now to be entering into a rather calmer atmosphere." On January 7 the main aviation story centred on the previous day's Cabinet meeting. No statement on the future of Concorde is expected before Parliament resumes on January 19, but there is no doubting the substance of the main line taken by the papers—that the Cabinet had decided that the project would definitely continue. What also seems clear is that, to quote from the *Financial Times*, "the review is not yet complete." For some time, therefore, reports of proposals to trim the Concorde programme down to two prototypes, or to stretch its development to 1974, are likely to be speculative.

The *Daily Express* was overjoyed by reports of the Cabinet's decision, which, said its first leader, would be welcomed by everyone, including "the workers employed in the industry whose jobs will be secured." People working on the TSR-2, the P.1154 and HS.681, which are still under review, may feel that the future of the industry as a whole is far from secure. Friday's *Daily Telegraph* reported flatly that the TSR.2 programme "will be cancelled." It was "almost certain," the *Telegraph* added, that a number of TFXs would be ordered instead.

By giving an interview to the magazine *Der Spiegel*, Herr Werner Kreipe, head of the German Ministry of Transport's aviation department, made headlines in the *Daily Express*, *The Times* and *Financial Times*. According to the *FT*, Herr Kreipe, who is also a member of Lufthansa's board and a former Luftwaffe general, told the magazine that there was a plan to "palm this bloody BAC One-Eleven off on us." *The Times* made it the "damned" One-Eleven and the *Express* omitted the epithet altogether; but from all accounts it was clear that Herr Kreipe thought that Lufthansa would go back to losing money if it bought One-Elevens. Whatever Lufthansa's views on the One-Eleven, I was assured by the airline's London spokesman that Herr Kreipe was airing his own views. And what was the actual word he used? Answer: *verdammt*, which the spokesman considered milder than "damned"; he thought "deuced" or "blooming" would be nearer.

The airlines' best-ever year was the subject of an informative feature article on December 30 by the *Financial Times* air correspondent, Michael Donne. The paper's leader column, picking up Sir William Hildred's forecast that the airlines might make a positive net profit in 1965, was quick to ask "is the current two years' period of fares stability too long?"

Problems with the Bristol Siddeley Nimbus engine made news last week in five national dailies. The engine was not achieving its intended overhaul life, and last year the manufacturer ran an intensive 2,000hr bench and flight development programme to bring it up to the required standard. By December modified engines were being delivered to the Army ahead of the promised schedule, and a fully modified Nimbus has just completed a 400hr intensive flying trial. By normal newspaper standards this is dull stuff, but tension in the Far East made it topical and newsy. Under a front-page headline "Far East Helicopter Force in Blunder," the *Daily Sketch* reported: "The movement of British troops in the Far East is being seriously hampered because more than 100 Scout helicopters have proved unreliable." But a *Western Daily Press* story on the same subject quoted a Defence Ministry spokesman as saying that the problem of the Scout's Nimbus engine "would affect Army operations only to 'some small degree,' if at all." Other reports indicated that most of the 100 Scouts ordered were in service in Borneo. Exact numbers of Scouts delivered, and their disposition, have not been revealed. But I am reliably told that the great majority are not in Borneo and, of those which are there, less than half have run out of engine hours; moreover, the Army has taken delivery of more modified engines than there are Scouts in Borneo.

Finally, a *Flight* leader last week reproved the SBAC for setting up a committee "to put a flea in the ear of Richard Worcester." The SBAC took exception to this; there is no such committee, the Society states.

AIR TRANSPORT

CONCORDE GREEN LIGHT?

AFTER weeks of inspired (and uninspired) guesses about British Government policy on the BAC-Sud Concorde, more positive news—which was undoubtedly inspired—became known last week. Reduced to essentials the news was not much more than a statement on the Government's intentions on the Concorde might be made soon after Parliament re-assembles on January 19.

The fact is that various Ministers were called to attend a meeting at No 10 on January 6. These included the Ministers of Aviation, Defence and Technology—so it was assumed (probably correctly) that the meeting was about the British aircraft industry and the Government's plans for it. It is now believed that the Government will continue with the Concorde project, but will propose a plan to stretch out the period of its development and production. It remains to be seen whether France will agree to this compromise.

The last communication between Britain and France on the subject of the Concorde project was an *aide memoire* delivered by the French Ambassador to the Permanent Under Secretary at the Foreign Office on December 18. This was in reply to the British memorandum of December 4, which set out the form and extent of the review which the British Government thought to be essential before proceeding with the project.

ONE-ELEVEN ON THE ROUTES

BY the time this issue appears BAC One-Eleven G-ASJI, the ninth destined for British United Airways, may have left Gatwick for Genoa at the start of an intensive 200hr four-week route-proving programme. To be conducted jointly by BAC and BUA crews, this proof-of-the-pudding programme should be the short-haul airliner's final hurdle before full certification.

On a typical day's operations the route-proving One-Eleven will make four return flights—to Genoa, Jersey, Malaga and Majorca. All these trips—giving a total daily mileage of approximately 7,500 miles, in an elapsed time of about 14hr—will be based on a 60min turnround at the destinations to simulate the type of high-intensity operation for which the One-Eleven was designed. Other points to be included in the programme are Barcelona, Gibraltar, Las Palmas, Tenerife, Amsterdam and Rotterdam in Europe, and Bathurst, Freetown and Accra in West Africa—all BUA destinations to be served by One-Elevens.

BUA's preparations for the new aircraft are well in hand—even coming so hard, as the One-Eleven does, on the heels of the newly acquired VC10 fleet. Regular commercial services should have settled down very well by the beginning of the summer rush (including that of Easter); 34 crews (68 pilots) should be operational by the end of May and a full fleet personnel strength of 40 crews (80 pilots) should be available soon after. All ten of BUA's One-Elevens should be delivered by May.

The Hurn production line has already turned out 12 One-Elevens which have accumulated around 1,400hr on 950 flights involving some 1,650 test and training touch-downs. Fourteen more aircraft are in an advanced stage of assembly including the first for Aer Lingus and Mohawk. Components are in production for 80 aircraft; the number of aircraft ordered stands at 74 with another 16 on option; 50 are to be delivered this year. First deliveries, to BUA and Braniff, are scheduled for next month.

IS BOAC'S RUBBER AXE WORKING?

INITIAL results of Sir Giles Guthrie's plan for voluntary early retirement within BOAC (*Flight*, October 8, 1964, page 619) are expected to be available within a few weeks. No figures are yet to be obtained from the corporation, but a BOAC spokesman says, nevertheless, that the management is "most satisfied" with the results of the scheme so far.

This scheme has now been in action for the first three months of a preliminary period of about two years. The target for this first three months has, the spokesman said, been "quite considerably"

This picture of a section of one of the two final assembly lines at BAC's Hurn, Bournemouth, plant shows the first One-Eleven for Mohawk Airlines and another for Braniff Airways. The bright-finish aircraft in the centre is one of two 400 Series development prototypes. This series has been ordered by American Airlines and Philippine Air Lines

First Antonov An-24B to be seen in Britain was one operated by Lebanese Air Transport (OD-AEN). This photograph of it was taken at Prestwick during the An-24's 4hr transit stop on January 1. Reports from Prestwick said that it had come from Amsterdam and was going to Keflavik, Iceland. Ultimate destination was given as Nassau, Bahamas. It carried no passengers or freight. From February 1 the operator's name will be Lebanese Overseas Airways (see "Flight," December 24, page 1068)

AIR TRANSPORT...

exceeded and "many hundreds" of applications for early retirement are being considered by the management.

The plan is that some 3,700 among the 20,600-strong employee force (of September 1964) should leave voluntarily with appropriate compensation during the next two years. By the end of 1966 it is hoped that about 1,830 from engineering, 610 from flight operations (including some 110 pilots), and 1,260 commercial staff and service department members will have enjoyed golden "handshakes" in amounts based on their salaries and lengths of service.

The aim is to ease out those in the middle- and late-middle-aged groups who might prefer early retirement (with compensation), or who feel that they are capable of making a new career elsewhere with the help of compensation sufficient to tide them over the "look-out" period. BOAC's management meanwhile retains the right, subject to the individuals' decisions, to choose those who go and those who stay—by means, presumably, of financial encouragement or otherwise.

Total cost of the "rubber axe" programme was, last September, expected to be about £5m. A sum of £12.4m was set aside for "special provisions" in the accounts for 1963-64 which were published on November 5. The majority of the early retirements among the expected 3,700 are likely to be agreed during the first 18 months of the two-year period, so it may be assumed that about 500 have already agreed to go, or are among those whose applications to leave and be compensated are being discussed.

The whole operation will continue to be an extremely delicate one, not only for the staff members concerned, but also for the management of a nationalized business which must inevitably make some attempt to keep its policies in line with those of other industries which, though comparable in the eyes of the general public, are really not so very similar.

GERMANY AND THE ONE-ELEVEN

THE campaign in Germany which has been so damaging to the British aircraft industry—and to the British Aircraft Corporation and the One-Eleven in particular—came to something of a head last week when the journal *Der Spiegel* published some acid, angry (and unreasonable) comments by Herr Werner Kreipe. This campaign has been against "British attempts to pursuade Lufthansa to buy BAC One-Elevens" as a means of dealing with the balance of payments deficit.

Herr Kreipe's comments were particularly unfortunate because not only is he head of the Aviation Department of the Federal Ministry of Transport, but he is also a member of Lufthansa's board of directors. He said to *Der Spiegel* that German purchases from Britain to ease the payments deficit should consist of arms and equipment—but now, he added, the British have come upon the "glorious idea of palming off their damned BAC One-Eleven on us." He went on to criticize the One-Eleven's characteristics and to say that Lufthansa's technical and commercial staff were unenthusiastic about it. He protested against the purchase of a "political aircraft" from Britain and said that its purchase would "drive" Lufthansa "into a new deficit."

Herr Kreipe really should know better. Whatever the pros and cons of the suggested means for dealing with the balance of payments problem, nobody on either side imagines for one moment that Lufthansa will, in the end, be forced to buy any aircraft which does not suit its needs and does not show positive economic and engineering advantages. The One-Eleven is a *commercial* aircraft, is being sold as such, and Herr Kreipe, his Ministry and Lufthansa must know this perfectly well.

1964 TRAFFIC INCREASE BIGGEST FOR DECADE

BIGGEST increase in world passenger-miles since 1955 was recorded by international and domestic scheduled airlines of ICAO member states in 1963-64. The increase, of 17 per cent, equals that for 1954-55 and has been exceeded, since 1946, only by the 25 per cent increase recorded in 1950-51. Cargo ton-miles in 1964 showed an increase of 20 per cent on the figure for 1963.

The traffic figures for 1964 as estimated by ICAO, are 156m passengers carried (135m in 1963), 107,000m passenger-miles (91,500m) and 2,690m cargo ton-miles (2,240m). Passenger numbers have almost trebled in the past ten years.

STILL THE SAFEST YEAR

ADJUSTMENTS to last week's table of fatal air carrier accidents (page 5) still leaves the statistical safety level for 1964 as the highest in any year for scheduled services. The October 2 accident to a Union de Transports Aériens DC-6B should have been noted as one of those on scheduled services. This modification brings the provisional total up to 656 passengers killed on scheduled services. Using ICAO's estimated scheduled-service passenger-mile total of 107,000m, the fatality rate per 100m passenger-miles is increased to 0.61—which is a reasonably low figure, but not quite as low as that originally estimated (0.545).

There are likely to be other modifications before any final accident-rate figures can be stated with reasonable certainty, but that of 0.6 fatalities per 100m passenger-miles is likely to be approximately correct for the world's carriers outside the USSR and China.

Preliminary figures from the US Civil Aeronautics Board show that, on the same basis, the passenger fatality rate on the scheduled services of US certificated route carriers was 0.27 for 1964 by comparison with 0.23 for 1963. For the third consecutive year there were no passenger fatalities on the civil and military operations of supplemental air carriers. In 1961 the rate for these carriers was the very high one of 9.7 per 100m passenger-miles; in the three years 1956, 1957 and 1958 there were, again, no fatalities.

The US passenger death rate on scheduled services has been less than one per 100m passenger-miles every year since 1951. Highest rate was 0.86 in 1952 and the lowest was 0.07 in 1954. In 1964 there were 200 passenger deaths in nine fatal scheduled air-carrier accidents. Highest number of US scheduled passengers killed in any one year since 1951 was 336 in 1960.

ONE-ELEVEN BLIND LANDING

THAT automatic landing is a desirable capability for all categories of transport aircraft is now beyond serious doubt; the facility is even being developed for application to the smallest of executive jets. Nevertheless, the path to full "zero-zero" weather minima is still a long one—though well defined for the BAC One-Eleven.

While this new short-hauler is now on the eve of commercial service, one test aircraft is being made ready for actual low-weather-minima trials. The first stage, using minima of 100ft cloudbase and ½-mile visibility, should be approved before the next European winter. Development flying to the stage 2 minima of 100ft/280yd (with Type 4 equipment, described later) should begin next January.

How feasible are automatic approach and blind-landing systems? The answer, of course, lies in the acceptable failure rate. BAC has assumed (in line with the airworthiness authorities) an acceptable dangerous failure rate of not more often than once in 10m landings. The common electronic autopilot forms the basis of most currently proposed automatic approach and landing systems, yet with present production and inspection techniques the mean time between failures is 250hr to 500hr, giving, in the present context, an unacceptable incident expectancy of 1 in 10,000. However, a duplicated self-monitoring system (as in the VC10 for instance) can meet the 1 in 10m safe landings requirement even with an equipment mean-time-between-failures of only 26hr per channel.

The aircraft's basic systems, on which the automatic controls rely, obviously must be no less reliable. The One-Eleven has a fail-safe structure and fully duplicated and independent systems. Other notable features are: considerable surplus electrical generating capacity; the minimizing of the work-load of two-man crews; and an unsurpassed field of view from the flight deck. Good flight-deck visibility is fundamental to correct pilot participation in automatic approaches and landings. The One-Eleven is the first aircraft to meet the FAA's vision requirements without concession. The 20° downward view below the fuselage datum (compared with 10°-15° on most current jets) permits an additional 100yd of approach lighting to seen at 100ft on finals.

British research into blind landings has been under way for at least ten years. The only major change of principle has been that high-precision ILS developments have replaced the leader cable for azimuth guidance of the aircraft. A Standard Telephones ILS localizer at Hurn achieves centre-line displacements of less than 5ft.

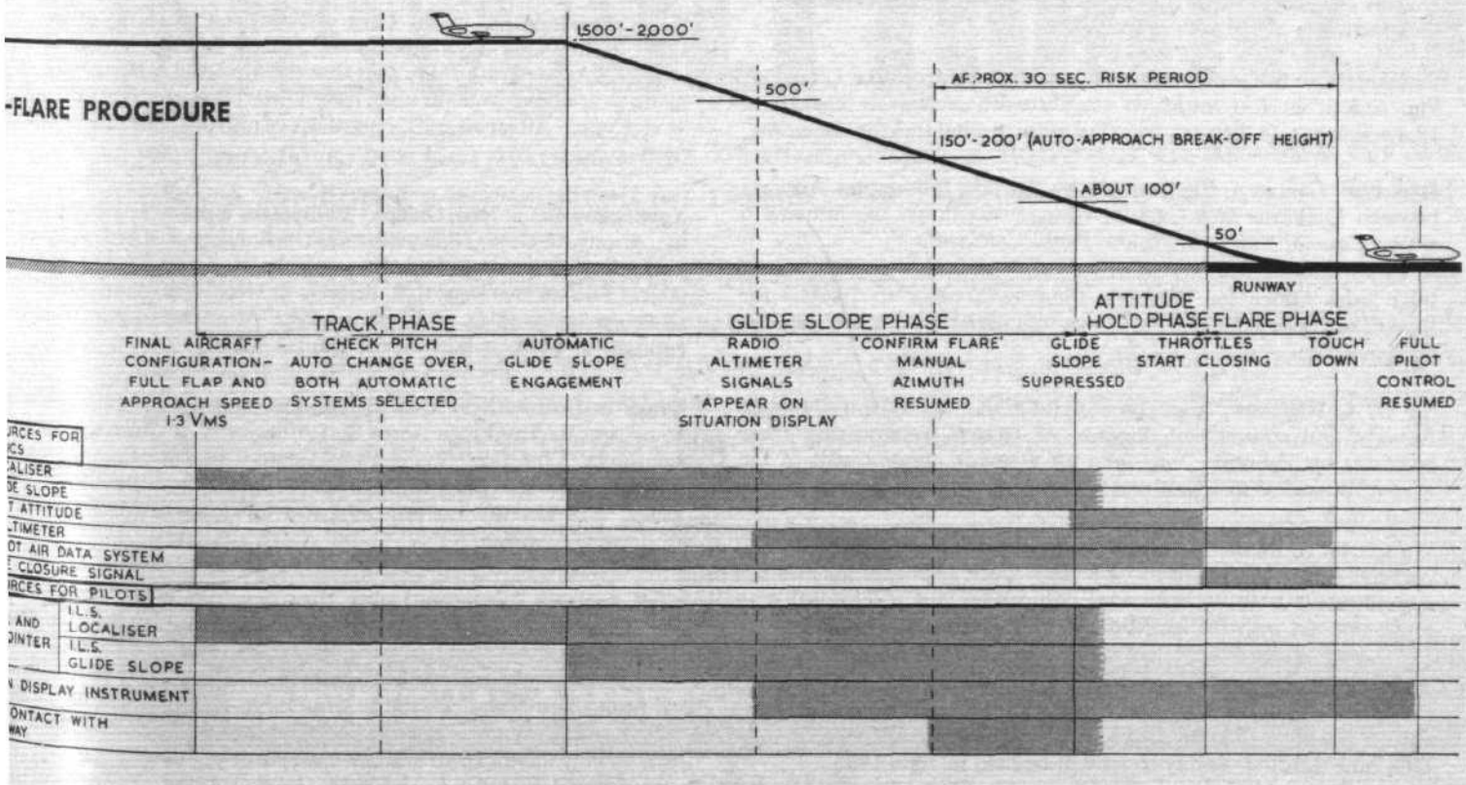
Eventually, six types of automatic approach equipment will be approved and offered to One-Eleven customers. The likely weather minima for each system have been assessed by BAC following informal discussions with the ARB, BLEU and the MoA.

One-Eleven Type 1 automatic approach equipment comprises the standard Elliott 2000 basic autopilot with separate pitch and azimuth computers and pitch monitor. The fully proven system will have an autopilot break-off point no higher than 150ft and will be cleared for 200ft/½-mile weather minima. Type 2 will simply have the addition of a lateral monitor on the autopilot (and an advanced flight director) to give a completely disturbance-proof disconnect in the event of a runaway. Weather minima will not be less than with Type 1 but the autopilot will be cleared down to the beginning of flare-out at 50ft.

The addition of a single autothrottle unit, radio altimeter and monitored radio, to form the Type 3 system, will permit a halving of the weather limits to 100ft/¼-mile, but still retains the 50ft autopilot disengage point. The autothrottle working from air-data sensor inputs will control speed to within 3kt; the recommended STR 53-A radio altimeter has already produced accuracies of ±1ft at touchdown over many thousands of BLEU and FAA trials.

Automatic touchdown, in simplest form, will first be offered by the Type 4 equipment (Type 3 with the addition of single-channel auto-flare). Automatic flare is achieved by feeding the autopilot with the commands of a self-monitored computer programmed to the exponential flightpath flare-out (as developed by BLEU) and

The various phases of a One-Eleven automatic landing. The complete approach and landing sequence is as follows. First set runway heading, tune ILS and localizer. Set the approach speed and engage autothrottle. Select the glideslope to "auto" (situation display unshutters). At or before reaching the glideslope, select final approach flap and undercarriage down and adjust airspeed. Check radio altimeters with test switch. Engage second pitch channel and check automatic change-over. Assume azimuth control and continue to land if all indications satisfactory at break-off height. Check flare initiation. Disconnect automatics after touchdown



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with the application of the accurate height information provided by the radio altimeter. For all types of equipment up to and including Type 4 the procedure in the event of a system malfunction is to overshoot. For monitoring of the whole system a situation display, measuring 1¾in × 11in, faces the pilot. The instantly readable indicator shows the maximum beam-capture capabilities during an approach and an indication of correct functioning or otherwise of all other units of the system. The minima for Type 4 are expected to be 100ft/280yd.

Type 5 involves simply the addition of duplicated auto-flare to Type 4. In itself this may offer no reduction in statutory weather minima but it will offer greater security and result in the change of philosophy to one of "continue in the event of malfunction."

The ultimate stage will be offered in Type 6 for which weather limits will be zero/50yd. The system will be as Type 5 except for a second azimuth control, to complete system duplication, with automatic change-over. No official time limit has been set for the availability of Type 6 but the system principle is being developed on the VC10 under a Government-sponsored programme.

INCLUSIVE-TOUR APPEAL ADJOURNED

THE appeal by British European Airways last week (January 4) against the granting of inclusive-tour licences for Malaga and Valencia to four private airlines was adjourned without the hearing of evidence. The Commissioner, Sir Arthur Hutchinson, said that the appeal was to be adjourned provisionally until January 12 in the hope that by then the Minister of Aviation would have made known his decision on a similar appeal by BEA over the Palma IT services (*Flight*, December 17, page 1034).

No Longer "Cigarettes Only Please" BEA now permits pipes and cigars to be smoked in the aircraft on its services.

Mr Keith Morrice has been appointed sales promotion manager for UTA in Britain. Mr Morrice joined UTA's predecessor in 1958.

A C-46 of Zantop Air Transport crashed during its approach to Detroit on December 30 during a cargo flight from Cleveland. All four members of the crew were killed.

Pan American to Use Kerosene It is reported from the USA that Pan American is in future to use kerosene exclusively instead of JP.4 which has, in the past, been the more normal fuel for the airline.

Djakarta - Canton First service by Garuda Indonesian Airways between Djakarta and Canton, China, was flown on January 6 with a Convair 990A via Phnom Penh, Cambodia.

Irish Sales Office for BOAC First sales office in Ireland for BOAC has been opened. Previously the reservations were handled by Aer Lingus.

Mr D. A. Whybrow, chief commercial executive of British United Airways and commercial director of BUAF, relinquishes these positions on February 1 to take up a senior appointment in the Leroy Tours Group which was acquired by Air Holdings last year.

Wg Cdr H. A. Roxburgh has retired as chairman of British Midland Airways—previously Derby Airways—and also relinquishes his appointments with its associated companies, but will continue to retain contact with British Midland in a consultative capacity.

An International Aerospace and Science Exposition proposal has now been announced by Mr N. E. Halaby, administrator of the FAA. It will be sited at Dulles International Airport, Washington, DC, and the first 10-day show will be held in June 1966.

Mr Frank Marshall has been appointed a director of British Midland Airways. He has been the airline's technical manager for the past two years and joined Air Schools at Derby in 1940.

Aero-Nord is the name of a new Danish charter and IT operator which has bought three DC-7Bs from American Airlines. Management and most of the staff were formerly with Nordair which ceased operations a few months ago.

BOAC Appoints Scottish Cargo Officer Mr Alec Mackie has been appointed to a new BOAC post with responsibility for advising industry and commerce on export problems and to develop air freight.

British Westpoint Airlines has suspended all flights between the West Country and London during January and February. Reasons given are the uncertain weather and the need to complete aircraft major overhauls.

A Contract for a Third F-27 has been signed by East-West Airlines of Australia, which has just taken delivery of a second F-27. Total F-27 sales in Australia now stand at 28 out of a world total of 289, including 107 by Fairchild Hiller.

Japan Air Lines Fleet Requirements A total of 20 DC-8s are expected to be needed by JAL during the next three years. Six more Boeing 727s may also be ordered to supplement the airline's present order for six.

Strike of BOAC Crews in the USA was called off on January 7 after six weeks. The strike has effectively stopped BOAC flights to and from Boston, Chicago and Detroit, though the majority of services to and from New York have been unaffected.

Extension of Kingford Smith Airport's N/S Runway is now well under way. According to reports from Sydney, a total of 1.5m cu yd of sand has already been dredged from Botany Bay. When completed, the runway will be 8,500ft long and will extend 3,000ft into the Bay.

Lufthansa's Short Haul Fleet Needs A total of about ten short-haul jets are likely to be required by Lufthansa initially and about ten more within a year. If there is no decision to go ahead with the Boeing 737—or if it is delayed for several months—Lufthansa will, says *Aviation Daily*, be in the market for BAC One-Elevens or DC-9s.

DME Requirements in the USA The FAA plans to extend its DME equipment requirements to include foreign aircraft flying in the USA. *Aviation Daily* says that the proposal is that all aircraft flying at or above 24,000ft must have DME equipment by December 31 this year. All jet aircraft, regardless of altitude, must carry DME by this date.

Application for a New Guinea - Philippines Service has been made by Ansett-ANA to the Australian Minister of Civil Aviation. According to *Interavia* DC-6Bs would be used initially and Electras later. The airline says that there is a weekly demand for 25-30 seats on the service at present. Port Moresby airport is large enough for Electras but not for Qantas 707s.

Crash in Costa Rica An unspecified freighter aircraft reported to be operated by Linea Aérea Sud Americana of Chile, crashed on the slopes of the Turrialba volcano, Costa Rica, early in the morning of December 30. Six people, apparently all crew members, were killed. The aircraft was returning to Chile after delivering a cargo of horses to Mexico.

Civil Aviation Expansion rather than new roadways is judged to be the need in many parts of Africa according to Mr Edmond Hutchinson, the US aid director for Africa. Mali and Chad, former French West African colonies, have been cited by Mr Hutchinson. In Mali there is the possibility of a cargo link between the inland cattle-producing areas and the coast; in land-locked Chad, flooding is a serious handicap to surface transport.

A NEW JET TRAINER

British Aircraft Corporation has been awarded a contract to develop for the Royal Air Force a pressurised jet trainer, the BAC 145, to be known in the RAF as the Jet Provost T Mk 5.

Design of the BAC 145 is backed by the experience already gained in over 300,000 Jet Provost flying hours and in producing already more than 450 Jet Provosts for the RAF and five overseas Air Forces. Jet Provost flight experience, supplemented by exhaustive fatigue research carried out during actual flying training programmes, enables an airframe life of 15 years, assuming normal utilisation, to be confidently forecast for the BAC 145. Versatile, and as reliable as the Jet Provost, it retains the well-proven Bristol Siddeley Viper engine and, with its pressurised cockpit will allow protracted training exercises to be carried out at high altitude in safety and comfort thus widening still more the scope of the syllabus that can be undertaken by a single aircraft type.

BRITISH AIRCRAFT CORPORATION

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AIR TRANSPORT . . .

GOOD YEAR FOR BOAC

A WORLD-WIDE increase of about 20 per cent in total passengers carried on scheduled services was recorded by BOAC in 1964 in comparison with 1963. The two figures were 1,139,000 and 946,231 respectively. Total for scheduled and non-scheduled operations was 1,212,100 by comparison with 1,043,374—an increase of 16 per cent.

North Atlantic results showed, as for most if not all of the other 18 airlines on the route, the biggest increases (see *Flight*, December 31, page 1106). On this route a total of 440,600 passengers were carried (17 per cent up), including those on charter and inclusive-tour flights. More than 317,000 were flown between the UK and USA.

INADEQUATE INVESTIGATION CO-OPERATION

A MAJOR issue at the January 19 ICAO meeting in Montreal is expected to be the question of international co-operation (or lack of it) in accident investigations. The US airline and manufacturing industries are concerned about the variations in the amount of co-operation between US investigators and foreign governments in investigations of accidents involving American aircraft and citizens.

After the recent TWA take-off accident at Fiumicino, for instance, the Italian Government invited both the CAB and the FAA to take part in the investigation. On the other hand there have been accident investigations to which no US representatives have been invited. Cases mentioned by *Aviation Daily* include the Air France 707 take-off crash at Orly in June 1963, when 130 persons, many of them US citizens, were killed and the CAB was not allowed to participate. No report on this accident had yet been received by the US authorities. The report on the Sabena 707 accident in February 1961—in which all the US Olympic skating team members were killed—was eventually received last year.

SOFT-FIELD LANDING GEAR

BOEING's soft-field landing gear has now become the subject of a patent application by the three inventors—Wendell B. Fehring, Friedrich W. Scherer and Lloyd E. Shuman, of the company's product development organization. Tests were made last year with an experimental gear fitted to Boeing's Dash-80 707 prototype on Harper Dry Lake, California (Air Commerce, *Flight*, October 1, 1964, page 582).

The patented gear includes extensible axles for spreading the load, and a self-jacking feature so that wheels can be changed and the aircraft "walked out" of soft earth. It is claimed that the wheel separation increases the undercarriage's "flotation capability" by from five to 50 times with the same number of wheels.

The specification is for a four-wheel unit with two wheels on each side of the supporting strut. The axle on which the outer wheel is installed telescopes with that for the inner wheel. The wheels on each side of the unit can be spread apart and are returned to a closed position for retraction. Brakes are provided on both inner and outer wheels.

When the undercarriage is being self-jacked, hydro-pneumatic or other power is used to extend the landing-gear strut. When two units are installed on each side in tandem, this self-jacking makes it possible to change wheels without the need for wheel jacks. The system also allows the aircraft to be moved under its own power when stuck in soft earth. In this case first one landing gear unit would be raised and a supporting surface placed under it. The gear would then be extended, lifting the aircraft. The second unit would be jacked clear and similarly supported so that the aircraft could then be moved under its own power.

ACE FREIGHTERS' YEAR OF EXPANSION

AVIATION CHARTER ENTERPRISES, better known as Ace Freighters, the all-cargo carrier based at London Gatwick Airport, continues to expand. First operational with one L-749A big-side-door Constellation last March 1, the company soon acquired a DC-4 as the *ad hoc* all-cargo charter business began to develop.

By March 1 this year Ace Freighters expect to be operating eight aircraft—two DC-4s and six L-749 Constellations. Four of the Connies have already been bought from South African Airways and are being made ready. Their small doors are not expected to be a handicap yet; much of the present traffic is in the form of small packages.

Mr Mike Cullen, formerly aircraft sales manager of British Eagle, and recently appointed commercial manager of Ace Freighters, told *Flight* last week how business in the first nine months' operations had been well up to expectations. "We certainly have no qualms now about being purely and simply an all-cargo airline." The freedom from passenger-handling considerations has obviously let Ace make an uncompromised attack on the much talked-about "air-freight potential."

ICAO's AFRICAN PLANS

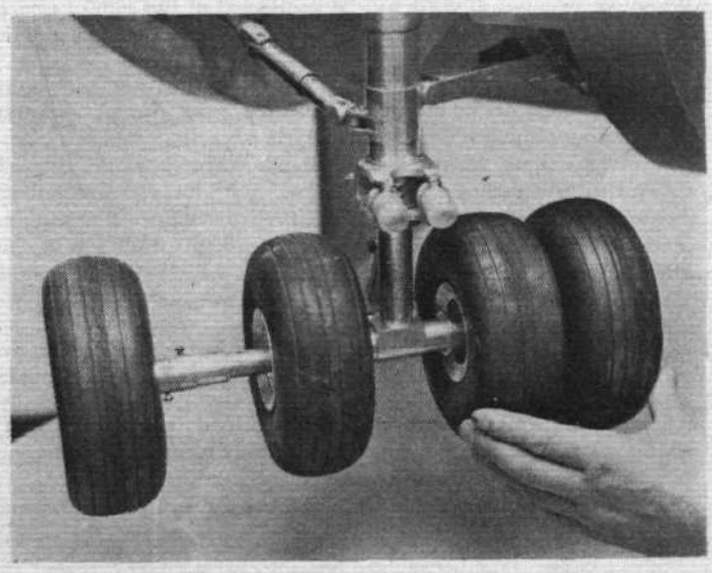
THE ICAO Africa-Indian Ocean Regional Air Navigation meeting in Rome just before Christmas agreed to a five-year programme of improvements to be made to all parts of the air transport infrastructure throughout the region.

The meeting, when dealing with communication facilities, concluded that the present service for carrying point-to-point messages was largely obsolete. A new network of some 90 radio or landline teletypewriter circuits was required. For more rapid co-ordination between various area and FIR controllers 85 new direct-speech circuits were proposed. Necessary improvements in the actual ground-to-air communication system were agreed, and included better quality transmissions and a draft plan for more meteorological broadcasts. A new departure for the region was the proposal for extended-range VHF speech communications.

On the difficult question of ground navigation aids, DME, as an approach aid, is recommended for the first time in the region. Two terminal-area radars were recommended—for Dakar and Cairo. ATC services covering the climb and descent phases should always, it was agreed, have priority over other requirements.

Airport facilities are also scheduled for improvement. With the emergence of independent nations many airports dealing only with local-service airliners are now faced with the prospect of longer-haul international services. Fifty-eight airports, already operational in the latter category, are judged to be in need of major improvement. The aerodrome plan embodies improved specifications for visual aids, including approach lights and runway markings; a requirement for Visual Approach Indicator Systems in the region has been introduced for the first time.

A model of the Boeing soft-earth landing gear (see story on the left) which has extensible axles, for distributing the aircraft weight when the undercarriage is down, and self-jacking capability



AIR TRANSPORT...

MALAYSIAN'S 1963-64 REPORT

A POINT made in Malaysian Airways' annual report for 1963-64 (to March 31) was the big increase in traffic—particularly between Malaya/Singapore and Sabah/Sarawak—following the creation of the new nation of Malaysia. This growth, described in the report as being "totally unpredictable," was 39 per cent by comparison with the 12-15 per cent growth in previous years.

An operating profit of £120,000 was recorded. This represented a 37 per cent increase over the figure for the previous year. Total traffic revenue increased by 24.6 per cent to £3,460,000. Profit before taxation was £70,000; after adjustments the amount available for appropriation was £93,000.

GOOD YEAR FOR AIR CANADA

AS for other North Atlantic carriers, Air Canada's biggest passenger traffic increase (19 per cent) in 1964 was recorded on this route. Greatest amount of passenger traffic for the airline (93 per cent of the total) is carried over North American routes and the increase for this traffic, in passenger-miles, was 3 per cent.

Overall, Air Canada's passenger total in 1964 increased by 5 per cent to 4,070,000. Total passenger-miles, at 2.889m, showed a 7 per cent increase over the figure for 1963. Freight recorded the biggest increase—of 26 per cent to 40m ton-miles.

After paying interest the airline showed a profit for the 11th time in 14 years. Gross revenues topped the $200m (£67m) mark for the first time.

BIG PAWA 1964 TRAFFIC INCREASE

A SCHEDULED network passenger-mile increase of 17.5 per cent was recorded by Pan American for 1964 by comparison with 1963. The total was 8,187.1m. Cargo ton-miles on scheduled services totalled 264.7m—a 34.6 per cent increase. The 1963-64 gain of 70.7m ton-miles for all the airline's cargo operations represented more than the total increase recorded during the previous four years.

Area by area Pan American's passenger increases on scheduled services were nearly 20 per cent for the Atlantic, 21.2 per cent for the Pacific, 22 per cent for Alaska and 10.5 per cent for Latin America. Scheduled cargo ton-mile gains were nearly 32 per cent for the Atlantic, 65.4 per cent for the Pacific, 30.4 per cent for Alaska and 10.5 per cent for Latin America. Pan American expects an accelerated rate of growth in both passenger and cargo traffic during this year.

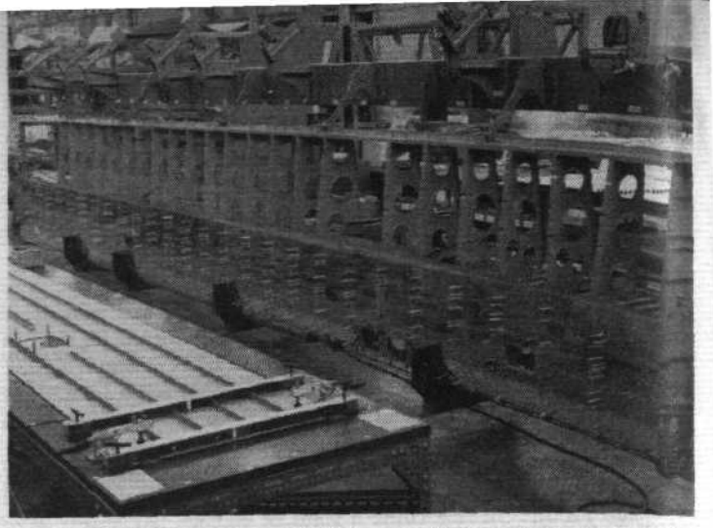
TWIN OTTER PROGRESS

DE HAVILLAND OF CANADA has made considerable progress with the tooling, jigging and building of the first batch of five Twin Otters since the project was announced last September. Although similar to the DHC-3 Otter in fuselage cross-section and basic wing form, the DHC-6 Twin Otter calls for extensive tooling. While the first five aircraft will be completed at the rate of one a month, tooling is designed for production of two aircraft per month after certification.

By the end of November, engineering information had been issued for 5,000 of the estimated 6,900 parts per aircraft. Several major sub-assemblies for the prototype were then nearing completion and some second and third sets were in work. In the cockpit section jig the framework was ready to accept skinning. Substantial progress was to be seen in the main wing assembly, fuselage rear end, and cabin side panels. Main assembly of the first airframe is due to be completed late this month. The second set of components has been allocated to the structural test department.

The final set of Pratt & Whitney PT-6 turboprop engines to power the first Twin Otters have been delivered and are being made up into their individual powerplants. The PT6A-6 originally scheduled for this aircraft has been replaced by the PT6A-20, giving an additional 50 s.h.p. per engine maximum continuous power and greatly increasing single-engine performance.

The first flight is scheduled for June, and certification by the end of the year.



The Twin Otter, progress on which is described on this page, is taking firm shape in the de Havilland Canada Downsview factory. The first wing is in an advanced stage of assembly; the jig for this is very similar to the one used in Otter production

INQUIRY INTO US VISCOUNT CRASH

DURING this week the US Civil Aeronautics Board is holding a public hearing in an attempt to discover the cause of the accident to a United Air Lines' Viscount on July 9, 1964. In this accident, which occurred near Parrottsville, Tennessee, the aircraft apparently caught fire and started to disintegrate in the air. The crew of four and the 34 passengers were killed in the crash; another passenger was found 1.6 miles from the crash site and was a "free-fall casualty." Nearly 30 people have been called to give evidence at the accident-investigation hearing, which was expected to last about three days.

BEWARE THE BOGUS PART

A RECENT Air Registration Board notice draws attention to the dangerous influx of "bogus" parts into aircraft stores. It says: "The Federal Aviation Agency of the USA has long been concerned with 'bogus' parts, numbers of which have been found in use. Superficially many of these parts are identical with the genuine parts which they replace."

In order to give wide publicity to this serious problem, the ARB says, the US Flight Safety Foundation some years ago prepared and published a comprehensive booklet defining these parts as: "Parts which are not airworthy. Parts the source and identity of which have long been lost. Parts of unknown material, fabricated by processes at variance with industry and Government specifications . . ." A revised edition of this booklet, *Bogus Parts, a Continuing Threat to Safety in Aviation*, has now been published, and copies (price $1.00) are available from the Fight Safety Foundation Inc, 468 Park Avenue South, New York, USA.

The ARB says that: "recent experiences in this country show the problem is not confined to the USA. The two examples which follow are typical and both were experienced by the same purchaser:

"A quantity of NAS bolts were purchased from a stockist in the USA. These were to be fitted to an aircraft in positions where the bolts were subject to a fatigue-life limitation. Whilst being tightened to the required torque loading the head came off one of these bolts. Investigation revealed an old fatigue crack extending over approximately 80 per cent of the cross-sectional area of the shank. Other bolts from the same batch had similar cracks; all were secondhand but had been re-plated before delivery.

"At a later date a further batch of NAS bolts was ordered from a stockist in this country. The order specified that the bolts should have rolled threads. When delivered the bolts had the characteristic 'R' on the heads, but closer inspection revealed that the threads were cut and were very rough. Following investigation it was found that the supplier had attempted to meet the requirements of the order by having longer bolts re-threaded, the shank then being cut back to the right length. The stockist concerned no longer holds the approval of the Board."

The ARB warns that the above exceptional examples serve to show the care needed when buying spares of foreign origin. Such items should be purchased either direct from the manufacturer or from a source known from the purchaser's own experience to be reputable.

One of the Survey Princes operated by Hunting Surveys Ltd "Flight" photographs

Survey Season

THE ORDNANCE SURVEY'S AIR OPERATIONS IN 1964

On the job in Scotland with a Survey Prince; left, Capt R. Keith Cannon, Hunting Surveys pilot, and—on a tour of inspection—Lt-Col J. Kelsey, Assistant Director, Geodetic Control, Ordnance Survey

Williamson F.49 6.3in camera in a Dove survey aircraft

IT would have surprised Major-General William Roy to see at Inverness Aerodrome, near the site of the Battle of Culloden, an aircraft taking off to do the sort of work he trudged over the Western Highlands doing from 1746 onwards. At the time of that famous conflict Roy was a young man living in Edinburgh, and was called-in by the Chief Engineer of the Duke of Cumberland's victorious army to make a one-inch to one-thousand-yards survey of the Highlands and Lowlands during the English "pacification" of Scotland. Roy's advocacy of the need for a national mapping organization led eventually to the formation in 1791 of the Ordnance Survey, of which he is now looked on as the "father." Were he to have visited Culloden Moor some time between March and October 1964 and walked to the nearby airfield, he would have been agreeably astonished at the latest turn in survey techniques; whilst a visit to the Western Highlands might have increased his astonishment.

In the March-October 1964 season the Ordnance Survey completed its largest-ever flying programme, including major tasks in the Highlands and Islands of Scotland. Fixed-wing aircraft were used to obtain photographs for the Survey's mapping tasks at the scales of 1/1250, 1/2500 and 1/10,560 (six inches to one mile), and two Bell 47Gs of Helicopter Services Ltd to transport surveyors and their equipment in Highlands areas. The fixed-wing aircraft included a Hunting Surveys' Prince based on Inverness, a Dove of the Ministry of Aviation's Flying Unit operating northwards and southwards from Blackpool, and similar Doves flying from the unit's parent base at Stansted, Essex. All these aircraft obtained photography for mapping in various parts of Britain, but their main work was over Scotland.

The Ordnance Survey's major task in that country is to resurvey the Highlands and Islands at a scale of six inches to one mile, with contours at vertical intervals of 25ft. The method is to plot as much detail as possible and all the contours from aerial photography at the Ordnance Survey's Chessington, Surrey, HQ, then for 55 Field Survey Group, based on Inverness, to complete the survey on the ground—which is the stage when helicopters come into use.

The technique of aerial photography for mapping purposes is well known. The aircraft flies a series of parallel straight lines over the terrain at a steady height, speed and course. These lines are plotted in advance on a Decca lattice for MoA aircraft, and on one-inch maps for visual navigation in the independently operated machines. Following these lines, the aircraft photograph overlapping strips of terrain. The aim is to have 20-25 per cent overlap between adjoining strips, and a 60 per cent overlap within the strips themselves, so that every inch of ground is covered. This technique involves both careful flying and accurate navigation, and it is satisfying to record that in 1964 there was no rejection of photographic results due to navigation errors.

Use of aircraft by the Ordnance Survey has steadily increased

SURVEY SEASON . . .

since 1960. At one time (up to the end of 1951), airborne photography was provided by the RAF; subsequently—until 1962—various Doves, and occasionally a Prince, from the MoA Flying Unit at Stansted were employed. In 1963 these aircraft were augmented by another Dove, G-AROG, chartered for four months and sub-contracted to Huntings. In 1964, in addition to aircraft on MoA contract (one Dove, G-ANUW, on a full-time basis and two—G-ANAP and G-ALFU—on an "opportunity" basis for sorties from Stansted when required), the Survey employed one Hunting Surveys machine—a Prince, G-ALRY. Each photographic aircraft operating for the Survey is supplied with a pilot and navigator, whilst the Ordnance Survey provides the camera operator and two cameras—of 12in and 6in focal length. The Prince, operating mainly from Inverness, had 6in Wild RC8R and 12in Williamson F.49 cameras; the MoA Dove sited at Blackpool, 6.3in Williamson F.49 and 12in Zeiss RMK cameras together with a 6in Hilger and Watts F.105 camera for part of the season; while the MoA Doves at Stansted had two Williamson F.49s, of 6.3 and 12in. A single film on an F.49 has 180 exposures, while the Zeiss film has 470.

The fixed-wing aircraft operating over the West Highlands area—which is described by Survey officers as "the most difficult target in Scotland"—have been photographing from 14,000ft above sea level. For this type of work, freedom from cloud cover or haze is essential; and as clouds are companions of mountains the number of days when conditions were suitable was very limited—five or six days in the year. Even if the aircraft got to the right position to start a photographic run, it might then have to return to base empty-handed. These photographic machines were therefore uneconomic in strictly commercial terms, but implied a vast saving in time to the Survey in terms of what they produced when conditions were favourable. A few hours' flying can provide months of work for the plotting instruments at Chessington.

It is fair to say that the use of helicopters has revolutionized the transporting of surveyors and their equipment in such an area as the Western Highlands. At the Ordnance Survey's headquarters officials agree that, while the cost per hour is high, the use of a helicopter brings about an overall saving in time, with the result that costs are about the same in country most suitable to the helicopter method. The advantage gained is speed, for, whereas before the surveyors had to travel by vehicle—and then probably on foot—to the point where they wished to work, now the helicopter carries one or more surveyors directly to the appropriate location: it can drop one and come back for him, and sometimes a surveyor can do his work while still airborne. Ordnance Survey officers have nothing but praise for the helicopter pilots: "they have geared themselves to our requirements—they almost became surveyors themselves."

This was the first time the Ordnance Survey had used helicopters for this purpose, though such machines had been employed previously for positioning concrete pillars marking triangulation points. Last year's contract with Helicopter Services specified 250hr flying. Actual time was 234hr 45min—most of it by one aircraft.

The two Bell 47s initially employed were first based at Ullapool in Ross and Cromarty, from May 4 to 21; then one of them moved to Kinlochewe (farther south in the county) where it stayed until June 9, when it was withdrawn. The other aircraft, which did the bulk of the flying, moved from Ullapool northwards to Lochinver in Sutherland on May 21; then on June 6 it went from there to Spean Bridge, Inverness-shire, and finally on July 4 northwards to Aultbea, Ross and Cromarty, where it was used until July 31 and subsequently from September 7 to 16. Each of the two helicopters, G-ARXH and G-AODK, had its own pilot (respectively Mr R. M. Fryer and Mr R. A. Lister) and was supported by a mechanic, spares vehicle and fuel supply.

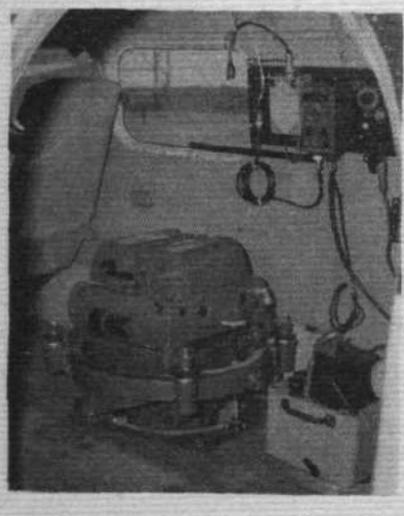
During these summer months the Ordnance Survey men in the Highlands worked a seven-day week, from dawn to dusk each day. Air reconnaissance in an area was followed by a survey flight; then the helicopter transported the surveyors to wherever each man wanted to work on his field document (a piece of astrafoil with existing features already delineated, on which changes or additions can be drawn); finally there would be an examination flight, a more senior surveyor checking the work that had been done. This was the pattern of daily activity in last season's contribution to the re-survey of the Western Highlands—the first time helicopters had been used by the Survey for what they call "field completion," which precedes the actual process of drawing and printing new maps.

Ordnance Survey work on re-surveying the Highlands is continuing until the 1970s and helicopters will be used again this year.

Photographic and other survey work which was done over Scotland and elsewhere during the 1964 season is now being processed by the map-makers at Ordnance Survey headquarters.

Application of aircraft to the Survey's work has meant a tremendous saving in effort in re-surveying the United Kingdom for new maps, and the Survey has confirmed its belief in the use of airborne methods by considering the placing of contracts for three aircraft to be used in this coming season's work. H.W.

A Bell 47 of Helicopter Air Services on work for the Ordnance Survey. The scene is Spean Bridge in the Scottish Highlands



Left, Hilger & Watts F.105 camera and Zeiss IRO intervalometer mounted in a Dove aircraft

Right, Mr J. E. G. Pierpoint, an Ordnance Survey camera operator, using the equipment

One of Iran Air's DC-6s. The airline's livery is a smart blue and white

Airline Profile / **NUMBER TWENTY-TWO IN THE SERIES**

IRAN NATIONAL AIRLINES

By Daryl May

IN an age when airlines are hastily buying jets and nationalistically displaying them around the world, I was gratified to hear these words: "The direction of our growth is based on the nation's internal needs . . . We have no desire simply to show the flag and cross oceans."

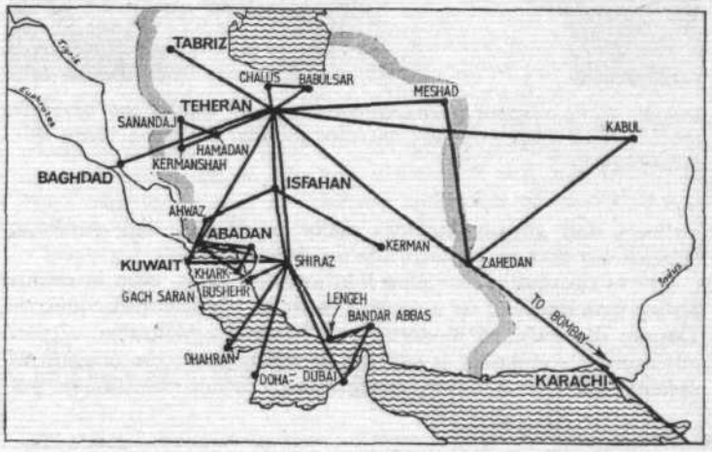
Speaking was Maj-Gen Ali Khademi, managing director of Iran Air. And his words underline a no-nonsense approach to airline management that speaks of public service before profit, and profit before prestige.

Such an approach to running an airline is no less patriotic because it is sensible; in fact, Iran Air's plans are closely in accord with national policy. Iran's Third Plan, involving some £1,500m between now and 1967, will raise *per capita* income and gross national product a lofty 27 per cent. "Within three years," says Khademi, speaking as a man with some knowledge of aviation's place in an undeveloped community, "the country will need us as never before."

Iran's population is 22m, spread thinly over an area approximately that of the Common Market countries together. About one-third is desert and another third forest and mountain, surely ideal showgrounds for the benefits of aviation. But the nation's *per capita* income is about £65 per year; and the airfields are high, indifferently equipped, hot in summer and sometimes icy in winter. The airline may find Iran a showground for public service; but in the showground can it show a profit?

In recent years Iran Air *has* shown a profit, but to achieve this has demanded some negative yet wholly necessary reorganization—the airline had sunk into a morass engendered by the complexity of its administration.

Originally 50 per cent belonged to the Government, 20 per cent each to Persian Air Services and Iranian Airways, and 10 per cent to the public; by early 1962, when Persian Air Services stopped operating, the then Iran Air had a debt of £500,000, interest owing of £155,000, and was minus 33 per cent of its stock. Debtor was the American finance corporation FATD, which in 1957 had loaned the airline £900,000. By April 1963, FATD had agreed to cancel the accrued interest and interest for the next three years, reduce the principal of the loan, and give back £46,000 of the stock. This is, of course, the bare bones of a very fleshy story: it suffices to say, however, that Iran Air benefited by £400,000 and became wholly Government-owned.



In the year following the change of ownership scheduled-service passengers increased by 31 per cent to 218,000, compared with the previous year's increase of 18 per cent. A stimulus to account for the large traffic-rise was a 1963 winter fare discount of 25 per cent. Maj-Gen Khademi, pointing to a passengers *versus* month-of-the-year graph, said: "At first the winter trough was much less marked. Then we had Iran's worst-ever winter . . . icy runways; we had to cancel flight after flight." So winter traffic resumed its usual downward trend, but not before the traffic increase had encouraged the airline to continue to offer winter discounts—though perhaps not 25 per cent again—for four months in 1964-65.

Worst-ever winters do not help boost revenue, and a three-month suspension of the Kuwait service was equally unfortunate. The 31 per cent traffic increase generated only a 12 per cent revenue rise —sufficient, however, to provide a profit even after wage increases to employees.

The off-season discount, together with proposed reduced night fares and coach flights, is intended to increase aircraft utilization, which is at present about 1,700hr a year for the airline's Viscounts and DC-6s and rather less for the DC-3s. Low utilization is blamed

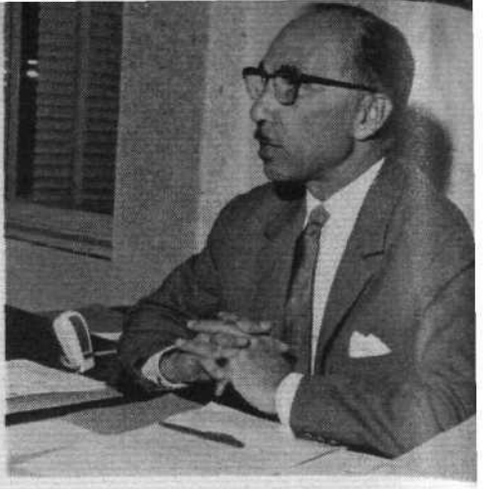
Footnote: Derivation of Iran Air's eagle in profile (seen in the heading) is twofold: figures of this sort are found in the Apadana Palace at Persepolis, and similar designs are found engraved on vessels of the Achemenian period.

IRAN NATIONAL AIRLINES . . .

primarily on bad airports without night facilities, a matter which the Government may correct with £12m in the present plan.

With this corrected, and promotional fares in force, the limiting factor behind utilization will be maintenance. "Our most urgent need," Maj-Gen Khademi told me, "is for trained maintenance personnel."

To help correct this deficiency, Iran Air concluded last March a technical and management agreement with Pan American, made possible through a $1.5m US aid loan. Fifty of Iran Air's staff of 750—including pilots and groundcrew and sales and operations personnel—will receive training in Iran and the United States. The



Maj-Gen Ali Khademi, Iran Air's managing director

Iran Air public relations make considerable use of "educational advertisement." Here a party of Teheran schoolchildren are being shown DC-3 maintenance

airline's staff already includes many expatriates; one American captain has been with the airline for over ten years.

One is constantly reminded that aviation skills, even in routine airline maintenance, do not come easily to undeveloped countries. Despite the outward modernity of Teheran's Mehrabad airport, engineering equipment is said to be inadequate; the educational system, Maj-Gen Khademi complains, does not rival for his purposes the English apprenticeship schemes. The need for newer airliners is hampered by the difficulty of maintaining them.

Iran Air's internal route pattern does not make for happy economics. Radiating from Teheran are too many routes operated once weekly, and too many stops on each route. The high-density routes—if one may use this term in application to the Middle East—are from Teheran to Tabriz, Meshed and Abadan, operated with Viscounts and DC-6s. At present these aircraft types are adequate, but there is an urgent need, the managing director says, for a DC-3 replacement: "On our routes to the Caspian, 80 miles from Teheran, we have to fly over 14,000ft mountains. The DC-3's engine-out performance—even if new—is just not good enough." Nearly every manufacturer has made presentations—for this and other equipment—and the airline will decide on a replacement "as soon as possible."

The route to Europe is at present operated in conjunction with SAS, the weekly DC-8 service being timetabled as a joint flight. By spring next year, if negotiations with one of several airlines are successful, Iran Air will lease jets for the European route, scheduling them variously through Beirut, Athens, Istanbul and Rome.

"Why not *buy* jets?"

"Because we can't maintain them ourselves, unless we bring in a lot of expatriates to do the job for us."

At present the airline's international flights are to Baghdad, Karachi and Bombay, Kabul in Afghanistan, Kuwait, and various neighbouring Persian Gulf sheikhdoms; nearly all these services are operated with Viscounts.

Excitement has been caused in the airline's management by recent successful negotiations with the Soviet Union and Aeroflot for reciprocal services between Moscow and Teheran. Negotiations started on July 26 and were concluded after 22 laborious sessions. As soon as the agreement is ratified in Parliament, twice-weekly Viscounts and Il-18 flights will begin, Iran Air acting as Aeroflot agents in Iran and Aeroflot for Iran Air in the Soviet Union. IATA rates will apply.

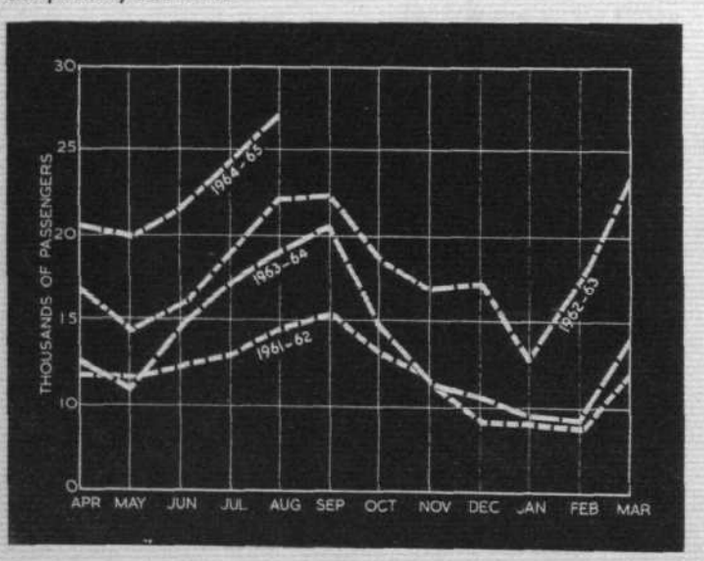
In view of the seemingly cool relations between the two countries exemplified by the small passenger-traffic between them—it is possible that both airlines see the agreement as useful mainly for its onward possibilities. Iran Air will continue from Moscow to Stockholm, Frankfurt, Paris and London; Aeroflot will operate from Teheran to Baghdad, Bombay, Rangoon, Colombo and—perhaps significantly—Djakarta.

Unorthodox traffic is Iran Air's "Haj business," as someone described the airline's part in the Moslem pilgrimage to Mecca. This involves the airline very deeply in the move in a fortnight each year of nearly 20,000 passengers to Jeddah, the airport for Mecca. Bigger airlines may carry this number of passengers in one day, but for such a small operator it necessitated chartering aircraft from MEA, BUA and Sabena. Next year, if the jets it is planned to lease arrive a little early, Iran Air may manage alone.

Each pilgrimage is a lunar year apart—rather than a solar year—so that the Haj operation will fall earlier this year. For the next few years at least, the Haj peak will fall nicely within the winter traffic-drop.

Pilgrim charters mean much the same to a Middle-eastern airline as IT charters mean to a European one. The passengers get religion instead of a holiday, and get it quickly and cheaply; the airline gets the same hard cash, but also—and significantly—has the opportunity to introduce air travel to a normally conservative (though not necessarily poor) section of the community.

Revenue passengers carried. Promotional fares reduced the normal winter trough in November-December 1963; the subsequent decline was caused by such factors as the cancellation of Kuwait flights and an exceptionally bad winter



Originally supplied to the Shah of Persia in 1961, this Viscount 839 was operated by Iran Air from March 1964 until quite recently, when it was sold to the RAAF. The airline continues to operate three 700-series Viscounts

Not only do pilgrims go from Iran to Jeddah, but a service has recently been started from Karachi to Meshed to bring Pakistani pilgrims to the tomb of Imam Reza.

Air freight business stands at 664,000 tonne/km a year; and this is an aspect that is receiving special attention, with a big sales office, just for cargo, recently opened in Teheran's central Ferdowsi Square. I asked Maj-Gen Khademi whether impetus here would be the result of the Pan American agreement, knowing this airline's emphasis on air freight. The answer was "no"—Iran specially needs air-freight links with Europe, and the present internal freight services were only the beginning. Land routes might be blocked for political reasons, and sea services take too long.

I was impressed with the honesty with which my questions were answered, even when the answers were not flattering to the airline. On punctuality, the figures came right out; 90 per cent of flights actually depart, 65 per cent arrive on time. The managing director showed me graphs for the last three years. "We are trying to improve matters," he said frankly.

Looking for hidden subsidies, I found that landing fees are not paid at domestic airports, except for lighting (where there is any). Handling at Teheran is managed by a subsidiary company, MAS —Mehrabad Airport Services—which is paid in full and serves other airlines besides.

Food comes from the Mehrabad Restaurant, which is one of Teheran airport's attractions to visitors. A deliberate attempt has been made to maintain an informal atmosphere at the airport, with none of those no-entry-unless-you-are-a-passenger-or-friend-of-a-passenger notices one finds elsewhere. The airport may be reached by bus from any point in the city for 4d or less, and the ratio of visitors to passengers has been estimated at ten to one.

An air-minded public is the intention, and this is being worked for in other ways. The advertising manager, Mr Kalhor, spoke with pride of his "educational advertisement," whereby high-school children are shown around the workshops: "We have difficulty getting rid of them—they have so many questions."

Together with the Haj business, and its stimulus to air-mindedness, ideas of this kind result in a public that has taken more quickly to the air than in most neighbouring countries of similar living standard.

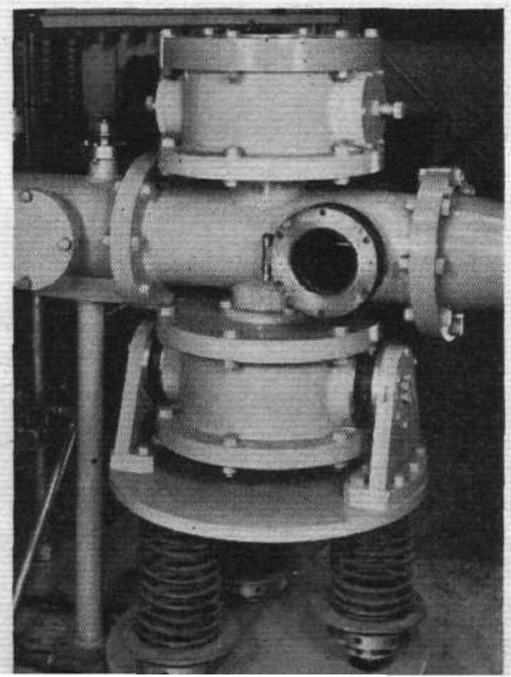
Foreign passengers are significant in number but not overwhelming. The advertising manager estimates about 10 per cent of internal traffic to be foreign in origin. A good part of this is tourist traffic to Shiraz (for Persepolis) and to the famous bridges at Isfahan. Iran Air loses a large potential revenue in the transport of foreign engineers to Abadan, where the world's largest oilfields are placed. Abadan is served directly by a number of foreign airlines, including BOAC and KLM, who predictably carry most of the British and Dutch personnel to and from Europe. The carriage of this traffic by Iran Air to Teheran, the main international gateway, would add significantly to revenue. But there is no intention to restrict foreign traffic rights.

Iran Air's future is at present seen to lie in operational collaboration with the Pakistan and Turkish national carriers. These countries are planning to co-operate with each other and with Iran in many far-reaching political, economic and cultural unions, and air transport is high on the list. It has been suggested that the international operations of the new association will lean heavily on PIA's experience, and that internal operations will continue for a while on their present courses.

Whatever the future, Iran Air is efficiently looking after the present.

SHOCK-TUNNEL IMPROVEMENT

The vibration-isolating support for models in the NPL Mach 11.6 shock tunnel. It weighs 800lb, and the coil springs are of 6in diameter



Crown Copyright photograph

IN shock-tube tunnels, and to a lesser degree in all short-duration wind tunnels, the sudden release of the stored energy results in rapidly changing vibration of the tunnel structure and even of the building in which it is mounted. It is common practice to use a computer to correct the lift and drag force measurements obtained from strain-gauges attached to a model in the tunnel, but this presupposes accurate prediction of the transient accelerations. Dr L. Pennelegion, of the National Physical Laboratory at Teddington, Mddx, has devised a scheme for the NPL's 2in Mach 11.6 shock tunnel which isolates the sting and model from such accelerations.

Instead of being attached to the tunnel itself the sting is mounted on a sprung suspension system of considerable mass supported by three coil springs which result in the natural frequency of the support system being not more than one cycle per second. The inertia of the assembly is increased by heavy bobweights above and below the model (they occupy the drums above and below the working section in the picture) which prevent any sudden pitch or translation by the model. The model suspension, which must be completely vacuum- and pressure-tight, can absorb accelerations of up to 20g and allows the tunnel vibration to by-pass the model entirely. This NPL tunnel uses high-pressure helium or nitrogen to burst a retaining disc and generate a shock which acclerates the tunnel air to a maximum of some 8,000 m.p.h. for four-thousands of a second.

Dr Pennelegion's work was described recently in Paris at the first International Congress on Instrumentation in Aerospace Simulation Facilities.

OPEN WIDE PLEASE

The Hawker Siddeley Argosy has front and rear doors accepting 108" pallets . . . the world's only feeder/distributor aircraft compatible with long-range freighters and designed specifically for profitable operation over short and medium stages.

The Argosy accommodates six 108" pallets. Its 'Rolamat' cargo handling system, at truck-bed height, enables palletised loads to be handled through front and rear doors simultaneously—13 tons in and 13 tons out in 12 minutes or less.

With the steady growth of air freight (up 200% in eleven years and still rising), you can profit from this expanding market only with the right equipment. That means the Argosy—already operating with BEA. Your enquiry will be met with an assessment of how the Argosy could give you more profit per cargo ton over every mile of your short and medium stage routes.

Still civil registered, Convair's Charger flies in clean configuration during its first 27hr flight test programme

CONVAIR'S CHARGER

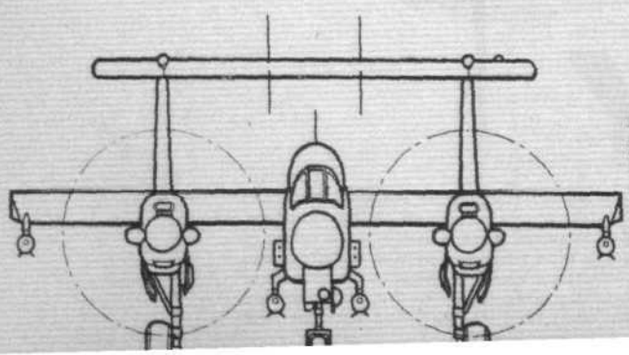
IT is fascinating to see the resources of a major manufacturer devoted to the development of a small aircraft. Many of the major companies tendered for the US Navy Light Armed Reconnaissance Airplane (LARA) specification—later Counter Insurgency (COIN). North American Aviation won the official development order with the NA.300, which is to fly later this year powered by two AiResearch TPE331 turboprops, but General Dynamics Convair went ahead with their Model 48 Charger submission as a private venture, finished detail design and construction in under 40 weeks and have now flown 27hr 42min since November 29. Powerplant has been two 550 s.h.p. United Aircraft Canada PT6A turboprops, but modifications now in hand include fitting of the PT6A-17 and PT6A-17H opposite rotation pair of engines giving 650 s.h.p. for 5min, 600 s.h.p. military and 565 s.h.p. normal power. Definitive engines are the more powerful -15 and -15H.

Although the COIN aircraft can do virtually anything tactical, the Charger is offered in two principal equipment standards, the original LARA weapon and transport system and the two-seat surveillance system. At normal gross weight of 7,100lb, the Charger, carrying one pilot, 1,175lb of fuel and 1,217lb payload can reach 50ft in 485ft, fly 50 miles, loiter for 2hr at sea level and return to land from 50ft in 488ft at 5,300lb. With extreme fuel for 2,600 n.m. it can reach 50ft in 1,710ft. Wing-tip and fuselage centreline pylons can each carry 600lb and two lateral pylons beside the cabin can each take 1,200lb. Fixed armament is four 7.62mm machine guns in fuselage blisters with 500 rounds each and ammunition boxes which can be replaced in flight. Pylon loads include Sidewinders, air-to-ground missiles, bombs, cargo containers, gun pods, flares and so on. Sample payload is four Mk 81 bombs and their carriers. The second crewman is only carried for surveillance or artillery spotting; and the six parachutists are accommodated rather uncomfortably squatting in line astern with the sixth above in the rear cockpit.

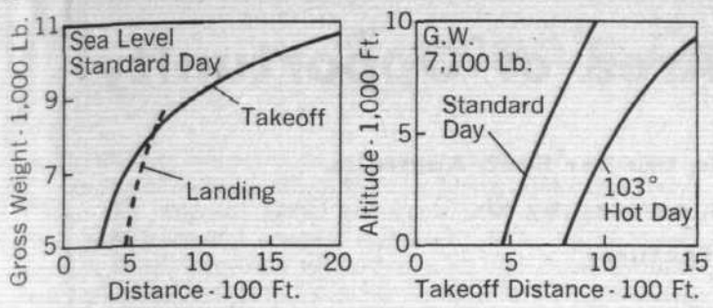
Though the Charger is stressed for a normal 8g and ultimate 12g and can attain dive speeds of around 400kt, its maximum level speed, clean, is 277kt, at which it would presumably be very vulnerable for just the type of weapons emplaced in the targets it should attack. The right kind of terrain could be used for cover, but its survival in a straight ground-attack role is problematical. Being able to operate virtually alongside troops and from any sizeable helicopter base, the Charger's greatest attraction is probably as a helicopter escort or destroyer, a role which is increasingly engaging the attention of armies all over the world.

Convair are on their own in selling the Charger but, though there is yet no official US support, final clearance to offer the aircraft abroad has not yet been received. Convair's main interest in Europe is in selling the type to NATO countries. The RAF, for one, is devoted to supersonic capability as an essential survival factor for strike aircraft. Nevertheless, Convair have produced detailed specifications and plans for testing, development and production. The first "customer airplane" would fly six months after go-ahead and first production aircraft after 11 months. First production delivery would be after 12 months and 500 aircraft would be completed in 34 months at a fly-away cost of about $250,000 per aircraft. For aqueous areas, Convair have tank-tested a model with amphibious float gear, whose top speed would be reduced to 190kt, but weapon capability quite unaltered.

Aerodynamics and Controls The wing is of 27ft 6in span, untapered and unwashed-out with a chord of 84in and a NACA 63A-4 section of 18 per cent thickness. Double-section, single-slotted flaps occupy 44 per cent chord and 90 per cent span, with maximum deflection of 60° for the inner section and an additional 30° for trailing-edge



Left, head-on view showing pylon and gun layout of the Charger. Right, a manufacturer's cut-away shows simple structure, Krueger flaps inboard of the engines, tab-operated ailerons on the outboard flaps, lateral control spoilers, tab-operated tailplane with anti-balance surface, PT6A-17 engine installation with 9ft, three-blade propellers covering most of the 27ft 6in wing, Doppler radar in port boom, fuselage gun blisters, pilot's access step and rough-field undercarriage



Take-off performance in various altitude, temperature and gross weight conditions

The Charger gets away from Lindbergh Field, San Diego, with take-off flap and gear extended

portion to give deflected-slipstream lift. Maximum speeds for take-off and landing flap are 146kt and 100kt respectively. Krueger flaps are fitted under the leading-edge between engines and fuselage.

Lateral control is ostensibly by a combination of knife-edge spoilers and spring-tab actuated movement of the trailing-edge flap sections, though the tab mechanism has been moved from the outboard flap to the inboard since the first flight. The right spoiler is showing in photographs of the prototype flying clean with the unhanded propellers first installed.

Pitch control is by "stabilator" with a narrow, full-span trailing-edge tab, which may be a servo actuator or simply a trimming surface. Final control layout probably remains to be decided. The two rudders have geared tabs.

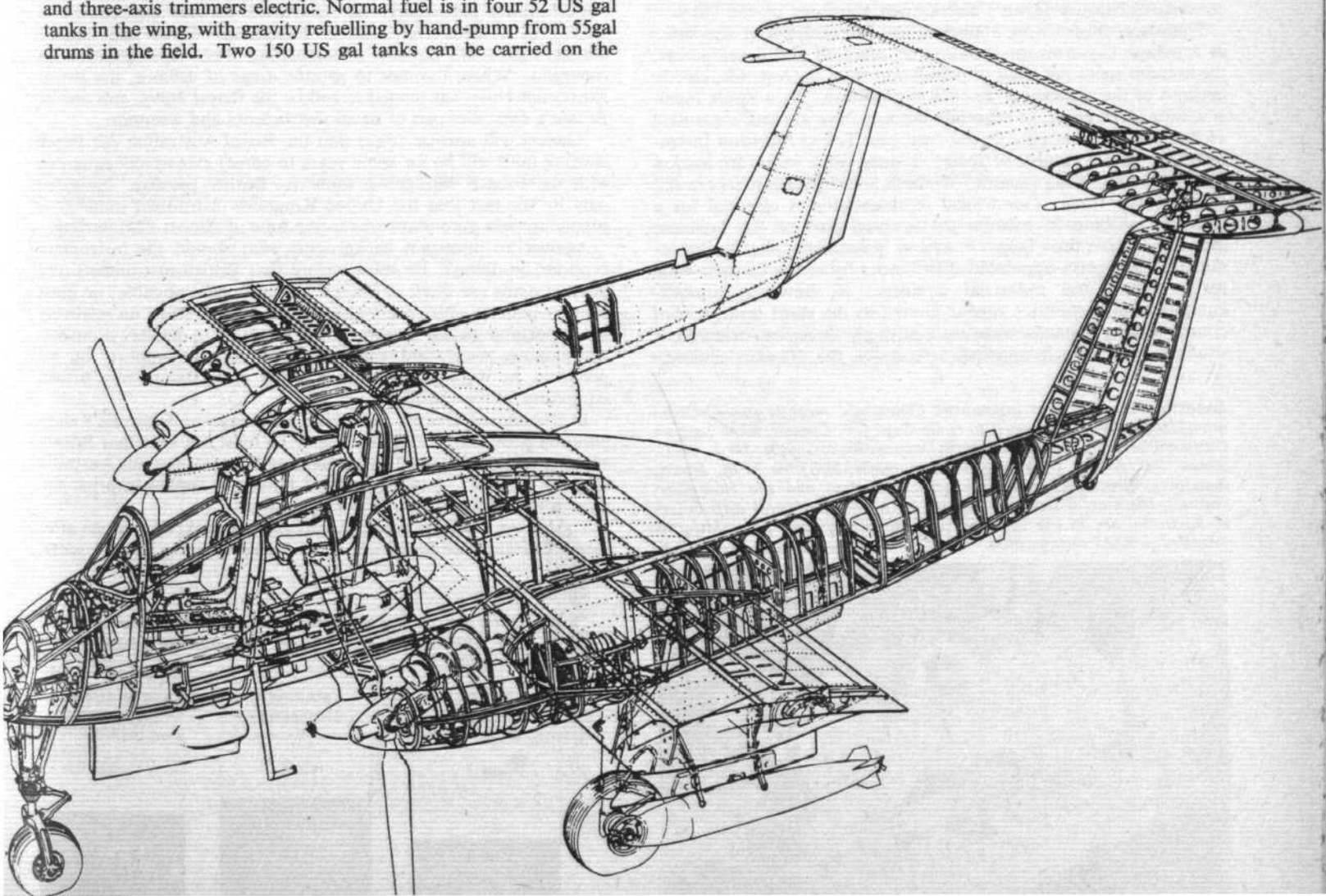
Handling is designed to produce a good gun platform, but for the engine failure case an automatic torque equalizing system ensures that both engines produce the same power if one fails and that control shall be adequate to provide forced-landing survivability equivalent to that accepted for helicopters or single-engined aircraft. Normal take-off safety meets civil standards.

The undercarriage has long-stroke oleos and large tyres to absorb a 20ft/sec impact on to a 4in bump. Contact pressure and powered nosewheel steering allow operation on mud.

Systems Flaps, Kruegers and undercarriage are hydraulically operated with optional mechanical stand-by. The under-floor cargo-dropping door is hydraulic. Flight controls are cable-operated and three-axis trimmers electric. Normal fuel is in four 52 US gal tanks in the wing, with gravity refuelling by hand-pump from 55gal drums in the field. Two 150 US gal tanks can be carried on the fuselage pylons and a 300 US gal ferry tank pack can be installed in the aft cabin. Standard 55gal drums can be transported in the cabin.

The cockpit is ventilated and heated, has a bullet-proof windscreen and wiper and can have an armour kit to resist small-arms bullets at 500ft. The zero-zero ejection seat in the prototype is an optional fitting. Electronics basically include com/nav radio, IFF and optional additions such as Doppler in the port tail-boom, camera pack, sideways-looking radar pod, low light level TV, infra-red senser, with a reconnaissance load up to 6,000lb for the present overload gross weight of 10,500lb. The sea-level 100ft/min climb on one engine depends on jettisoning enough equipment to return to 9,170lb weight.

The second seat, which can have dual controls, is normally occupied only in the surveillance role or by the sixth parachutist, who must clamber down into the main bay to follow his squatting companions through an electrically actuated hatch beneath the hinged tail cone. The parachutists' position is uncomfortable, but related to a probable flight time of as little as 15min. On the other hand the extreme range of 2,600 n.m., with 20min reserve, will keep the single pilot in the cockpit for at least 15hr.



FEANZ—Area of Opportunity

Export potential in the Far East, Australia and New Zealand, as seen by an Instrument Manufacturer

By M. L. JOFEH, OBE, MIEE, AFRAeS

Chairman and Managing Director, Sperry Gyroscope Co Ltd

DURING the past few months most of us have become saturated by the continuous flow of exhortation to "do something about exports." Lest it be thought, therefore, that I am yet another armchair supporter of Government policy I should perhaps mention that my marketing director and I have travelled more than 100,000 miles in recent months to Japan, Australia and New Zealand to seek out new business, and to consider improvements in our existing organization. Naturally, as instrument and control specialists in the broadest sense, we visited important aeronautical and shipping customers as well as government and defence organizations.

First then, a word about Japan. As everybody knows, her industrial growth rate has, for the past decade, been the highest in the world. Not so well known perhaps (because only recently apparent) are an unfavourable balance of trade and a roaring inflation which puts Tokyo's cost of living in a similar category to that of New York. For these reasons, Japan's "edge" in the instrument business is becoming less and less a matter of price, more and more a matter of technical merit. This is not to forget the persistent and far-flung nature of Japan's promotional effort.

However, the price difference between Japanese and British products remains an obstacle for the immediate future and one cannot expect large sales of British technical equipment at the moment, more particularly (as far as companies like Sperry are concerned) because Japan's defence needs are met by the USA.

There are, nevertheless, opportunities. For example, if one looks at Japanese Government spending on research and development, the amount spent per head of population is on the low side, chiefly because of the absence of defence expenditure. As a result Japan is willing, even eager, to negotiate licences from abroad, regardless of the country of origin. In our own case Tokyo Precision Instrument Co hold a number of Sperry licences, while we in turn market their data-acquisition systems. We both look forward to increasing this two-way trade. Good local representation is essential for a company wishing to become an accepted part of the Japanese industrial scene; thus Tokyo Precision Instruments play an important part as Sperry-appointed distributors by virtue of their wide aero, marine and industrial contacts. If, however, aircraft-equipment opportunities appear limited in the short term, it is of course because Japanese aviation is strongly American-oriented, a situation which such excellent aircraft as the Hawker Siddeley HS.125 executive jet and the Short Skyvan can help to change.

At this stage the reader may well feel that I have put up something of an Aunt Sally by dealing at length with an area of restricted opportunity. I have done so, however, because the Japanese trade situation rubs-off to a remarkable extent on Australasia, where (according to *The Economist*) "Few countries have moved so fast in the last ten years and promise more in the next."

The question is "How much of the promise is to come Britain's way, how much to the United States, to Japan or, indeed, to the rest of Europe?" Each is struggling to get on to the bandwagon, Japan—geographically closest—hardest of all.

Japan's much-improved living standards enable her to buy increasing amounts of meat and wool from Australia and New Zealand. They in turn buy many technically advanced industrial products from Japan to support industrial growth—an important consideration in relation to Australia, where already a quarter of the quickly growing working population is employed in industry. Fortunately for us, Australia's industry is in the development stage and there is a growing demand for instrumentation and control equipment, giving rise to export opportunities.

The defence situation is no less interesting and attractive. From my talks with Service chiefs it became apparent that the introduction of newer and more complex equipment is leading to serious shortages in the field of technical support. This again offers considerable opportunities, particularly as Australia's defence expenditure is increasing. Accordingly, some companies—EMI and Sperry among them—are already strengthening their representation in Australia. When it comes to specific areas of defence, the Royal Australian Navy has tended to follow the Royal Navy, still one of Britain's best salesmen of naval instruments and weapons.

Readers will also be aware that the Royal Australian Air Force is being (and will be for some years to come) extensively equipped with the French Mirage—a blow to British prestige, mitigated only by the fact that the United Kingdom instrument industry is supplying twin gyro platforms to the tune of almost £2m sterling.

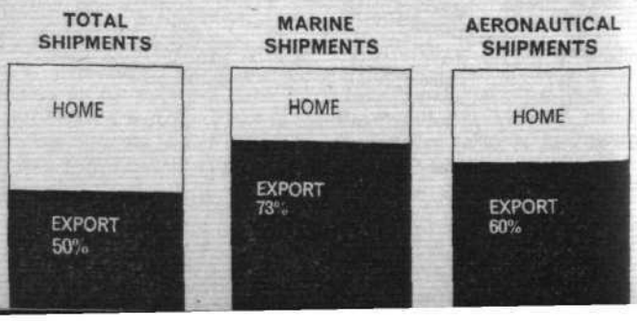
Against an uncertain background what should the instrument exporter be doing? He must ensure that British instruments and flight systems are fitted in foreign aircraft where possible; he must support policies which ensure a concentration of effort on relatively few exportable aircraft types; and, by attention to delivery promises, maintaining prices and ensuring good service support for his products, he must prepare the way for Australia to buy British equipment in the future.

In the marine area he must take advantage of Australia's shipbuilding plans; similarly, in industry he must see to it that Britain supplies the sophisticated instruments and control systems Australia is going to need. Naturally, what I have said applies in principle, though to a lesser extent, to New Zealand.

To sum up, I believe good markets exist in FEANZ if we go after them. Certainly we found our experience rewarding in every sense.

Inspecting the National Instrument Company's recently opened clean-area facilities at Essendon: (l to r) Gp Capt J. P. Godsell, RAAF Support Command; Mr J. L. Knott, Secretary, Department of Supply; Mr P. W. C. Stokes, MP; Mr M. J. Ryan, general manager, NIC; Mr R. M. Ansett, managing director, Ansett Transport Industries; and the Hon Allen Fairhall, Minister of State for Supply. NIC, who are Sperry distributors in Australia, are to use the area for maintaining twin gyro platforms installed in RAAF Mirage IIIOs "Aircraft" (Australia) photograph

Sperry export figures. The company is responsible for almost half Britain's aircraft, marine and gunnery control instrumentation



Europe's Comsat Plans

EUROPE has embarked on a firm programme of component and satellite development in order to contribute effectively to the proposed global communication satellite system. To gain experience and compete realistically with United States companies in the provision of hardware for the global system, orbital tests using European Launcher Development Organization vehicles are envisaged.

European plans were crystallized during the latter half of 1964 under the aegis of the European Conference on Satellite Communications, culminating in a meeting of the full Conference in Bonn during October 27-29. Earlier deliberations included meetings of the space technology committee of the Conference in London in September, October and November of 1963 and in January, April, July and October 1964.

In the first four meetings of the space technology committee, the main objective was to gain a clear insight into the technical plans of the US Communications Satellite Corporation. Joint meetings were held with the Americans and with the artificial-satellite working-group of the European Conference of Postal and Telecommunications Administrations, and a fact-finding mission visited Washington. Interim negotiations with the USA and other countries were then continued on the basis of European acceptance of the technical programme proposed by the US Comsat Corporation, since the space technology committee endorsed the experimental geostationary proposal and plans for choosing the characteristics of the next succeeding phase of this programme.

The fifth, sixth and seventh meetings of the committee were mainly devoted to formulating a possible European development programme, so that Europe would be able to take advantage of the right to supply approximately one-third of the global requirement in equipment and services, should she wish to do so. A development plan was drawn up (see diagram); this, the committee believed, indicated the only path by which Europe could hope to be in a position to supply adequately developed equipment for use in the global system from 1970 onwards.

In attempting to plan a co-ordinated European comsat development programme, the planned activity of the interim committee (for the global comsat system) and of ELDO clearly formed a starting point. At the July meeting in London a broad, three-phase programme was agreed:—

(1) System studies and laboratory work on components, techniques and sub-assemblies should extend over the period 1965-67. This work, at least for the first two years, could be done by individual countries at their own cost.

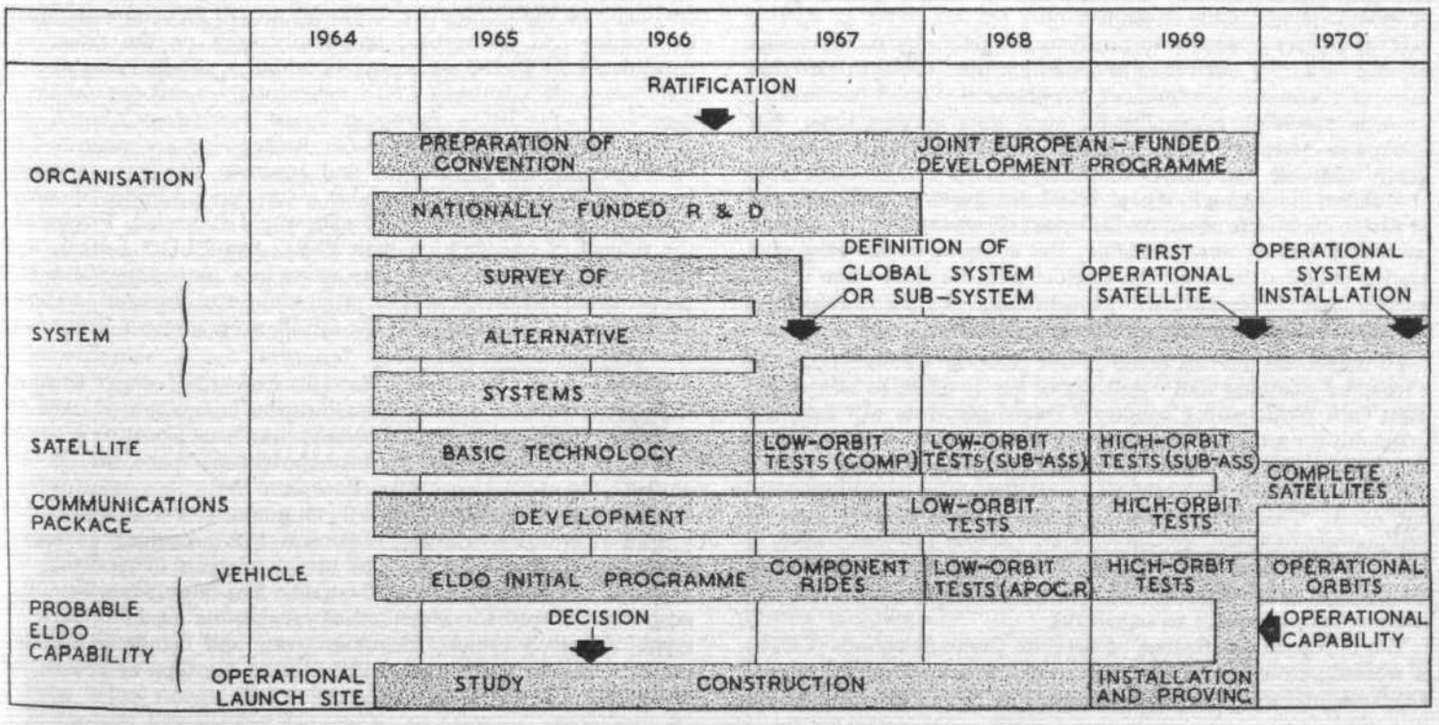
(2) A joint programme should begin not later than the end of 1966 under which selected sub-assemblies could be fully developed to the point of trial firings in 1967 and 1968. These flights would not need to be made at full comsat orbital heights, and the use of Europa 1 (carrying heavy test capsules in relatively low orbits), and cheaper, smaller launchers such as Diamant, would be of interest. The use of European Space Research Organization ground stations for receiving information from these orbital payloads could well be valuable.

(3) The global system for operation beyond 1970 would need to be agreed during 1967 or, at the latest, early in 1968. When this system and possible sub-systems were defined, European work (by that time jointly financed) could be concentrated on the operational versions. High-orbit tests should be undertaken in 1969 and prototypes should be placed in their correct comsat orbit in 1970. The proposed ELDO B launcher would meet this requirement in both performance and time-scale. Because the period needed to specify, develop and test a satellite for flight is about two years, 1970 flights must be specified by the end of 1967. This was seen as an added reason for ensuring that the joint European programme came into force not later than early 1967.

At the October meeting of the space technology committee the programmes subcommittee reported that, while the development of space technology and programmes (particularly those of the USA) should be kept under review, European programmes should follow an independent line. These should aim to give Europe an all-round general capability in satellite technology. Exploratory studies should enable Europe to define particular areas where European industry would be really competitive with US industry.

Overall aims of the programmes would be to facilitate European contributions to the global system; and to enable Europe to set up a subsystem of the global system if necessary. (A third suggested

Development plan for European communication satellite co-operative programme, as proposed by Britain and accepted by the European Conference on Satellite Communications



EUROPE'S COMSAT PLANS . . .

aim, to establish a competitive system if necessary, was not accepted by the subsequent meeting of the full Conference in Bonn.) In considering the European comsat effort it was recognized that the question of launching the satellite into orbit was crucial; and, in particular, it would be necessary to discuss with ELDO the intergration of the satellite with the launch vehicle.

Co-operation with ELDO is clearly a key factor in the European comsat effort, and this was discussed in detail by the space technology committee. ELDO representatives emphasized that feasibility studies had shown that design considerations dictated a very close engineering integration between the apogee stage of the launch vehicle and the payload. Experts from both ELDO and the comsat conference, it was considered, must meet to work out how the ELDO test satellites, to be orbited in 1968-69, could best be designed to provide maximum use in the comsat programme.

On the other hand, the committee recognized that far-reaching decisions on comsat design were inadvisable at such an early stage; during the initial period of co-ordinated national programmes, no decisions should be taken that might financially commit the subsequent, jointly financed programmes. Nevertheless, the possibility of tests using the ELDO apogee system would be explored.

Recommended Activity

Broad plans were narrowed down to firmer detail at the October meeting of the full Conference. The Conference had before it four specific lines of activity recommended by the space technology committee:—

(1) Individual countries should immediately initiate research and development programmes (where not already in being) to continue for two to three years, aimed at providing the basic techniques and components needed for the construction of a European communications satellite. Simultaneously a central technical planning staff of the Conference should begin detailed technical studies of overall comsat systems in order to collaborate with the US Comsat Corporation in the choice of future global systems.

(2) Early in 1965 work should start on the initial aspects of drafting a convention or financial protocol to enable jointly financed development programmes to be started in Europe before the end of 1966. Such a jointly financed and integrated programme should be the aim, subject to a satisfactory outcome of the intergovernmental discussions on the future programmes of ELDO.

(3) Immediate technical contact should be set up at working level between the Conference and ELDO's technical directorate to work out how best to utilize the capacity which ELDO may have in 1967 to provide low-orbit testing of components, and 1968 the testing in higher orbits of subassemblies or components using the proposed apogee motor system.

(4) If ELDO decided to proceed to a high-energy rocket design capable of testing assemblies in communication orbits in 1969, the European comsat development programme should be directed towards providing assemblies for such tests by that time. For Europe to develop a communication satellite by 1970 it would be highly desirable that ELDO should be able to provide these types of facilities for testing in space. It did not appear possible to work to such a time-scale based on European designs unless a European launching facility were available; the complex engineering integration required between the satellite and the final stage of the rocket could be carried out on schedule only if the respective groups of technicians were closely united.

To implement the first phase of this plan, the Conference set up a technical planning staff consisting of highly qualified technicians from each participating country. These specialists will assemble frequently for group meetings, returning to their own establishments between meetings to carry out detailed technical studies. Only in this way, it was felt, could the best available brains be utilized without delay. This staff will co-ordinate existing comsat work in national programmes, and study both US and European work in the areas of space communication systems and orbits, basic space technology, communication equipment to be carried aboard the satellite, and launching arrangements.

The European Conference on Satellite Communications (CETS) is working closely with the European Conference of Postal and Telecommunications Administrations (CEPT) in its current activity, and at the Bonn meeting a division of responsibility was agreed between the space technology committee of the former group and the artificial-satellite working-group of the latter organization. The CEPT would be expected to advise on the following items:—

(1) overall performance of communications circuits,

(2) numbers and types of circuits to be provided,

(3) degree of multiple access required and approximate numbers and locations of ground stations,

(4) areas of the world over which communications were to be provided,

(5) resulting from considerations of items 1 to 4, the range of satellite orbits that were of interest,

(6) cost of ground stations and any necessary ground system control network, and

(7) specification of the electrical performance of the telecommunications package, including aerials.

The CETS space technology committee will be reponsible for advising on:—

(1) launch sites and launch vehicles,

(2) the optimum orbit, from within the range of orbits suggested by CEPT,

(3) ground stations for the control of launchers and satellites,

(4) satellites, excluding the specification of the electrical performance of the telecommunications package, and

(5) the cost of the above items.

Among the broad conclusions reached at the Bonn meeting was firm approval for the first of the space technology committee's four points, on individual national programmes. These programmes are to be co-ordinated by the central technical planning staff, in addition to their other duties.

Jointly Financed Programme

On the second point, that of the jointly financed programme, the Conference decided to examine the various types of organization (including the possibility of integration with an existing organization) which might be envisaged to achieve the jointly financed European programme for the design and realization of the successive phases of the global system. Technical, scientific, economic and financial viewpoints are to be considered prior to the next meeting of the Conference.

The third point, continuing contact with ELDO, was agreed to be within the space technology's existing terms of reference. On the fourth point, concerning ELDO's possible future high-energy vehicle, the Conference agreed that the committee's outline should be followed, but that the possibility of alternative launching arrangements should also be examined.

Co-operation and co-ordination with ELDO, as indicated earlier, is a basic part of the comsat development programme envisaged by the Conference, although non-ELDO countries such as Sweden and Switzerland had reservations on the extent of dependence on ELDO decisions. In addition, detailed discussions have taken place between CETS representatives and the technical directorate of ESRO's European Space Technology Centre. A critical comparison of the probable development programmes for both communication satellites and scientific satellites indicated many points in common, but also a surprising number of areas where completely different approaches would be needed. Extending the subject of co-operation with ESRO and ELDO further, the possibility of one of these bodies acting as a management agency for the communications satellite programme was discussed; no firm decision is to be taken until the CETS programme is defined in more detail.

Postscript On January 7 the US Communications Satellite Corporation announced that nine European companies, in addition to 16 US firms previously announced, had been asked to propose studies of launch vehicles for medium-altitude spacecraft for the global comsat system. The European firms are Compagnie Générale de Telegraphie Sans Fil, Hispano-Suiza and SEREB of France; Contraves Italiana, Fiat and Finemeccanica of Italy; Hawker Siddeley Dynamics and British Aircraft Corporation of the UK; and Bölkow of West Germany. The launch-vehicle study proposals will provide a method of judging the merits of various types of launch vehicle, including costs, and details of further study needed to reach a final decision on the type of vehicle to be used.

AIRPORT ADMINISTRATION

Part 2: Information Sources in Literature

BY D. E. DAVINSON, FLA
(Senior Lecturer, Leeds College of Technology)

Last week (pages 9-10) we published Part 1 of this article, in which Mr Davinson dealt with national and international organizations whose information services are available to airport operators. In this second and concluding instalment, he lists a wide assortment of current and recent literature which the operator may profitably consult.

THERE has been nothing of significance published in the United Kingdom in the way of comprehensive bibliographies of airport administration. The three most important works are all American in origin. *Bibliography of Aeronautics*, published by the American Institute of Aeronautical Sciences, has a volume on airports issued in 1937 with a supplement published in 1941. It is Vol 37 of a 50-volume series and contains, including the supplement, some 4,250 entries. The United States Library of Congress publication *Airports: Planning, Design, Construction and Operation; a Selected List of References*, contains only 28 references. The most up-to-date item is the bibliography compiled by Li Shu-t'ien for the American Society of Civil Engineers in 1960 and entitled *Bibliography on Airport Engineering*. This bibliography, international in scope, is arranged in 26 subject-groups containing 2,335 entries.

The writer of the present review feels that high priority should be given to the production of a really comprehensive bibliography of airport administration for British purposes. For up-to-date material on the subject the best sources are the indices to the periodicals listed below, though in some cases the literature is not readily available.

Periodicals Both of the periodicals referring specifically to airport administration and published in Great Britain in the years since the end of the Second World War are now defunct. *Airports and Airline Management* (formerly known as *Airports and Airport Administration* and also as *Air Transportation*) was published between the years 1946 and 1962 by Clarke and Hunter (London) Ltd, of 66 Hill Street, Richmond, Surrey. Among the topics regularly covered were terminals, economics of airline operation, planning of airports, and traffic problems, and an annual index was also published. Unfortunately the publishers do not hold any stocks of back issues. *World Airports* was published by Princes Press Ltd, of Victoria Street, London SW1 every month from 1960 to the end of 1962, but here again the publishers hold no stocks of back issues.

Airport Post, published from Newspaper House, Ickenham, Uxbridge, Middlesex, since 1954, is a newspaper designed for sale to London Airport personnel and is a change-page edition of the *Hayes Weekly Post*. While it carries a considerable amount of news about the airport it cannot be considered as a periodical truly devoted to airport administration. One must, therefore, turn to aviation periodicals *per se* for current news on the subject.

Regular news on airport activities and frequent features and special issues on equipment and individual airports appear in the two principal British aviation periodicals, *Flight International* and *Aeroplane and Commercial Aviation News*. Both of these periodicals are widely available, and libraries usually keep back-files which are often extensive. A new periodical, *Airways International*, published monthly by Air World International, 30/31 Furnival Street, London EC4, is devoted to the technical and commercial aspects of airline administration. The editorial policy statement specifically refers to an intention to publish news and features on airports.

Periodicals concerned with local government affairs take a considerable interest in airport matters and report activities at municipal airports. The three principal items are *Municipal Journal*, a weekly published from 3 Clements Inn, London WC2; *Local Government Chronicle*, also a weekly, published from 11-12 Bury Street, St Mary Axe, London EC3; and *Municipal Review*, a monthly and the official organ of the Association of Municipal Corporations, Victoria Station House, London SW1. This last publication reports, among other things, the deliberations of the AMC Municipal Airports Sub-Committee. References to engineering problems at airports are sometimes to be found in *Municipal Engineering*, issued weekly by the publishers of the *Municipal Journal*.

ITA Bulletin, published weekly by the Institute of Transport Aviation, always contains at least one item of interest to airport operators. The issue for April 6, 1964, for example, contains articles analysing the traffic statistics of four airports, Amsterdam, Dublin, Los Angeles and Tegucigalpa.

An unusual place in which to find an important article on airport administration is the quarterly periodical *Public Administration*. In the Spring 1964 issue is a long article entitled *The Administrative Problems of the Long-term Planning of Airports*, by J. M. Wilson, CB, Deputy Secretary, Ministry of Aviation. The article covers such topics as the present range of the responsibilities of the Ministry in connection with Airports and the proposals for adjusting such responsibilities as contained in the White Paper on Civil Aerodromes and Air Navigational Services (Cmd. 1457). A number of textual references to important Government documents concerned with airport administration are made.

Guides to Information Contained in Periodicals There are references to airport affairs in many periodicals other than those already mentioned, some of them apparently unrelated to the subject field. To trace such information contained in periodicals, standard specifications, patents and report series, there are two principal abstracting services which are arranged in order of subjects, namely *Index Aeronauticus* and *International Aerospace Abstracts*. The former item, an HMSO publication, uses the subject headings "Air bases" and "Air transport" and the latter the term "Air terminals" as a means of indexing relevant material culled from a wide range of periodicals. *Urban Transportation Research and Planning Current Literature*, published by the United States Department of Commerce Bureau of Public Roads, makes frequent reference to articles appearing in periodicals on airport planning. *Air University Periodicals Index*, published from the Maxwell Air Force Base in the United States, is also a fruitful source of reference. Other periodicals indexing services and abstracting services of a more general character also include references to airports. *Engineering Index* has entries for design and construction aspects. *Business Periodicals Index*, issued by the H. W. Wilson Co; *British Technology Index*, issued monthly by the Library Association; and *Public Affairs Information Service*, all have references to various activities at airports.

Directories and Yearbooks *The Aeroplane Directory* contains a list of British landing fields, together with a note of their official reference numbers and the length of their longest runway, but little else of direct interest to persons interested in airports. *Municipal Yearbook* contains a regular feature noting progress in civil aviation, with specific reference to municipal airports. This same directory also contains a complete list of airport health authorities, as well as notes on the responsibilities and functions of such authorities. There is no directory in this country quite comparable with the *AOPA Airport Directory*, issued by the Aircraft Owners and Pilots Association of the United States; this lists over 7,000 landing places in the United States and its possessions.

The HMSO publication *Imperial Service Calendar and Civil Service List*, gives the names and designations of senior staff, including "Air Traffic Control Officers Grades 1 and 2 at National Airports and Regional Control Centres" as well as Ministry of Aviation staff.

Dictionaries and Encyclopædias Information on airport ground services is surprisingly difficult to find in general reference books on the air transport industry. There has been nothing recently which matches the treatment in Section 10 of the *Encyclopædia of Aviation*, written by L. C. Burge under the title *Ground Organization*; the encyclopædia was published in 1935 by Pitman.

The most comprehensive specific source is the International Civil Aviation Organization loose-leaf reference book, *Aerodrome Manual*, which was recently being thoroughly revised. Terminology is treated in the International Air Transport Association *Traffic Glossary*, a tri-lingual series of terms adopted as recommended practice by IATA Traffic Conferences; the languages are French, Spanish and English.

Standard Works The available texts are principally American in origin, there being very little material originating in Britain. There

AIRPORT ADMINISTRATION...

are several useful publications which, emanating from the International Air Transport Association, can be obtained from the IATA Superintendent of Documents at 1060 University Street, Montreal 3, Quebec.

The Airport and the Community is an IATA pamphlet written by members of the staff of the Economics and Statistical Office. It summarizes the advantages which accrue to a community in whose area an airport is established by way of income, employment and industrial development potential. It is intended both for the planner and the public speaker.

Descriptive coverage of various airports is given in J. H. Stroud's *Famous Airports of the World* (Muller 1956), though John W. R. Taylor's *Airlines and Airports of the World* (Transatlantic Arts Inc, 1962) is much fuller. The most definitive treatment of administration is still the American *Air Transportation: its policies and practices* (Wiley, 1952), by J. L. Nicholson. Two important special studies are: Lynn Bollinger's and Arthur Tully's *Personal Aircraft Business at Airports* and Lynn Bollinger's and others' *Terminal Airport Financing and Management*, both published by the Division of Research of Harvard University's Graduate School of Business Administration in 1948 and 1946 respectively.

Many individual airports have their own descriptive publicity brochures, for example that issued by the Manchester City Information Bureau to describe Ringway Airport. There is also M. Allward's and R. McLeavy's pamphlet *London's Airports*, published in 1962 by Ian Allen Ltd.

The problems of using English as the *lingua franca* of aviation are dealt with comprehensively by W. S. Barry's *The Language of Aviation* (Chatto and Windus, 1962). This is a manual of procedures and standardized drills for airport practice and air traffic control procedures designed to assist in the creation of an English language standard for airport and airline management.

Engineering and Planning Aspects—Standard Works Because of the absence of any recent detailed studies from British sources it is once again necessary to turn to American sources for the principal standard works, though in both British and American general reference works on Civil Engineering there are good sections relating to airports.

For planners and designers the notes provided in the IATA pamphlet *Airport Building and Aprons* serves as a handy introduction to such problems as fixed servicing installations, boarding systems and terminal design.

The fullest British treatment of airport engineering is in pages 115-144 of Vol 4 of J. Comrie's *Civil Engineering Reference Book* (Butterworth, 1962), this section comprising an article by E. V. Finn on "Airports and Airfields." Another general reference book on engineering with a detailed section on airports is R. G. Hennes' and M. I. Ekse's *Fundamentals of Transportation Engineering* (McGraw-Hill, 1955). The most comprehensive individual source is R. Horonjeff's *Planning and Design of Airports* (McGraw-Hill, 1962).

From 1942 to 1948 the Road Research Laboratory produced in collaboration with the Air Ministry *Aerodrome Abstracts*, which was published as a supplement to the *Journal of the Institution of Civil Engineers*. More recently the Laboratory has noted a number of important articles and reports on airfield construction and use problems in its monthly *Road Abstracts*, Vol 1, 1964, available from HM Stationery Office.

Statistics The Ministry of Aviation produces a monthly typewriter-script bulletin detailing traffic movements, both passengers and aircraft, into and out of the airports of the United Kingdom. Its title is *Activity at United Kingdom and Channel Island Aerodromes*, and it is freely available from the Ministry of Aviation, Main Buildings, Whitehall, London SW1. The statistics given relate to the activity at the 40 principal airports handling passenger traffic and are given both individually for each airport and in summary form for London's airports as a group, Channel Island airports as a group and for other British airports as a group. The statistics are rendered in physical terms and there are seven columns of figures: total aircraft movements; air transport movements; total passengers handled; terminal passenger movements; transit passenger movements; freight (in short tons) set down and picked up; and mail (in short tons) set down and picked up. The MoA also issues a broadsheet commenting upon trends discernible from the statistics.

The Ministry is also responsible for the compilation of the trading accounts and balance sheets for the State-owned airports; these are compiled in separate series for each of the Groups 1-4 of such airports.

Standard Specifications Several British Standards specifications refer directly or indirectly to airports, usually in respect of lighting standards or runway strengths. Descriptive abstracts of these specifications, indexed by subjects, appear in the annual publication *British Standards Yearbook*.

The International Civil Aviation Organization series, *Annexes to the Convention on Civil Aviation* are, in effect, forms of standard or codes of recommended practice. Annex 14, first published in 1958, refers to airport matters and is revised frequently.

Patents Any new patents of significance to airport planning and design matters are reported in abstract form in *Index Aeronauticus* (HMSO monthly).

Report Literature The principal series of reports which deal with airport affairs, among other things, is the Ministry of Aviation CAP series, details of which are to be found in the HMSO *Sectional List of Government Publications No 48*. Typical examples of reports in this series are: *CAP 132—Planning of Air Stations for Single-engined Helicopters*; *CAP 145—Report of the London Airport Development Committee*; and *CAP 173—Report of the Committee on the Planning of Helicopter Stations in the London Area*.

Other Government departments have also issued reports concerned with airport design and safety. These are best traced by using the HMSO annual bibliography *Government Publications: Consolidated List*. Examples of such reports are: Fire Research Station—*The Fire Hazards of Fuelling in the Open* (Fire Research Technical Paper Series No 1, 1951); and Road Research Laboratory —*The Distribution of Moisture in Soils at Overseas Airfields* (Road Research Technical Papers No 58).

The International Civil Aviation Organization's publications programme includes many special reports on various topics, including airport operation. These publications are available from HMSO in Great Britain and are listed in that office's annual publication *International Organization Publications*; they are also listed in the *ICAO Sales List*, available from ICAO at 1080 University Street, Montreal, Quebec 3, or from HMSO at PO Box 569, London SE1.

Libraries and Information Services The first source to consult for most problems affecting airport operation and administration should be the Aerodrome Owners Association, of Artillery Mansions, Victoria Street, London SW1. Although its first duty must obviously be to its members the Association can usually be relied upon to supply any information not detrimental to its members' interests.

There are two public libraries which have special collections relating to airport administration. These two have built up such collections as part of their responsibilities under the schemes for co-operative purchasing of British books which are carried out by certain groups of libraries. These collections are available for loan, through accredited libraries, on a nation-wide basis. The two libraries are Burnley Public Library, Grimshaw Street, Burnley; and Penge Public Library, Penge, Kent.

Other libraries are those of the learned societies (e.g., the Royal Aeronautical Society) and companies or corporations (e.g., BEA with its Engineering Base Library). In most cases, however, reasonable facilities are made available to non-members and details of the scope and availability of such collections can be checked by consulting *ASLIB Directory* (ASLIB, 1957).

Consultants *Interavia ABC*, a massive annual aviation directory, gives consultants' addresses on a world-wide basis for all aspects of aviation, including airport design, planning and operation. This same directory also has a list of airport construction specialists. British firms specializing in engineering consultancy in respect of airports are listed in the *Consulting Engineers' Who's Who and Yearbook*, which is available in most public reference libraries. Information of this kind is also readily available from the various professional associations, such as the Association of Consulting Engineers, Abbey House, 2 Victoria Street, London SW1; the Royal Institute of Architects, 66 Portland Place, London W1; the Royal Institution of Chartered Surveyors, 12 Great George Street, Parliament Square, London SW1; and the Incorporated Association of Architects and Surveyors, 29 Belgrave Square, London SW1.

The Institute of Transport Aviation administers a considerable consultancy service on behalf of its members, dealing principally with planning and organization of ground services.

The first VC10 for Ghana Airways (9G-ABO), which was officially handed over on December 18 ("Flight" December 31, page 1111)

GHANA'S LONG-HAUL JET

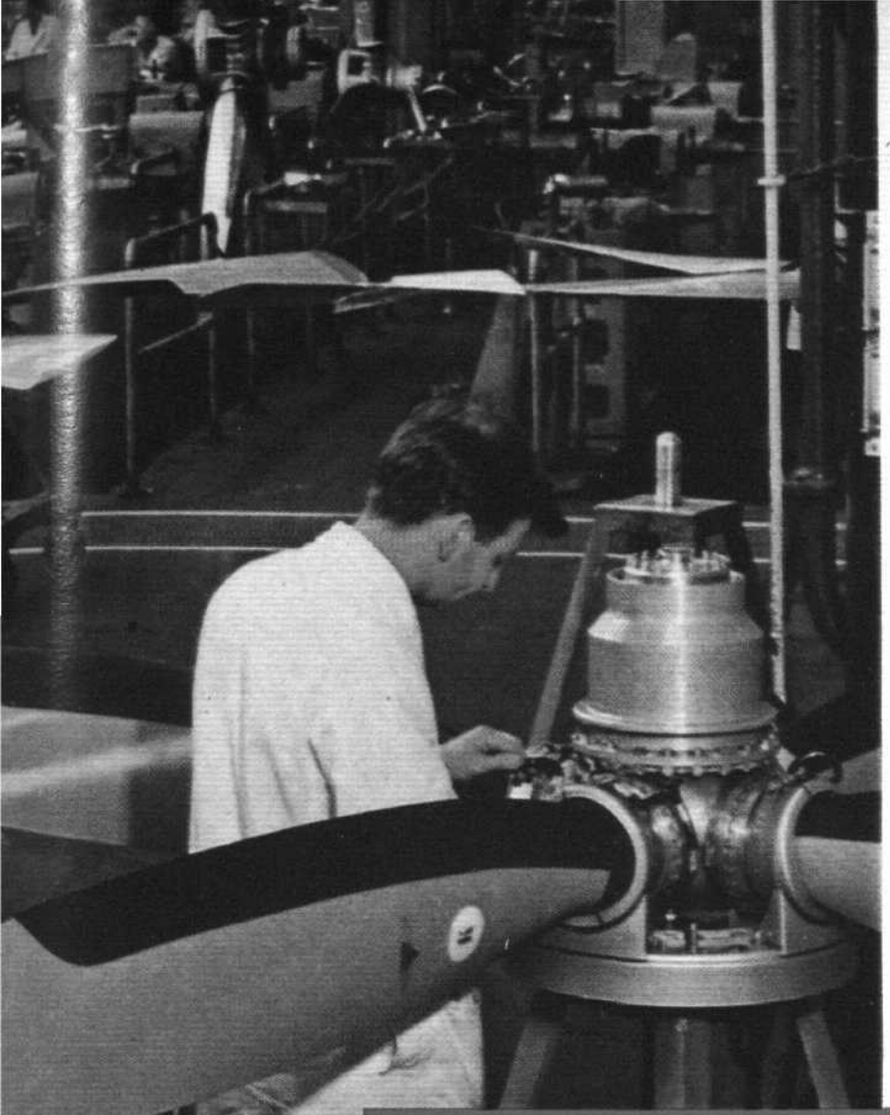
ON February 1 Ghana Airways' first VC10 will, if all goes well, go into service on the Accra-London service and, later, on the Accra-Rome-Zurich-London services. It will take over first from the Britannia 309 at present used by Ghana Airways and later from the Convair 990 leased to Ghana from Swissair. In due course Ghana Airways plans to develop further long-haul services and also to expand its freight operations with the second and third VC10s which are to have large freight doors and mechanized loading systems.

Flight crews have been under training at Wisley since December. These crews include six captains who have previously commanded Britannias. The work of crew conversion has been handled by BOAC, which also exercises ultimate technical control of the airline's VC10 programme. The trainee team at Wisley has been led by Capt. G. W. Daggett who is flight captain of Ghana Airways VC10 fleet.

Layout of the first VC10 for Ghana is arranged for 20 first-class and 87 economy-class seats. Crews will consist of two pilots, a navigator and an engineer on the flight deck, with a total of six cabin crew consisting of three stewards and three stewardesses.

Ghana Airways' plans for expansion of long-haul service are still under consideration, but it is possible that the initial development will be that of services to the Middle East and beyond, via Cairo and Beirut. There will possibly also be extension of the present European services into Western Germany. Services to the Far East are also under consideration.

Large freight doors, which are planned for the second and third aircraft, and the first VC10 has the 4 per cent extra chord at the wing leading edge. This first aircraft, 9G-ABO, was handed over to Ghana Airways on December 18, when Mr. A. J. Dowuona-Hammond, Ghana's Minister of Communications, signed the documents which made Ghana Airways the first overseas airline to buy the VC10.



DOWTY

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PROPELLER ASSEMBLY

Eastern Air Lines was, with United Airlines, one of the first two carriers to buy the Boeing 727—each ordering 40. Last month Eastern ordered five more 727s and is to lease another five, bringing its total order to 50

FUTURE FOR MEDIUM-HAUL JETS

JUST over four years ago—on December 5, 1960—Eastern Air Lines ordered 40 of Boeing's projected tri-jet medium-haul, medium-capacity 727 transport. At the same time United Air Lines placed a similar order. After a relatively slow start to sales, the total stood for a year or so at about 100—and well below the required break-even figure of about 200 aircraft.

Today the prospects for the 727 look better than ever before—and the same is also true of its British and French rivals, the Hawker Siddeley Trident and the Sud-Aviation Super Caravelle. The reason seems to be twofold. First, all three of these aircraft are "second-generation" jet transports and the two which have now been in service for some time have shown remarkable reliability. Secondly (and perhaps a corollary of the first fact), they are proving to be very economical—as in the case, for instance, of an earlier second-generation aircraft, the classic Douglas DC-6B of the 1950s.

But perhaps the real secret behind the present hopeful long-term prospects for these three airliners is that there are no immediate prospects that they may be superseded by technological developments. On longer hauls the supersonic transports are still an unknown quantity but a likely possibility; and for short hauls VTOL is a threat. The medium-haul, medium-capacity market is likely to remain theirs for many years to come.

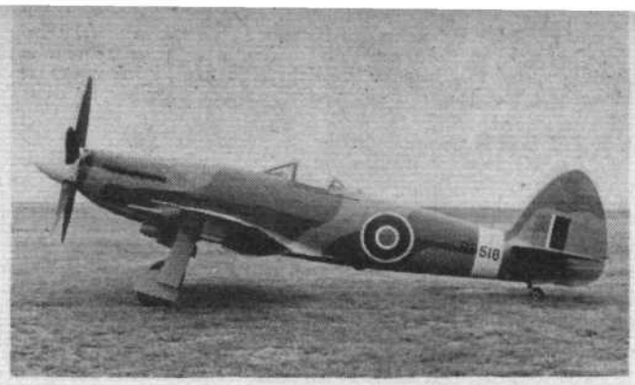
More than 235 Boeing 727s have been ordered by 14 airlines—so the originally calculated break-even number of 200, for what it is now worth, has been substantially improved upon. After the initial orders from Eastern and United—which provided the impetus for the decision to start production—American Airlines, in the spring of 1961, gave Boeing a letter of intent to buy, and later placed an order for 25—since increased to 27. First carrier outside the United States to buy this medium-haul jet was Lufthansa. This "foreign" order was followed later by orders from Trans-Australia Airlines and Ansett-ANA. In keeping with the competitive "two-airline" 'policy in Australia, each of these airlines bought two and this order has since been increased to three each.

Comparatively few orders for the 727 have, in fact, so far come from carriers outside the USA. More recently British West Indian Airways ordered three, South African Airways ordered five and All Nippon Airways became the sixth foreign carrier in the 727 order list with a total requirement for six.

Recent repeat orders—in particular, for instance, from Lufthansa—show that the requirement for the medium-sized, medium-haul jet is a continuing one and that there is likely to be a market for this size and type of aircraft for a dozen years at least. This market has probably been further widened by the Boeing proposal for a combination passenger-freight version of the 727, though only three of these have so far been ordered—by Northwest Airlines. The problem for the manufacturers will be that of keeping the production lines open on a basis of a continuing series of relatively small repeat orders and those from minor airlines which have yet to reach decisions on future re-equipment.

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.



The Vickers-Supermarine Spiteful (see letter from Mr T. Connaughton) was a post-war descendant of the Spitfire, with straight-tapered, square-tipped wings and a deeper fuselage. This is the Rolls-Royce Griffon-powered F.16 Spiteful which in 1947 attained a speed of 494 m.p.h.

Atlantic Prestige and Profit

SIR,—Mr Baldwin's calculations (Letters, December 24) over-estimate the descent fuel by 2,000lb, so that his basic fuel requirements for the VC10's flight would be 114,560lb. The diversion fuel to Montreal would be about 7,700lb, the stand-off reserve and *en route* contingency fuel another 18,700lb. The grand total would thus be 140,960lb, compared with the Boeing 707's requirement, on the same basis, of 136,560lb.

The height of 34,000ft is fairly representative of the cruise altitudes normally used and was chosen because it is the maximum height the VC10 can reach initially with a maximum weight take-off and i.s.a. conditions. A stepped-climb cruise would improve consumption a little for both aircraft, but not to a significant degree. With the current congestion on the Atlantic a level cruise is the rule rather than the exception.

Work has already taken place to reduce the drag and increase the payload of the VC10. The result is the Super VC10. Fuel consumption figures are not available for this aircraft, but since its a.p.s. weight is 8,500lb more than that of the VC10 and its engines give more thrust, the consumption can hardly be less. Assuming it to be the same, we can make up a brief table of meaningful figures for the conditions previously discussed:—

	VC10	Super VC10	707
Initial cost	£2.6m	£2.85m	£2.4m
a.p.s. (lb)	149,000	157,500	133,000
Fuel required (lb)	140,960	140,960	136,560
Total (lb)	289,960	298,460	269,560
Max t.o.w. (lb)	312,000	335,000	312,000
Payload available (lb) ..	22,040	36,540	42,440

Load factors on the Atlantic are very high and payload available is critical.

I agree that the high a.p.s. weight is one of the basic failings of both versions of the VC10. The great failing is more basic still. The aircraft is more expensive to buy and operate than is its competitor, and over a given distance it carries less payload. It is also four years late in the field. In any business this is suicide.

Most of the world's airlines are currently buying new jets. They have been doing sums, similar to those above, albeit more sophisticated, and most are now buying Boeings. The best service anyone can do our aircraft industry is to show why this is happening. Pretending that it isn't will merely send us headlong into the next debacle.

Berks PUZZLED

"No Silly Squabble" says Cambrian

SIR,—Your news item on page 1107 of the December 31 issue headed "Licensing Sensation—2" apart from presenting an incomplete picture, does this company somewhat less than justice in referring to "a rather silly inter-airline squabble." We are far too busy trying to operate scheduled air services in accordance with public demand to waste our time, and the time of others, in "silly squabbles."

I am certain you know the Cambrian approval to operate a Liverpool - Cork service was granted only after we had produced our estimates of traffic potential, which were far in excess of what the then incumbent, Starways, was trying to cater for, and which they denied existed. At the subsequent appeal, Starways (now wholly controlled by British Eagle) again stated that our estimates of traffic potential were highly exaggerated. Since then there has been a further ATLB hearing and appeal, but with a difference—British Eagle are now using estimates of traffic potential to all intents and purpose identical with those produced by Cambrian a year-and-a-half before.

Far from being a "silly inter-airline squabble," this is a further example of the inadequacies of the present Civil Aviation Licensing Act and regulations. It is a farcical situation which allows an airline to sit on a licence and not develop the route—only to do so later under pressure created by another airline which has faith in the potential of that route.

Speaking of faith, it will be of interest to your readers to know that British Eagle suspended operations in the week ended October 17, and that on November 7—three weeks later—Cambrian had obtained bilateral clearance and had commenced to operate a thrice-weekly service—a higher frequency than British Eagle had operated during the summer peak period.

Cardiff (Rhoose) Airport, Glam L. B. ELWIN, *Managing Director, Cambrian Airways Ltd*

Wanted—A Spiteful

SIR,—I have just finished reading your article on "Racing at Reno," by Don Berliner (October 15) and of all the reports I have seen in all the magazines yours is without a doubt the best-covered and most well written. I found but one error: the engine in the Bardahl Special was claimed to give 2,450 h.p., not 3,400 as stated in the article. [We *did* say "reportedly" capable of developing 3,400 h.p.—Ed]

I'm sorry we could not make the cross-country; I feel confident we could have been first. But that's racing.

At present I am looking for a Supermarine Spiteful with the Griffon 101 engine. I would appreciate any information your readers could forward as to the whereabouts of one I could purchase. I do believe that this machine, with a few modifications, could very well be the world's fastest piston-engine aircraft, and I would like an opportunity to prove it.

2415 Lombard, Everett, Washington, USA TOM CONNAUGHTON, *Crew Chief, winning Bearcat*

First Life Saved by Parachute

SIR,—You were good enough to publish (page 828, November 12) a short summary of my lecture on the *History of Parachutes* to the Historical Group of the Royal Aeronautical Society on October 26.

In the lecture I cast some doubt upon the generally accepted report that a Polish balloonist, Jordaki Kuparentko, saved his life by means of a parachute during an ascent over Warsaw after his Montgolfier balloon had caught fire. Originally these doubts had been raised by a variance in the dates quoted for the incident. Monck Mason, who seems perhaps to have been the originator of the report, gives two dates in his book *Aeronautica* (published in 1838): July 24, 1804, and July 24, 1808. Various writers since then have mentioned the parachute descent, giving either one or other date without apparently checking the validity of the event.

In reply to an enquiry I had made, I recently obtained a

LETTERS . . .

letter from the Aero Club of Poland which casts considerable doubt as to whether Kuparentko used a parachute. The letter, from the president of the club, says that "according to some ballooning and parachute authorities in this country no special parachute had been used in this accident." My correspondent goes on to say that Kuparentko's life was probably saved because of the drag produced by the torn fabric of the balloon. This, of course, corresponds to a number of similar incidents during the century. While I am trying to obtain further confirmatory information from Poland, it would seem to me that those many writers who considered that Kuparentko was the earliest person who saved his life by parachute were incorrect.

Hitchin, Herts S. B. JACKSON

Southport's Old Stagers

SIR,—The D.H. Fox Moth G-ACEJ, mentioned and photographed by A. W. Jesse (Letters, November 5) resharpened the focus on my most memorable flying experience.

It was the summer of 1939. I had 2s 6d (or was it 5s?) which I paid to the man in the glamorous white overalls. Within seconds we were airborne, I for the first time in my life. As for Mr Giroux, the pilot, it would be impossible for him to count the times. Within ten minutes we had climbed, levelled off, flown as far as the pier, throttled back by the outdoor swimming pool, skirted the amusement park, and kissed the flat white sands again.

Exhilarated, I had at the age of 15 acquired myself an enchanting mistress—flying. And, a quarter-century later, she fascinates and satiates more endearingly than ever as I wing about piloting rented Cessna 182s on business and pleasure in Canada and the States.

I still cherish "Passenger Certificate No 146510" signed by Mr Giroux of Giro Aviation. Dated 8/8/39, it carries this quotation: "The Giro Aviation Co, of Southport, have carried over 130,000 aerial passengers during 19 years of post-war aviation."

On the reverse side of the postcard-size certificate is a photograph of the Fox Moth that started my affair. But, unlike the one you published, its registration is G-ACCB.

Agincourt, Ont DESMOND M. CHORLEY

End of the Industry?

SIR,—I have just finished reading, in an article in the *New York Times* of Sunday, January 3, that there is a very good possibility of the manufacture under licence, or outright purchase by the British Government, of (1) the C-141, (2) F-111 (TFX) and (3) Lockheed Orion.

This must be unwelcome news to the British aircraft industry. Do you realize that the whole British defence equipment would be based on American-designed or -built equipment? The Royal Navy will have Polaris, the RAF will have the F-111 and Coastal Command will have the Lockheed Orion; and, last but not least, Transport Command will have the C-141.

I am afraid this would signal the end of the British industry. Think of all the foreign exchange the American Government will be earning out of this! You will have to sell quite a few BAC One-Elevens to make up for it. If you take the easy way out, and start to rely completely on foreign supply for your defence equipment, Britain's voice in foreign affairs will become even smaller than it is now.

You have to stop living on past memories and think of the future. You have to take gambles in the world today, but before you can reap any benefits of a gamble you will have to stake a bet and put hard cash on the line. If I were a representative of a foreign government I would be afraid to place an order for aircraft with the British industry, because of the fear of cancellation of the project. You had better put an end to the go-stop-go-stop policy of your government.

I am sure the American aircraft industry would welcome some competition in any form.

Newark 12, NJ R. FULFORD

"What Constitutes Valid History?"

SIR,—With reference to a paragraph in Mr Jenkinson's letter (December 24), I would like to point out a few facts of which he is obviously ignorant.

I would say that there are more than 10,000 persons in the British Isles alone whose interests lie in what he terms "the immensely laborious and totally useless assembly of arid details—constructors' and Service numbers, civil registrations, colour schemes, successive owners, etc—of individual aircraft, from the production line to the scrapyard." After all, a history of any aircraft cannot be compiled without any of the above information, which he regards as being useless.

For his information, and for that of any others who are ignorant of the facts, there are many organizations in existence that devote all their time in the compilation of these "arid details." Most other countries also have many similar organizations, and almost certainly some form of aviation historical society, as in New Zealand, Australia, America, Canada and Sweden.

Most of these organizations publish a magazine in which one would not find an aircraft mentioned without some form of registration, construction number, colour scheme or owner being mentioned.

Camberley, Surrey J. HUNT,
Blackbushe Aviation Group

DIARY

Jan 14 *Institution of Electronic and Radio Engineers (Southern Section) and IEE: Joint meeting, "Attitude Control of the Skylark Sounding Rocket," by J. F. M. Walker.*

Jan 14 *RAeS Halton Branch: "The Concorde," by G. L. Auty.*

Jan 15 *Institute of Navigation: "Visual Factors in Aircraft Navigation," by E. Heap.*

Jan 19 *RAeS and IEE: Joint discussion, "Development of Dependable Fire-warning Systems in Aircraft," to be opened by J. R. Stevens.*

Jan 19 *RAeS Prestwick Branch: "Space Research," by D. H. Beattie.*

Jan 20 *Kronfeld Club: "The 1965 World Gliding Championships," by Ann Welch.*

Jan 20 *RAeS Agricultural Aviation Group: All-day symposium.*

Jan 20 *RAeS Bristol Branch: "High-supersonic Aerodynamics," by Dr J. Seddon.*

Jan 20 *RAeS Coventry Branch: "Man-powered Flight," by F. Vann.*

Jan 20 *RAeS Gloucester and Cheltenham Branch and IEE: Joint lecture, "Communication Satellites," by a GPO spokesman.*

Jan 20 *RAeS Manchester Branch: "Handling of Modern Jet Transports, with Special Reference to the Super Stall," by E. B. Trubshaw.*

Jan 20 *RAeS Preston Branch: "Structures and Materials for the Aerospace Era," by I. C. Taig.*

Jan 21 *RAeS Cambridge Branch: "The Wallis Autogyro," by Wg Cdr K. H. Wallis.*

Jan 22 *Society of Licensed Aircraft Engineers and Technologists: "Electronics Systems Reliability." The airlines' view: F. Hoyle; the manufacturers' view: J. Stewart.*

Jan 22 *British Interplanetary Society Western Branch: "Space Environment," by R. F. Ayers.*

Jan 22 *RAeS Belfast Branch: Annual dance.*

Jan 23 *British Interplantetary Society Yorkshire Branch: "Planetary Radar," by Dr J. H. Thomson, Leeds.*

Max Conrad's record-breaking Twin Comanche "Let's Fly" has eight times the type's normal fuel capacity . . .

SPORT AND BUSINESS

More on Max Conrad's Latest Record, briefly reported in last week's issue of *Flight*. Departure of the Twin Comanche from Cape Town was at 2min past midnight (American Eastern Standard Time) on December 24. Some 56hr 48min and 7,868 Great Circle miles later, it landed at St Petersburg, Florida, on December 26 to establish (subject to FAI confirmation) a new distance record for Class 4 aircraft (1,750kg to 3,000kg gross weight). The distance achieved was 200 miles more than Max Conrad's previous best, established in 1959 in a Comanche from Casablanca to Los Angeles.

The Twin Comanche's standard 75 Imp gal tankage (good for over 1,000 miles) was augmented for the attempt by a further 525 Imp gal system of tanks. The plan was to exceed the previous record by at least 1,000 miles; but things don't always work out, even for Conrad and his Piper.

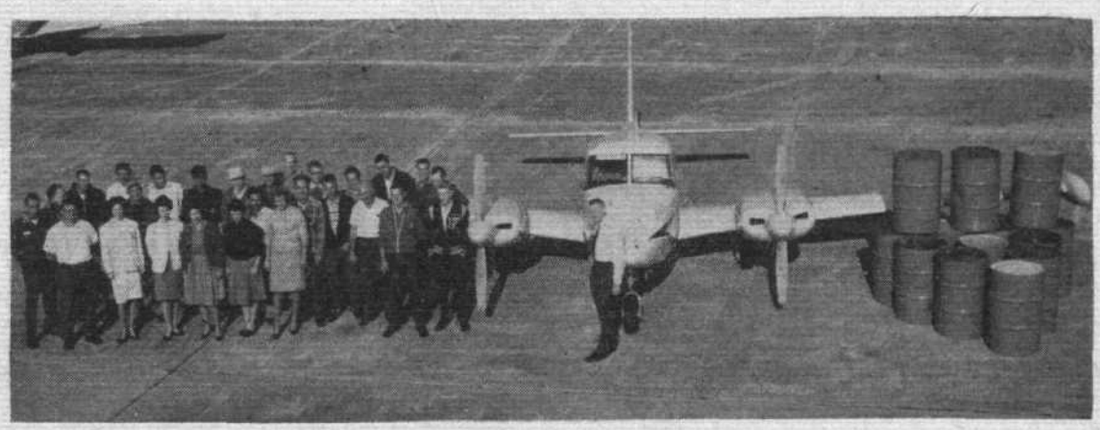
A night of "solid thunderstorms" on Christmas Eve over the South Atlantic, resulting in lengthy detours to the west of the straight-line course early in the flight, dashed Conrad's hopes for achieving the maximum distance. After the prolonged night of "not just four or five severe thunderstorms, but a continuous series of them," a landfall was made on the Brazilian coast south of Recife. A circuitous route was then followed around the bulge of Brazil—costing additional mileage.

The planned Great Circle route was a course of approximately 330° straight up the South Atlantic, and involving one of the longest continuous overwater flights—some 6,600 miles—ever attempted, by any kind of aircraft. The route passed 400 miles south-west of Ascension Island, past Brazil, across the Equator, and up the Caribbean to Barbados and Puerto Rico.

At one point Conrad felt he would have to abandon the flight because of the time and mileage lost through the South Atlantic thunderstorms. He contemplated landing at San Juan but before getting there he was in radio contact with a group on Elwell Island who said they were just sitting down to Christmas dinner and invited him to join them. He circled the island once, then made up his mind to continue.

Passing Nassau he calculated he had 4hr of fuel left and indicated he would land at St Petersburg. Later he felt his fuel state would permit continuing to New Orleans. An hour out over the Gulf of Mexico, as dawn came, with the entire Gulf Coast shrouded in fog and fuel running low, he decided to return to St Petersburg, where he landed at 8.49 a.m. (EST) at the Clearwater - St Petersburg International Airport. Ironically, when the tanks were officially inspected after landing, Conrad discovered an unexpected "good two hours" remaining in one of them, enough for 300 more miles.

For sustenance, the grand master of endurance flying carried four Thermos flasks of hot water, but no food. His legs were a little "rubbery" when he got out of the aircraft, but he was otherwise in excellent shape. Observers who had been on hand at Los Angeles after Conrad's Casablanca flight were impressed with the fact that he was in better shape after this latest flight. After talking to reporters he napped for a couple of hours on a couch in the airport office, then was up at noon. He then worked around his aircraft, checking tanks and removing the two official barographs which had been installed in a bed of foam rubber in the rear of the left engine nacelle.



. . . weighing 4,320lb, the consumable load is equivalent to 25 people (left), or slightly more than could be contained in 13 46 Imp gal drums (right). Max Conrad stands by the nose of "Let's Fly"

The Lerho Terraplane, a minimum-altitude primary trainer with powered-sailplane possibilities. Employing the "sailwing concept" developed by Princeton University Forrestal Research Centre, the Terraplane is being developed by Lerho Laboratories. Originally powered by a 22 h.p. engine, this three-axis controllable machine would only rise to the full extent of its fourth leg. The present 43 h.p. Nelson H-63 engine (right, also 2gal fuel tank) has taken the aircraft up to 15ft and full flight is expected. Span 22ft; length, 14ft 7in; empty wt, 260lb; gross wt, 660lb; landing speed, 37 m.p.h.; cruising, 60 m.p.h. Plans cost $20 and kits $620; full details from Nelson Aircraft Corp, PO Box 551, Irwin, Pa, USA

SPORT AND BUSINESS

More-expensive Landing Cards From January 1 the owners of UK-registered private aircraft are to pay more for their "red landing cards," but will be exempted from the new navigation service charges which came into force on November 1. The new prices are £15 for gross weights up to 2,600lb, £20 up to 3,499lb and £30 up to 4,499lb.

In view of the Royal Aero Club's special support for private operators against the Aerodrome Owners Association's revised scale of charges, it is ironic that the Club, as the MoA's sole administrators of the red card scheme, should now be forced to apply this increase. But it is known that by much behind-the-scenes pleading the result is very much less severe than had first been proposed.

Few private pilots will find the new scale unreasonable. For frequent users of Britain's superb and friendly State-owned airports the card is still excellent value. There has not been an increase in cost of red cards since 1952 and the present increase is much less than the fourfold rise in the casual-landing charges.

Train at Oxford . . . The Oxford Air Training School, a division of C.S.E. Aviation and officially approved for commercial pilot training, is all set for 1965 with the latest Piper equipment. Basic trainers are the Colt at £7 per hour and Cherokee 140 at £8 per hour—£10 for instrument rating instruction. For serious touring and business the Cherokee 180C at £11 per hour and Twin Comanche at £22 per hour are available. The latest Aztec C and Comanche 260 are available at rates on application.

Oxford is, of course, particularly well equipped for instrument rating training, for in addition to the usual D4 Link trainers there is the ex-BEA Ambassador flight simulator, which is unrivalled for twin-engined experience at the price. The handling characteristics and speeds are adjustable to approximate to those of the DC-3 and Dove. Last year 60 Oxford students passed their instrument rating tests, 60 per cent of them at the first attempt. The school also trained 125 students to PPL.

. . . then Fly Yourself Round the USA, following the successful introduction of this latest idea in touring by Air France last year, British Piper distributors C.S.E. Aviation are planning a tour for British pilots this year. On May 10 a party limited to 56 will fly Pan American to New York and, following a few days at the World Fair, will travel to the Piper factory at Lock Haven. In four-seat Cherokee Cs they will then fly themselves on a 6,000-mile, 21-day tour taking in Miami, El Paso, the Grand Canyon, New Orleans and Dallas. Details can be obtained from Mr Gerry Cutler, Express Travel and Transport, 9 Farringdon Road, London EC1.

LSF's New Director Mr John Schooling, an instructor with the London School of Flying at Elstree since 1959, has been appointed a director of the company.

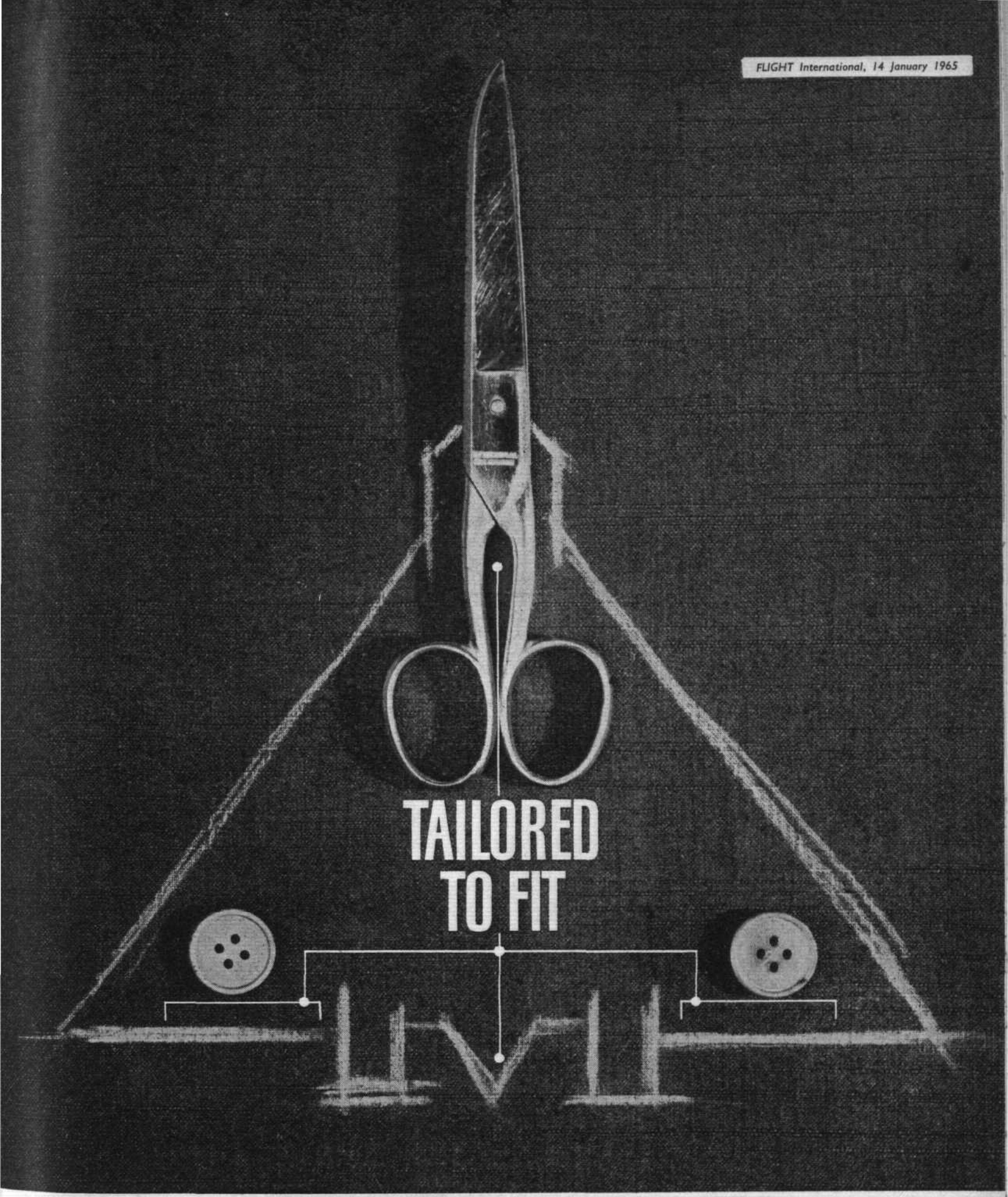
Military Aztecs Six Piper Aztec Cs have been bought off the shelf by the Argentine Army for liaison, command control and senior staff transport. The Army already had five Apaches and numerous Cubs.

Fletcher FU-24 in New Zealand The Fletcher FU-24 agricultural aircraft is to be built by Air Parts (NZ) Ltd, of Rukuhia, near Hamilton, New Zealand, who have purchased world manufacturing rights. The move is to save foreign currency and provide NZ operators with a cheaper aircraft. More than 68 FU-24s, assembled from US parts some time ago, are already operating in New Zealand.

Derringer Crash The second prototype Wing Derringer two-seat business twin (two 150 h.p. Lycoming IO-320s) (*Flight*, December 24) crashed recently into a 2,000ft-deep area of the Pacific off Los Angeles. The test pilot, Mr Thomas Heffner, was killed. On test for nearly two years, the aircraft was reported to be on a routine flight to check engine performance. A pilot witness said the Derringer was doing a high-speed 180° turn when it began to oscillate in pitch before spiralling into the water.

Rallye Developments Most powerful version of the variously engined Potez SEEMS (ex Morane Saulnier) Rallye flew last month from the maker's Tarbes Ossun airfield. Called the MS 893, it is fitted with a 180 h.p. Lycoming O-360 and is planned to be put into early production. Altogether 465 Rallyes of all types have been built, and another 150 or so are planned. Since the Potez take-over production has been concentrated on the 150 h.p. Rallye Commodore.

. . . And at Centre Est Aéronautique After specializing for many years on highly successful three-seat Jodels, CEA at Dijon has just flown the new and slightly bigger DR 200 as an interim development aircraft prior to the new four seater "quadriplace" DR 250. The DR 200 is powered by a 150 h.p. Potez flat-four and has a fractionally wider and longer cabin than the three-seat Sicile Record. The DR 250, to fly towards the end of next month, will be powered by a 140 h.p. Lycoming and not, as thought at the time of a *Flight* visit to Dijon in October (*Flight*, October 22, page 717), by a 120 h.p. injection development of the Potez. The DR 250 is expected to cruise at 135kt TAS at 10,000ft on 66 per cent power.



FAIREY HYDRAULICS

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

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THEY ARE TALKING TWIN OTTER

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THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO
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IN THE AIR

By Neil Harrison : Number 190 of the series

Lake LA-4 Amphibian

(One Lycoming O-360A1A 180 h.p.; Hartzell constant-speed Dural propeller 72in diameter)

Span, 38ft; length, 24ft 11 in; overall height on wheels, 9ft 4in; wing area, 170 sq ft; empty weight of basic aircraft, 1,575lb; empty weight as tested with comprehensive equipment, 1,673lb; gross weight, 2,400lb (normal 3.8g category); standard fuel capacity 33 Imp gal; wing loading, 14.1lb/sq ft; power loading, 13.3lb/h.p.

Performance (claimed) Max speed at sea level, 135 m.p.h.; cruising at 75 per cent power at 6,000ft, 131 m.p.h. (TAS) for a fuel consumption of about 8¾ Imp gal/hr the dry-tanks range is some 500 miles; max s.l. rate of climb, 800ft/min; take-off run to unstick (still air, gross weight), 650ft (land), 1,125ft (water); landing run from touchdown, 475ft (land), 600ft (water).

LAKE LA-4 AMPHIBIAN

EVERYONE seems to find the idea of outback flying appealing. To combine the excitements of aviating with the splendours of the great outdoors is, one supposes, the ultimate delicacy for the romantic and adventuresome spirit. Alternatively, what could satisfy an aeroplane-lover more than the sight of one actually doing a useful job of work? All this came true for the writer just before Christmas during four glorious days in Ireland, spent landing here, there and everywhere in the tough, versatile and delightful Lake LA-4 amphibian.

A casual enquiry to the Marquis of Headfort (European main distributor for Lake) at home in Kells, County Meath, had evoked the most generous and unrefusable invitation to try this newcomer to Europe in something approaching its natural surroundings. A quick skirmish across the Irish Sea, travelling by *Flight's* Baron with photographer Mike Barnes, was an obvious move; the amphibian was to depart early in the new year for an extensive demonstration tour of the Continent. For the seemingly endless number of things one can do in, on and with it, the Lake really is unique; certainly it ought to succeed in Europe.

At various times in the last 20 years there have been attempts to produce a light, four-seat amphibian for sportsmen, police, and small-time charter companies. Among notable attempts have been the Republic Seabee and the more recent, but not dissimilar, SIAI-Marchetti Riviera. The former never really caught on; it was heavy and possessed an indifferent performance. The latter looks promising but remains as yet relatively unknown. The most widely used and successful light amphibians are, of course, the Edo four-wheel twin-float conversions of Cessna 180s, Piper Cherokees and other land-based types. The uncompromised Lake LA-4, in the writer's opinion, is outstanding as the first thoroughly practical light amphibian (at any price) having a decent performance, range, and payload. Over 125, including predecessors, are now flying and production is in full swing at Sanford, Maine. Lake Aircraft's head office is at 5511 South Main St, Elkhart, Indiana.

The LA-4 dates from the 150 h.p. Lycoming O-320 powered two-seat Colonial Skimmer C-1, first conceived in 1946. Some 20 C-1s were built, together with a similar number of C-2s, fitted with a 180 h.p. Lycoming O-360 and three seats. Colonial's work was taken over by Lake Aircraft in 1959, the latter merging with Consolidated Aeronautics in 1962. Meanwhile the amphibian's development was taken a stage further and evolved as the LA-4 with a 180 h.p. Lycoming O-360, four seats, a longer hull to improve water-borne characteristics, a greater span and many detail improvements. At least 85 LA-4s are already flying and the current production rate is around four per month.

Since Headfort Aviation's demonstrator (EI-ANR, formerly N1133L) arrived on September 3 last, with the FAI class C3C amphibian record under her belt (Reykjavik - Belfast Lough, 855 miles), she has been out and attracted the first of many sales prospects in Scandinavia following demonstrations there. One (to be delivered in March) has been sold to Taxiflyg/Nygeaero of Nyköping, who will act as agents in Sweden. Denmark, Finland and Norway were also visited; France, Italy and Greece are next on the list. Three Lakes are serving with the Thailand Air Police, while in the United States there is at least one satisfied commercial operator of the type—Kodiak Airways of Alaska—as well as private owners.

What will she do and what does she cost? First, the Lake is truly amphibious; low and compact, with a wide-track retractable undercarriage and stout box-like tip floats, she is by any standards remarkably sure-footed on land or water. The four-seat cabin is fine for three adults, though a bit of a squeeze with a full complement, but a cavernous compartment behind the back seat, stressed for 200lb, easily takes water skis, collapsible boats, outboards, subaqua gear and so forth. At a gross weight of 2,400lb and an empty weight of 1,575lb (1,673lb on EI-ANR), a basic Lake can carry three 12-stone people plus 85lb baggage with the 33 Imp gal fuel tank full and sufficient for an absolute range of just over 620 miles,

"Flight" photograph

Winter sunshine and a threat of snow; the quiet and unobtrusive Lake LA-4, here aloft over the loughs and fields of Ireland

"Touching down on the step is a graceful and satisfying manœuvre . . ."

LAKE LA-4 AMPHIBIAN...

cruising at about 115 m.p.h. Maximum cruising speed is 131 m.p.h.

In her 100lb or so of extra equipment EI-ANR has a Stewart Warner combustion cabin-heater (36lb); a full blind-flying panel of vacuum driven instruments; a Narco Mk 12 VHF nav/com transceiver and a Bendix ADF T12B; night lighting; extra tip and float bumpers; an anchor, collision beacon, and sundry other items of safety equipment. The Lake is also a first class speedboat, manœuvrable and fast. When the machine is at rest one can walk about on her top surfaces, dive from the wings or fish from the nose.

A basic Lake costs $26,580 ex-works: to this must be added UK purchase and import taxes and ferry-flight charges, which bring the cost of the aircraft to about £11,000 in Britain. To those unaccustomed to thinking in terms of amphibians and what can be done with them (and this probably includes most European pilots), the bare facts of the Lake's performance and price are perhaps not particularly brilliant. Though the writer was partly converted to seaplanes, following enjoyable weekends last summer messing about with the Sea Tiger Moth at Lee-on-Solent (amounting to some dual and 10min solo), the loughs and pastures of Ireland were the scene for impressive, undreamed-of demonstrations.

Headfort Aerodome on the estate at Kells, 30 miles north-west of Dublin, was easily located. The 310 radial from Dublin VOR brought us in nicely for a "talk down" delivered from the steps of the mansion by Lord Headfort himself, passing directions *via* a Shorrock portable transceiver. Scores of estate employees stood listening for the Baron's engines, ready to aid with basic QDM information—luckily we had arrived in the middle of the annual Christmas party. The field was about the smallest cow pasture we had been into with the Baron. Seriously, it is a splendid aerodrome —even Cessna 310s have been in there. A modern hangar and workshop space has been erected ready for the expansion in Lake business. The spares holding will be progressively increased as the number of European Lakes grows.

Serviceability features of the Lake design include the propeller location—only under extreme conditions could the propeller be damaged; tyres, wheels and brakes interchangeable with those of Cessnas; standard hydraulic system components; a tough all-metal airframe with unusually stiff external panelling (in spite of the rumour that we sank the Lake, of which more later); and omni-accessibility to the engine through detachable "eggshell" nacelles. The only unusual feature for so small an aircraft is a multi-service hydraulic system—charged by an electric pump, or by a hand-pump if the flow of sparks fails. The large elevator-tip trim-tabs are moved hydraulically, as are the flaps, undercarriage retraction and wheel brakes. Jumping into the Lake through the vast opening left by the forward-hinging wrap-round windscreen/doors, even with the engine running and afloat or on land, is no trouble. The overall layout is ideal for mooring, docking, or coming alongside boats. Also, one can stand upright on the seat to take a look around. Nevertheless, to be first aboard from over the nose when docked head-on to beach or jetty demands a long arm and agility to reach the door handle. If your pens drop in the water at this stage, it is a lesson to be remembered later.

The cockpit is very snug; the adjustable-for-reach seats are comfortable and give good support; all-round visibility is excellent, with the wing and tailplane tips, floats and lowered mainwheels on one's own side visible without straining. The blind-flying instrument arrangement, however, is not one of the best. The artificial horizon is offset, low-mounted and partly obscured—the only really prominent instrument being the clock. The layout of remaining instruments and controls is good. The overhead throttle, pitch and mixture levers work conventionally (forward for "on, fine and rich"); confusion is likely to arise only if one looks at the levers and mentally inverts them, so to speak. Mounting the levers high gets them well out of the way for entry and egress and, of course, leads to simpler linkages to the overhead engine.

Now to handling; first as a landplane, for that was the writer's introduction to the LA-4. Ground manœuvring is easy enough, even though the nosewheel only castors (it would pose sealing problems to pass steering rods through the watertight hull) to differential mainwheel braking—necessitating the use of more power than usual to turn. Sitting low to the ground, as if cradled in the wide track, one finds the ride remarkably stable.

Take-off vital actions are: throttle friction, not applicable—the overhead lever is permanently damped; trim tabs, half nose-up—operated hydraulically through a press-and-hold lever on the floor between the seats (the adjacent indicator was not working on 'NR but the tab position could be checked visually); fuel "on" from the single 33 Imp gal centre-line tank (the selector is on the bulkhead behind the back seats and can just be reached from the front), fuel boost pump "on," too, for take-off; flaps selected (there are only two positions: up or down, the latter appearing to be about 20°) by a pull and move-down lever on the right of the panel centre-line, with red or green indicator lights as an alternative to a visual check of flap position; engine instrument needles in the green and hydraulic pressure adequate; hatches closed (each main door closes and latches positively by a single over-centre, cam-shaped

"The Lake is also a first class speedboat . . . "

"Steep-sided Lough Derravaragh, West County Meath, was our first stop . . ."

slot engaged by the single handle mechanism; seat harness secure, and you are ready to go.

Operating from Headfort's bumpy-in-places Runway 30 highlighted the importance of keeping the Lake well and truly on all three wheels until 60 m.p.h. is reached, resisting every tendency to bump the nosewheel off. If this is not done aerodynamic drag apparently lengthens the run noticeably, as the aircraft becomes slow to accelerate. As it was, even at gross weight, she would pull off cleanly at 60 m.p.h. after travelling only 900ft or so through the longish grass. After accelerating to 80 m.p.h. and retracting the gear (about 8sec to clean-up, but about 20sec before the locks go home and hydraulic pressure is restored) the Lake goes up nicely at around 500ft/min on continuous-power-climb settings of 2,500 r.p.m. and 25in boost. The flight manual recommends 65 m.p.h. for the best rate of climb with gear and flaps down, and 85 m.p.h. clean, the best gradient speeds being slightly less.

As might be expected, the high thrust-line of the Lake (ideal from almost every other aspect for this kind of aircraft) exacts a penalty in the form of unconventional airborne handling characteristics. Not immediately obvious or unpleasant during visual flying, but possibly tiresome on instruments, is the nose-down trim-change with application of power, and *vice versa*. At aft centres of gravity, too, extra caution is required in the use of the necessarily powerful elevator trimmers. The flight manual says: "Do not use full nose-up trim for take-off in the most rear c.g. reduced-weight condition, since engine failure will result in inability to pitch nose-down when the gear and flaps are retracted."

General handling is quite pleasant, if not particularly outstanding. Controls in all three axes are nicely co-ordinated, but on the heavy side; high inertias, too, make responses to stick movements relatively sluggish—particularly the inset ailerons, which also tend to nibble in steep turns.

A by-product of a tough airframe for ground handling considerations is a freedom from most speed limitation worries aloft. Never-exceed speed is 146 m.p.h.—well above the maximum achievable level speed; full control deflection (the manœuvring speed criteria) can safely be applied up to 121 m.p.h. Most useful of all is the ability to drop flaps and gear at normal cruising speed (125 m.p.h.): approaching the stall in this condition one hears a horn blow at about 60 m.p.h., followed by a slight judder and pitch-down at 50 m.p.h., and sometimes the port wing would drop slightly. Recovery is normal with or without power. In many little ways the Lake feels like a light twin—the effect of inertia on control response, remote engine noise, and all-round visibility are probably at the root of it. Cabin comfort and noise level are better than average for aircraft of this power—with the proviso that only short flights are tackled with four adults aboard.

Approaching to land on land, the downwind vital actions are: undercarriage selected down, check the green light adjacent to the pull-out-and-down wheel-shaped lever, panel-mounted left of centre (a mirror on the port tip float is for checking the nosewheel down—the mains can be seen); flaps down; carburettor hot air selected; fuel boost pump on; trim-out as required. Even glide-approaching power-off at 1.6 times the stalling speed (80 m.p.h.), the path is steep and the pilot has a superb view of the landing area since the aircraft is, if anything, slightly nose-down. As with twins, allow the speed to fall below the optimum approach figure and one is battling with the back of the drag curve as the bluff hull at incidence progressively accentuates the rate of descent. Control response on the approach always felt satisfactory at our various

The world's most expensive canoe?

LAKE LA-4 AMPHIBIAN...

intermediate weights and c.g. locations. A full-power overshoot is controllable with only a moderate push on the wheel. The hydraulic trimmers, slow acting to permit very fine and precise setting, are sometimes annoyingly slow—a small penalty to pay for their big advantage.

After the Lake was posed for air-to-air photographs in formation with the Baron, and familiarizing myself with the amphibian operating off land, the call of the loughs could be resisted no longer. Our first stop was steep-sided Lough Derravaragh in West County Meath, where Lord Headfort presented the craft in fine style to photographer Mike Barnes (afloat in a launch, expertly handled by Lady Headfort) with the splendid results seen on these pages. It was here that the Lake's speedboat capabilities came to advantage. On the step at 50 m.p.h. the aircraft was slammed into scorching wave-skipping turns and within minutes we had made countless passes at the launch without even leaving the water. Hydroplaning fans would know the score—but in the Lake you don't get wet and can always pop into the air if a submerged log heaves into sight. Those tip floats are *tough*. A favourite trick we didn't have time to try was circular take-offs; in this way the normal straight-line run of about 1,200ft can be coiled into a circle of about the same diameter as required for a straight-line landing (700ft), provided, of course, there is not too much wind or wave. We had no reason to doubt that it could be done!

This beautifully peaceful and popular fishing lough also emphasized the Lake in her idyllic moments at rest in the reeds or being paddled like a canoe—it's easy over the low sides. One cannot imagine a better vehicle for sporting trips to the lochs of these islands, the fjords of Scandinavia, or the harbours, bays and beaches of the Mediterranean. She makes less noise than most powerboats, and incidentally, does not foul the water.

Operating from water is not difficult it merely requires care of a different sort—handling boats is an excellent pre-seaplane exercise. So apart from knowing how to turn wind, tide, and current to advantage, amphibianmanship is mainly the art of selecting safe water free of submerged logs and rocks, deep enough, and not too rough. The makers say the Lake has been tested satisfactorily in 6in waves but this is obviously well within the boat's capabilities. After a 2hr session of circuits and splashes on Lough Ramor, the writer was landing in 18in waves which had built up deceptively. Meanwhile, unbeknown, the instructor (Lord Headfort) and Mike Barnes were being practically tipped out of their narrow rowing boat. I wasn't even using the rough-weather, stall-landing technique, but step landings (akin to wheelers on a tailwheel aircraft) normally reserved for smooth water. Lord Headfort has landed the amphibian successfully in quite big and longer waves in the exposed mouth of the Shannon river, using the stall-on technique.

Coming astern the aforementioned rowing boat to pick up Lord Headfort was the start of a minor mishap, distressing at the time but amusing in retrospect. Lowering the undercarriage is a recognized means of slowing right down when taxying on water if you don't want to stop the engine—and we didn't want to. What actually happened is not certain, but it seems likely that the starboard nosewheel door caught the boat's transom and twisted the hinges. On subsequent beaching it was found that the steel door had been pulled up higher than usual on retraction in the water and the corner of it had ripped an arc in the internal light-alloy bulkhead. After two unsuccessful attempts to get her on the step for take-off, water appeared above floor level. We made rapidly for the shore, firing soaking-wet red Very cartridges and baling furiously at loch water stained blue with shark-repellant from the submerged life jackets. The internal water level soon stopped rising, thanks to the multi-compartment hull and tip floats. Once hauled ashore on her wheels it was a quick matter of Pop-riveting on a patch, straightening the hinges, draining all compartments, and she was ready for launching.

Vital actions prior to a water take-off are the same as from land except for the following: make doubly certain carburettor air control is set to cold (preferably leave this to the last moment before opening up for the run because it should be left on hot after landing and for taxying); raise the water rudder, used only for manœuvring off the step; pitot heat "on" to dry out the sensor. To take-off, head into wind and waves, open up to full power, pull hard back on the control wheel; and then, as the boat begins to move and rise, ease forward and she invariably rolls nicely on to the step. Keep straight and the wings level so that the tip floats don't touch the water (both actions are easy as the controls bite early). Again, as on land, keep her in contact until 60 m.p.h. for the shortest run and cleanest unstick. Any tendency to porpoise can be checked by gently easing back on the wheel, then forward again when it stops. In the correct step attitude the pattering of the waves feels just under one's feet; nose too high and the sensation is under your seat; too far forward and there's a hollow slapping on the nosewheel doors.

Downwind for a water landing pilots are recommended to repeat "This is a water landing, the undercarriage is *up*." Other checks are as for a normal landing except for selecting full nose-up trim—a precaution with all seaplanes (to help guard against accidental diving-in) and necessitating a strong push on the control wheel. Flaring out and touching down on the step is a graceful and satisfying manœuvre—in smooth water! The rough-water technique is to flare out a few feet above the wave tops with power on and the stall warning horn just blowing, then cutting the power and allowing the aircraft to flop into the water.

Is there really much more one can say other than that here is an aircraft, thoroughly practical, combining the ultimate thrills of numerous sports? There is also a work-a-day side, but for pure escapism it is supreme and there is no equal at the price.

On land or water the Lake's broad feet give her remarkable stability

INDUSTRY International

Products

Company News

Great Britain

Warmer Hangars Chiefly by reason of their big door areas and (usually) thin walls, aircraft hangars and maintenance shops are notoriously draughty and difficult to keep at a comfortable working temperature.

The problems of economically heating these and other industrial buildings have been studied by Boscombe Precision Engineering Co (1963) Ltd, of 35 Warwick Road, Boscombe, Bournemouth, Hants, and the result is the production of a range of mobile paraffin-fired heaters.

Known as the "Million-Air," the largest unit in the range is rated at 1,000,000 BThU/hr with an air delivery of 20,000 cu ft/min. At this output fuel consumption is 7.5gal/hr; alternatively, a lower heat output may be given by resetting of a thermostat, with a corresponding reduction in consumption.

The trolley-mounted cylindrical unit (overall dimensions of which are 10ft 3in long by 4ft wide by 5ft 9in high) contains a stainless-steel firebox surrounded by an annulus leading to a nosecone with adjustable louvres. In the firebox is a fan-operated (½ h.p. motor, 400/440V 50c/s a.c.) burner, and air is independently propelled through the annulus by a larger motor (7.5 h.p.). Complete combustion avoids the emission of objectionable fumes, but there is provision for a chimney duct if required. Air ducting may be coupled to the nosecone. Various control and safety devices are provided—including a time switch, and a photocell-operated valve to switch off the burner in the event of a flame-out—and the makers state that the heater is approved by insurance companies for use in hangars.

The other, smaller, heaters in the range are the "Tropical" (150,000 BThU/hr) and the "Twin Tropical" (300,000 BThU/hr).

Recent orders for the "Million-Air" include two units for British United (CI) Airways, to be used at Jersey Airport.

One of Boscombe Precision Engineering's "Million-Air" heaters in service in a maintenance hangar of Air Couriers Ltd (see first news item)

Air Cdre J. G. Topham (centre), Commandant of the Royal Air Force College of Air Warfare, headed a group of 37 Commonwealth officers who recently visited Sperry Gyroscope Co at Great Neck, NY. Demonstrating Sperry's new "laser gyroscope" to him are Mr H. C. Bostwick (left), manager of international operations, and Mr Warren M. Macek, of the firm's electro-optics group

English Electric Integration The Luton Division of D. Napier & Son (an English Electric subsidiary) has been merged with the Aircraft Equipment Division of the parent company. Mr J. C. Rivett, who has been Napier's manager at Luton since 1962 and of the Aircraft Equipment Division at Bradford since April 1964, is general manager of the new unit. The activities and staff at Luton will remain unchanged and will henceforth be known as the English Electric Co Ltd, Luton.

The products of the Aircraft Equipment Division now include complete aircraft electrical-generation systems, motors and actuators supplied from Bradford; the Spraymat aircraft ice-protection systems, Sierracote windows and windscreens, and Sierraglo electro-luminescent panel lighting from Luton; and constant-speed drives from Netherton, Lancs.

Aviation Traders (Engineering) Ltd ask us to point out that their Type C and Type E ground power units, mentioned in our December 10 review of airport equipment, conform to the requirements of British Aircraft Corporation Specification VAA.114 (Elec) Issue 1; that Class E insulation is used throughout; that the units comply with B.S.S. 2613 and B.S. 2G.100; and that the 28V d.c. supply was made available specifically for starting the auxiliary power units of the One-Eleven and Trident.

Bond-tester Agents Bonded Structures Ltd, of Duxford, Cambs, have been appointed UK agents for the Fokker Bond Tester, made by Fokker's industrial division. The non-destructive test method deve-

loped by Fokker gives information in numerical form about the quality of the cured adhesive layer, by introducing a vibrating load at a high frequency and measuring the response of the bond electronically. The readings obtained are correlated to results of destructive tests, enabling an accurate forecast of the bond quality to be made. The bond tester was originally developed when Fokker adopted Redux bonding for the F.27 Friendships and has since been widely sold.

STC's New London HQ The office block being built in the Strand opposite St Clement Danes—the Royal Air Force church—is to be the new London headquarters of Standard Telephones and Cables Ltd. To be known as STC House, the ten-storey air-conditioned building will be completed in the spring.

A delegation of Royal Thai Air Force officials recently visited Hawker Siddeley Avro Whitworth's Division airfield at Woodford to accept the Hawker Siddeley 748 aircraft ordered for service with the King's Flight of the RTAF. Here Air Chief Marshal Harin Hongskula, Assistant C-in-C of the Royal Thai Air Force, is seen with Air Chief Marshal Sir Harry Broadhurst, chief executive, Avro Whitworth Division

USA

Record Contract for Lycoming Avco's Lycoming Division has been awarded its largest-ever single production contract by the Aeronautical Systems Division, USAF Systems Command. Worth $42,839,548, it is for an undisclosed number of T53-L-11 gas-turbine engines for use in Bell UH-1D Iroquois helicopters for the US Army and in UH-1E versions for the USMC. Recent big Iroquois purchases, with which this contract is undoubtedly linked, are detailed on page 77 in this issue.

Cessna's Big Sales Cessna's total 1964 sales amounted to $122,942,000, a $26,500,000 increase over 1963. With final audited sales figures for the financial year ending September 30, 1964 sales established an all-time record for the 37-year-old Wichita firm.

Commercial aircraft sales accounted for $71,700,000 of the total, a 25 per cent gain over 1963.

Cessna's military aircraft business showed a 41 per cent increase over 1963 and totalled $21,690,000. Much of the gain was attributed to increasing deliveries on the McDonnell sub-contract under which Cessna manufactures wing-tank and missile pylons for USAF and USN versions of the McDonnell Phantom II fighter.

Construction of a new Cessna plant in Scotland is under way to alleviate crowded conditions at the present plant, which manufactures hydraulic components for customers in the United Kingdom and Europe.

Low-Temperature Effects NASA experience at the Marshall Space Flight Center is reported in *Effects of Low Temperatures on Structural Metals*, a 55-page booklet (reference NASA-SP5012) available at 40 cents from the Superintendent of Documents, US Government Printing Office, Washington DC 20402.

Canada

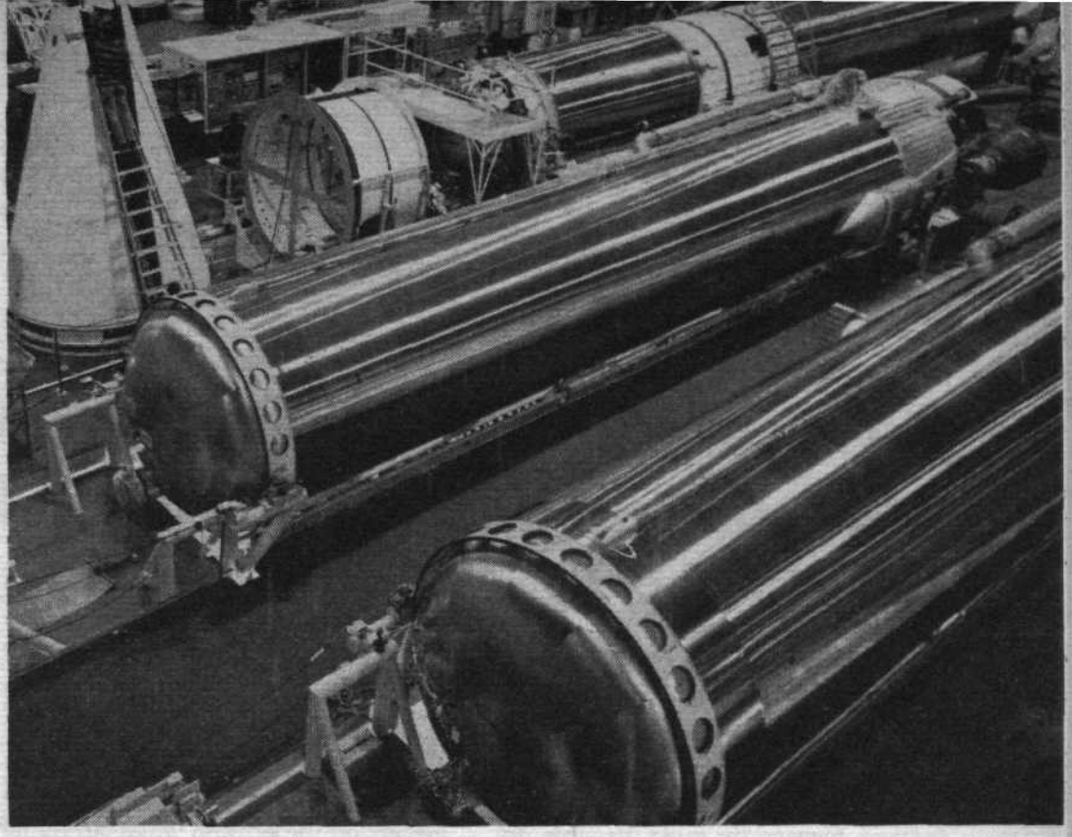
DHC Developing Mauler IRA The de Havilland Canada Special Products & Applied Research Division is developing, under joint sponsorship of the US Army Missile Command and the Canadian Department of Defence Production, an infra-red acquisition unit to provide passive surveillance and acquisition for the Mauler weapon system.

France

French Control Rods for One-Eleven BAC has placed an order with SARMA for 53 sets of elevator control rods for the BAC One-Eleven. The SARMA rods, made under a licence from Sud-Aviation, reduce the number of parts from 34 to six, conferring a considerable weight gain in addition to improved mechanical efficiency, it is claimed.

Progress at Toulouse in production of the first 25 Potez 841/842s. The fourth aircraft, an 841 with UAC PT6A engines, flew on December 22 and one 842 with Astazous has been ordered by the French civil aviation authority

Spaceflight



Prior to delivery to Cape Kennedy, experimental Atlas-Centaur 5 (AC-5) (background) scheduled for the next Centaur research and development test flight, undergoes composite test at astronautics division of General Dynamics, San Diego. This test marked the first time that the entire Atlas-Centaur combination had been mated in the factory and subjected to simulated countdown and flight. Operational vehicles will be tested with Surveyor spacecraft in a combined systems test stand now nearing completion in San Diego

MORE SOVIET PACIFIC TESTS

The Soviet news agency Tass announced on January 9: "With the object of the further exploration of outer space and the accumulation of experimental data, the Soviet Union between January 11 and March 1, 1965, will launch new variations of carrier rockets for space objectives into an area of the Pacific inside a circle with a radius of 65 nautical miles from a centre with the co-ordinates of 1° 35′N latitude and 164° 0.1′W longitude. Tass is authorized to state that, to ensure security, the Soviet Government has asked the governments of other countries who use sea and air routes in the Pacific to inform the appropriate bodies that ships and aircraft should not enter the area and/or the airspace over it from noon to midnight local time during the period of the tests."

PENTAGON ACQUIRES SYNCOM

The US National Aeronautics and Space Administration is handing over operation of its Syncom 2 and Syncom 3 communication satellites to the Department of Defense. This transfer began on January 1 and is to be completed by March 31. According to the text of a joint announcement, NASA "has completed its experimental research and development programme with the two synchronous satellites" and the DoD will operate them for the remainder of their useful lives.

Telemetry and command stations and range and range-rate equipment operated by NASA for the Syncom programme will be transferred to the DoD along with the satellites. The Defense Department, which for the past two years has provided the communications ground stations used to relay transmissions via the two Syncom spacecraft, will provide NASA with "certain telemetry and ranging data of continuing scientific and engineering interest."

SIMPLE SOUNDER

A relatively cheap scientific sounding rocket developed from the Skua meteorological rocket is being developed by Bristol Aerojet of Banwell, Somerset, under contract to the Ministry of Aviation for use in Britain's civilian programme of space research. The new rocket will be 7½in in diameter (compared with 5in for the Skua), approximately 9ft long, and will weigh 240lb. Fired from the same type of tube launcher as used by the Skua, the rocket should carry a 30lb payload to a height of 135km, reaching a speed of Mach 5.6 from a 29sec burn by the solid-propellant motor. Parachute recovery is planned.

Bristol Aerojet is the design authority for the rocket system, and the Rocket Propulsion Establishment, Westcott, is the design authority for the motor. Research and development authorities for the motor and the system respectively are the Ministry of Aviation and the Atomic Weapons Research Establishment, Aldermaston. The vehicle is expected to cost about £1,000, plus payload, and to begin flight tests in about two years' time.

EUROSPACE TO VISIT USA

Philadelphia has been chosen as the location for the second joint meeting between representatives of the European industrial association Eurospace and US space industry. First such meeting was held in Rome last June; the US meeting will take place next April. Overall objective is "to review together the problems which the evolution of space technology poses for the space industry, both in Europe and the United States."

One of the conclusions of the Rome meeting was that the US and European space industries should try to find a way to develop joint technical agreements. A specific reason for the Philadelphia meeting is to further explore this possibility, as well as to provide an exchange of information on current problems. According to Eurospace, "This Eurospace initiative may eventually lead to a joint space programme or at least complementary space programmes in the western world."

The Philadelphia meeting will last one week and will be followed by visits to major US space companies. NASA has been informed of the meeting and, Eurospace states, "has indicated strong interest in this initiative and is encouraging it."

Formed in 1961, Eurospace now has 120 member-companies, and a number of professional associations which are collective members, in 11 European countries. Fifteen European banks and 11 US aerospace companies are corresponding members.

GEC for UK-3 GEC (Electronics) Ltd has been appointed main contractor for electronic equipment aboard the UK-3 satellite, now being built by British Aircraft Corporation at Stevenage. The company's Applied Electronics Laboratories at Portsmouth have received Ministry of Aviation contracts for the provision of all UK-3 satellite electronic equipment except that incorporated in the scientific experiments. Working from design information supplied by the Royal Aircraft Establishment, the Laboratories will be responsible for the design, construction and testing of the electronics, and will work closely with BAC during the integration and proving of the complete satellite.

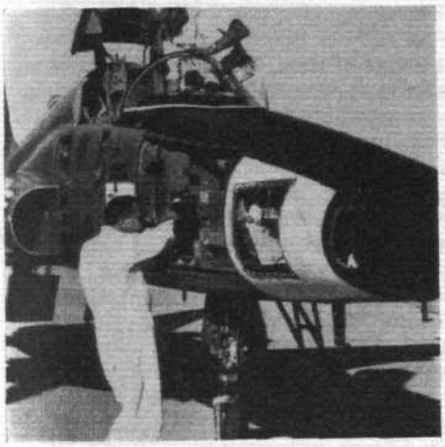
An airplane that is designed to protect and support ground forces is called a tactical fighter.

A tactical fighter must prevent hostile aircraft from attacking tactical targets. It must be able to intercept, outmaneuver and shoot down any intruder which penetrates at low enough altitude to be a threat (anywhere from the treetops to 30,000 feet) To do this it must have supersonic speed, rapid acceleration, a very high rate of climb and outstanding maneuverability. It must have greater endurance than its antagonists. It must carry cannon as well as air-to-air missiles.

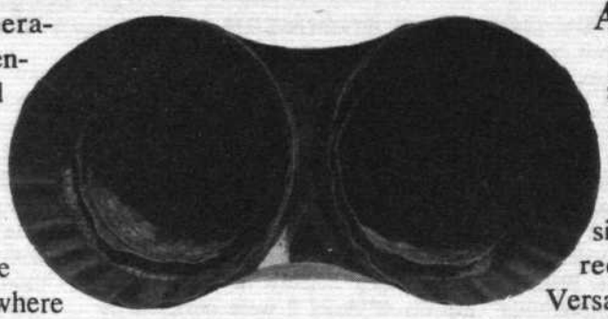
A tactical fighter must be able to attack and destroy military targets on the ground while surviving in the air. It must carry a variety of external weapons – missiles, bombs, rockets, napalm, dispensers – and must provide a stable launching platform for them. It must maneuver easily and safely at low altitudes with a heavy load of stores. If attacked by defending aircraft it must be able to counterattack.

A tactical fighter should be able to operate from dispersed fields and hastily prepared strips close to the combat zone – rough sod, packed earth, pierced-metal planking. It must be simple to rearm and refuel so it can turn around quickly between missions.

A tactical fighter should have a very high sortie rate – which means that it must be rugged, reliable and easy to maintain. All systems and components should be quickly accessible from ground level. Engine changes and field maintenance should not require heavy equipment. Maintenance man-hours should be very low.



A tactical fighter should be designed to survive combat damage and operational emergencies. It should present a small target to radar and ground fire. It should have redundancy where it counts—twin engines, dual hydraulic, electrical and fuel systems. It should be able to complete a mission and return to base if one engine is shot out, then take off on its remaining engine and fly to the rear for a replacement.

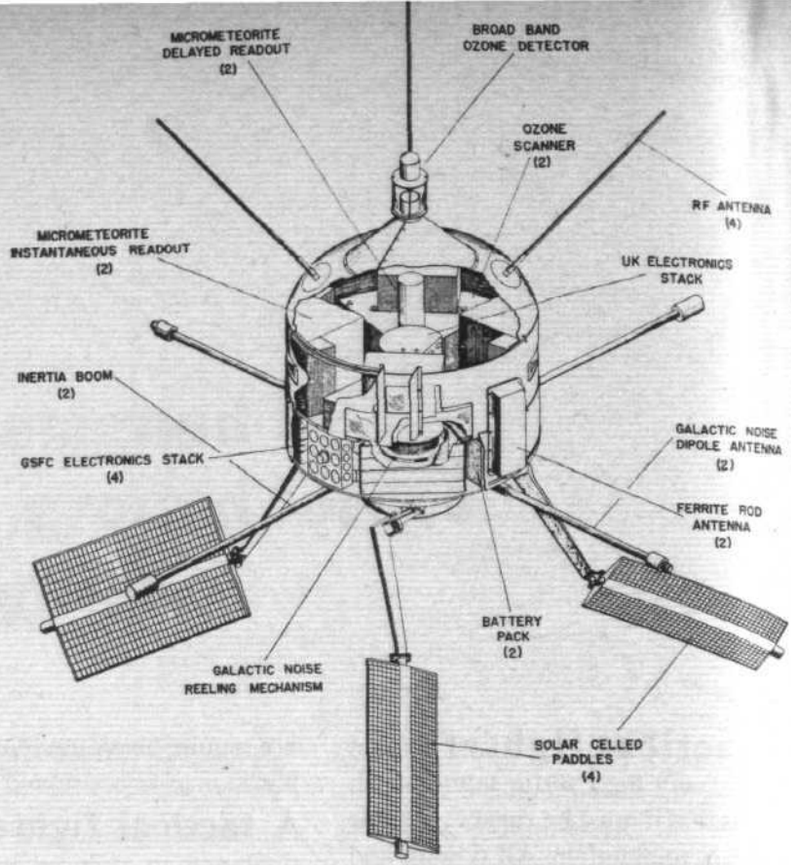


A tactical fighter should be readily adaptable to all types of support missions, including reconnaissance. Versatility and long-term growth should be designed into it from the start, so that major surgery will not be required to give it new weapons and avionics.

Spaceflight

Design of a Spacecraft

DEVELOPMENT OF ARIEL 2 SATELLITE DESCRIBED BY GODDARD ENGINEER



Basic elements of the Ariel 2 satellite are shown in this drawing. Its detailed design is outlined in this article

THE interplay between scientific experiments, on-board mechanical and electronic systems, and launch-vehicle design and performance in the development of the three joint US/UK spacecraft was the theme of a one-day symposium organized by the British Interplanetary Society in London on January 5. "Compatibility" aspects of Ariel 2 were outlined by speakers from the Space Research Management Unit, the Meteorological Office and the US National Aeronautics and Space Administration; and a progress report on UK-3 was given by a British Aircraft Corporation engineer.

A paper co-authored by Allen L. Franta and Arthur C. Davidson of NASA's Goddard Space Flight Center, *Achieving Ariel 2 Design Compatibility*, was presented at the meeting by Mr Franta. This gave a classic outline of the process of designing, building and testing a spacecraft—an exercise in design and development which contrasts markedly with the better-known techniques of aircraft production. This contrast is brought out in the following shortened version of the paper by Franta and Davidson.

The Ariel 2 satellite [Mr Franta stated] continued the joint US and UK research programme in and above the ionosphere. Its objectives were to supplement the ion, electron and radiation studies of Ariel 1 by measuring the galactic radio noise in the range 0.75-3.0Mc/s, the vertical distribution of atmospheric ozone, and micrometeoroid flux. The spacecraft was a co-operative US-UK effort, with the UK responsible for all flight instrumentation pertaining to the experiments and for data reduction and analysis; and the US responsible for the design, fabrication, integration and environmental qualification of prototype and flight spacecraft, except for the scientific experiments. The satellite was launched by a US Scout rocket in March 1964.

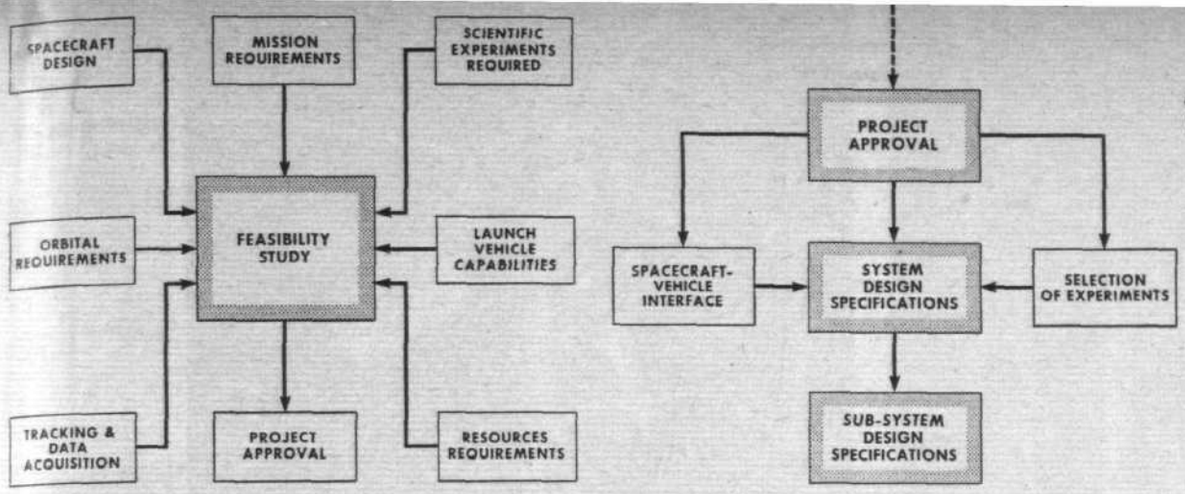
During the course of the development of Ariel 2, one of the "must" objectives was the attainment of functional compatibility of all the spacecraft subsystems and experiments. Individual subsystems engineers and experimenters are generally concerned, first, with obtaining a reliable operational design; and secondly, with compatibility of their design in the spacecraft environment. Being human, designers tend to be very concerned when their package receives interference from other subsystems, but not quite as concerned should their package be the source of interference.

Design compatibility is a prime responsibility of the project manager. Either he or his staff must monitor all design concepts and completed configurations to assure that the systems and subsystems in the completed assembly are compatible from both mechanical and electrical points of view. Compatibility problems will require either modification or compromise for their solutions. One modification may beget another (this occurs more frequently with mechanical modifications). A mechanical or structural modification requiring a package or appendage location change often dictates minor changes in the location of other assemblies. To secure compatibility of all the subsystems and mechanical components, their functional inter-relationships must be considered. The principal items involved are location of appendages, experiment view angles, interface compatibility of subsystems, data rate versus telemetry bandwidth, spacecraft power requirements, ground loop interference, magnetic susceptibility, experiment programming, pulse current induction and thermal control. The magnitude of the task involved can be understood by noting that there are 44 subsystems in Ariel 2.

Feasibility Study and Project Approval The demand for space research in a specific area of investigation can originate in any of the space-research-oriented universities and organizations in any of several countries throughout the world. At the time of project origin, the major portion of the activity is centred around a feasibility study generated by a small technical staff. This staff is generally headed by a project manager who requests the assistance of qualified technical personnel to assist him in the preparation of this study. The mission requirements must be defined in order that the scientific experiments required to accomplish it can be properly chosen. In planning the experiments, emphasis must be placed on a practical spacecraft design. If details can be adopted from tried and flight-proven spacecraft designs, the mission feasibility is enhanced. (The structural and component subsystems developed for Ariel 1 were used wherever possible to minimize the engineering and design work required for Ariel 2.) Information concerning satellite tracking and data acquisition requirements is factored in with the orbital requirements. Last but not least are the resources requirements. What will be the cost in manpower, money and facilities? Are the resources available? What will be the impact on other projects already in progress? After project feasibility has been demonstrated to Centre management the results of the study are submitted for consideration to NASA Headquarters.

During the feasibility study the detailed compatibility problem is not paramount, but any major problems concerned with the experiments are examined closely. For Ariel 2, these areas were:—

(1) Probable behaviour of the 130ft flexible dipole aerial used in



Left, elements of spacecraft project origin; right, generation of system specifications

the galactic noise experiment: it was believed that it would behave essentially as the rigid aerials on Alouette.

(2) Solar-paddle and boom shadowing of the micrometeoroid and ozone spectrometer sensors: a compromise was made by dropping the paddles so that shadowing of the experiment apertures would be reduced.

(3) Galactic-noise radiometer interference from inverter or IF carrier oscillators: checks were made using simulated power inverters; interference was not observed.

(4) Orbital requirements versus launch-vehicle capabilities: the Scout vehicle was found to be capable of injecting a 165lb payload into the desired orbit.

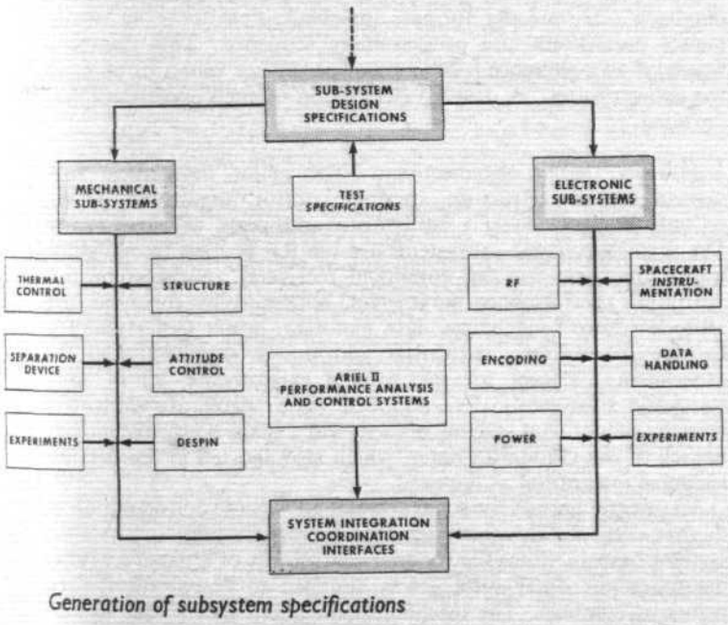
A close estimate of the spacecraft power requirements was made during the feasibility study. The power requirement was estimated to be 12.5 watts in sunlight and 5.3 watts in shadow for a supply voltage of 14.5. Metered power measurement made during the integration phase proved this estimate to be very close. The solar-cell array was located on paddles attached to extended hinged arms. Solar-array installation on the body of the satellite was considered for a time, but this would have required a larger-diameter spacecraft (to provide a greater surface area). When the original spacecraft design was laid down, it was determined that only the 25.7in Scout nose fairing would be available.

The ozone experiment on Ariel 2 acquires its useful data during the sunrise and sunset periods of the orbit. During the feasibility study, a plan to turn on the ozone experiment at sunset via the solar current was initiated. This method later proved to be incompatible with the experiment since solar current was not available during the spacecraft early dawn (1 per cent sunlight). The sunrise sensing was changed to solar-paddle voltage sensing.

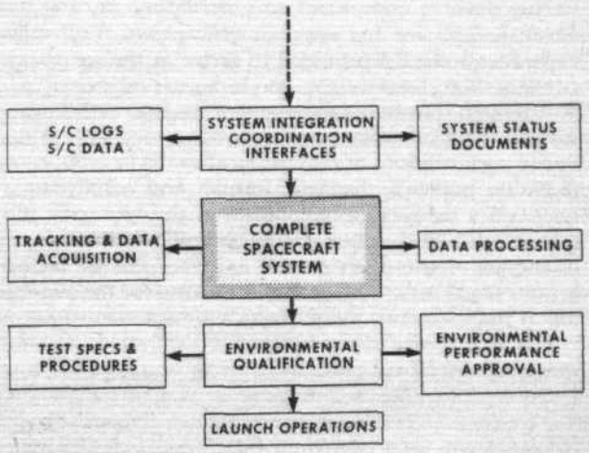
With regard to Goddard resources for the satellite, the amount to be accomplished in-house versus contract had to be determined. Since Ariel 2 was in many respects a design modification or extension of Ariel 1, a portion of the subsystem fabrication effort and all of the integration effort was contracted to the aerospace division of the Westinghouse Electric Corporation, Baltimore, Maryland.

System Design Specifications After project approval, all elements considered in the feasibility study were made definite in a detailed specification of the complete system, and the final selection of experiments was approved by the Space Sciences Steering Committee of NASA Headquarters.

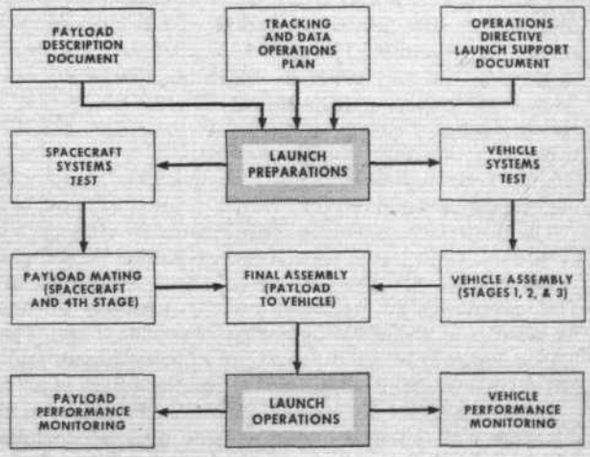
The spacecraft-vehicle interface problems were examined in detail to ensure functional and dimensional compatibility. The

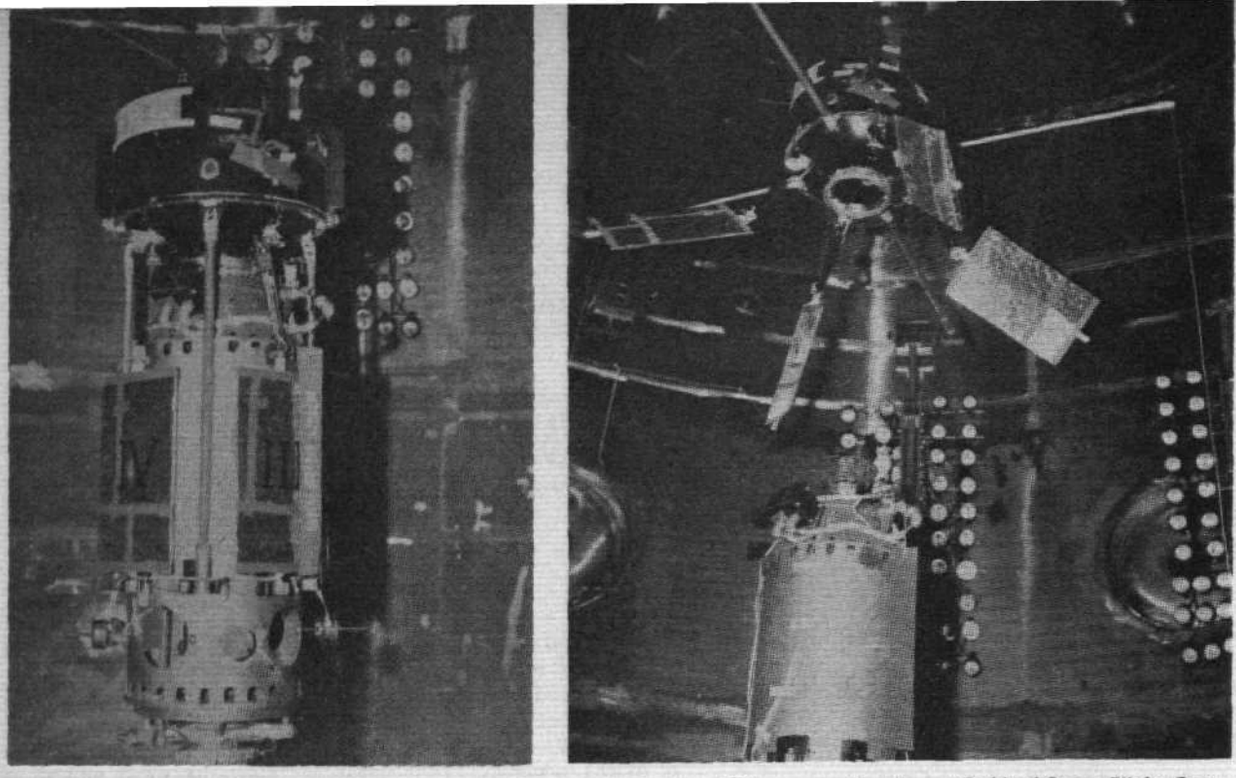


Generation of subsystem specifications



Above, integration, environmental qualification and launch operations; below, launch preparations, final assembly and launch operations





Ariel 2 prototype before and after dynamic spin-up and separation tests in 35ft vacuum chamber at Goddard Space Flight Center

Spaceflight

mechanical designers finalized the structural design, conducted stress analyses, and produced design specifications of all their subsystems (basic structure, de-spin mechanism, separation system, reeling devices, experiment and inertia booms, and release mechanisms). The size and approximate weights of all subsystems and experiments were determined to arrive at the spacecraft's physical configuration, total weight, and moments of inertia.

Although spin-stabilized satellites have no active attitude control system, the mechanical group was concerned with attitude changes due to perturbations of the spacecraft while in orbit, caused by solar radiation pressure, magnetic torques and aerodynamic drag. To maintain a favourable orientation of the spin axis, the spacecraft system must be designed so that the ratio of the spin axis moment of inertia to the pitch or roll axis moment of inertia is always greater than unity. This is another reason for the constant monitoring of the spacecraft weight, which always seems to grow.

The vehicle was also examined to determine the location of the spacecraft umbilical plug, the separation umbilical connector, the "turn-on" plug, the instrumentation plug, and the battery charging requirements. The overall spacecraft dimensions in a folded configuration were compared for physical compatibility with the inside dimensions of the Scout nose fairing, and the location of access doors for the payload plugs in the nose fairing was established.

The mechanical and electronic designers work very closely in determining the optimum location of all subsystems within the spacecraft structure. The preliminary layouts are made with spin stability as the only concern. Power dissipation, noise, RF interference and induced magnetism are all considered next in the detailed system design. The final design is a compromise, with no individual subsystem designer being completely satisfied. Many potential trouble areas are avoided through this mechanical and electrical integration interplay.

The project management staff, assisted by electronic integration personnel, contributed to the over-all design of the spacecraft by virtue of their advisory responsibilities to the subsystem designers. They exercised an influence on the selection of housekeeping functions and on the methods of telemetering them. They served a liaison function between the power system designer and subsystem designers, exercising some influence on the design of all subsystems.

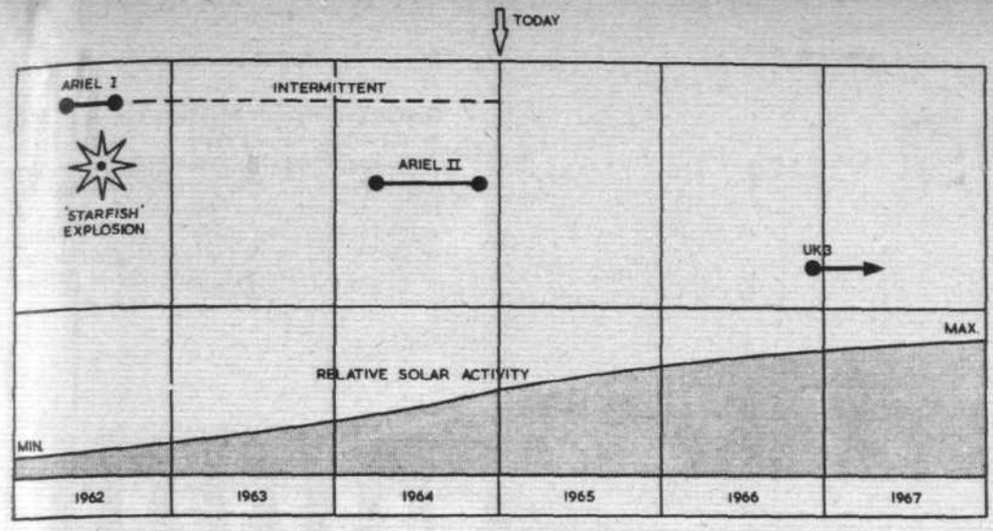
While the Ariel 2 system design was in progress, the project manager was required to prepare the project development plan, which defined the major areas of responsibility for all project personnel and established a detailed project master schedule. Following completion of the project development plan, the system design specifications document was generated through joint consultation between project management and all the subsystem designers. Included in it were detailed values and limits of the major parameters of all the spacecraft subsystems and experiments. The chief parameters were: voltages, voltage regulation, power requirements, impedance matching, weight and size, recording speed, playback rate, encoder format, appendage final location, performance parameters and programming sequence. This document was used as a reference for the major parameter values throughout the entire project. A detailed description of each experiment was included.

Subsystem Design Specifications The major mechanical subsystems are the structure, thermal control, separation device, attitude control, de-spin mechanism and parts of experiments. The major electronic subsystems are the RF portion (modulators, transmitters, aerials, and command receivers), spacecraft instrumentation (performance parameters, housekeeping functions and attitude control), encoding, data handling, power (solar paddles, batteries, converters, regulators and power supplies), and the experiments. Except for the Ariel 2 experiments, all of these electronic subsystems were supplied by a spacecraft electronics branch, a flight data systems branch, and a space power technology branch of the Goddard Center, which also assisted in the detailed technical integration as required.

An integral part of the structural design was the consideration of thermal control. This subsystem was the responsibility of a thermal systems branch. Since the thermal control was of a passive nature, the spacecraft outer surface was designed to accept the desired paints or coatings. The mechanical designers assisted the experimenters and subsystem suppliers with any mechanical design problems they encountered. They designed special mechanisms and booms for the experimenters and pressurized containers for flight tape recorders. They assisted the power group by designing special cases and containers, heat sinks for converters, and solar paddle structures. The electrical designers contributed by designing circuits for supplying power to all the electro-mechanical areas, such as release mechanisms and erection systems.

The electronic systems group for the project assisted the subsystem designers in the completion of their specifications, and thereafter kept the experimenters informed on the system philosophy and physical design, alerting them to possible system problems.

The subsystem design specifications for Ariel 2 were generated by the system engineers (project management staff with contractor support) and subsystem design engineers. They were followed by detailed dimensional drawings, drawings, block diagrams, and



Firing dates and active lifetimes of the three joint US/UK scientific satellites (from paper by Blonstein of BAC at the symposium)

schematics. These specifications and drawings were reviewed on an as-produced basis by the project management staff. At this point in project development, weekly meetings were held by project management to promote schedule compatibility of the subsystems. These meetings, attended by experimenters, subsystem designers, test engineers, contractor personnel and the staff, served as a clearing house for all compatibility problems for the duration of the project. Schedule compatibility was aided by use of a PERT chart, which was up-dated during the course of the project to reflect any anticipated slip-time due to late procurement of critical subsystems.

The interconnection system problems are best resolved as early as possible by management and system-integration personnel interviewing each subsystem designer and experimenter, advising them of the spacecraft wiring reliability objectives, and assisting them in the assignment of specific redundant leads and pin connections, complete with pin numbers. The desired redundancy of interconnections between subsystems must be decided during subsystem specification generation. The general philosophy for the optimum redundancy throughout the cabling assembly was to provide redundant wiring for all critical signal and power leads. This resulted in approximately 70 per cent of the conductors in Ariel 2 being redundant.

Test specifications were generated by members of a test and evaluation division as soon as the subsystem specifications were completed. The interface test parameters and limits were arrived at by conferences between the subsystem designers, integration engineers, test engineers and project management staff. Each interface of all subsystems was investigated for source and terminal impedance values to obtain compatibility with the test equipment complex. Determination of the number of test points requiring monitoring was made on a subsystem basis first, then screened as to their priority to reduce the number of test leads in the spacecraft interconnecting harness to provide the desired overall system monitoring. From the compatibility point of view, the fewer test leads in a spacecraft system the better, since any one could introduce detrimental crosstalk. From a test philosophy point of view, the greater number of monitoring points obtained the better. A compromise between these two viewpoints was made.

While all of the subsystem suppliers were engaged in the detailed design and fabrication of their prototype and flight hardware, the integration groups designed and produced all of the necessary ground support equipment. The mechanical group designed all the jigs, fixtures, spacecraft handling dollies and shipping containers simultaneously with their design of the overall structure. The electronic group designed and produced the spacecraft control and spacecraft performance analysis systems prior to integration.

Fabrication and Test of Structures and Subsystems The fabrication of the Ariel 2 spacecraft was started as soon as the subsystem specifications and drawings were completed. There were changes and modifications to both the specifications and drawings as the fabrications proceeded.

For structural test purposes, two units were fabricated. The first was a dynamic test unit which simulated the weight, size and centre of gravity of the spacecraft and had all attaching appendages necessary for the dynamic separation and de-spin tests. The second unit constructed was an engineering test unit which closely simulated the detailed structure of the completed spacecraft. Dummy subsystems and experiments inside the spacecraft were used for weight and centre-of-gravity simulation. The skins, frame appendages and separation system were exact duplications of those to be used in the actual spacecraft. This unit was employed for vibration testing. Several minor modifications to the structure were necessary to correct defects which appeared during tests of the engineering test unit.

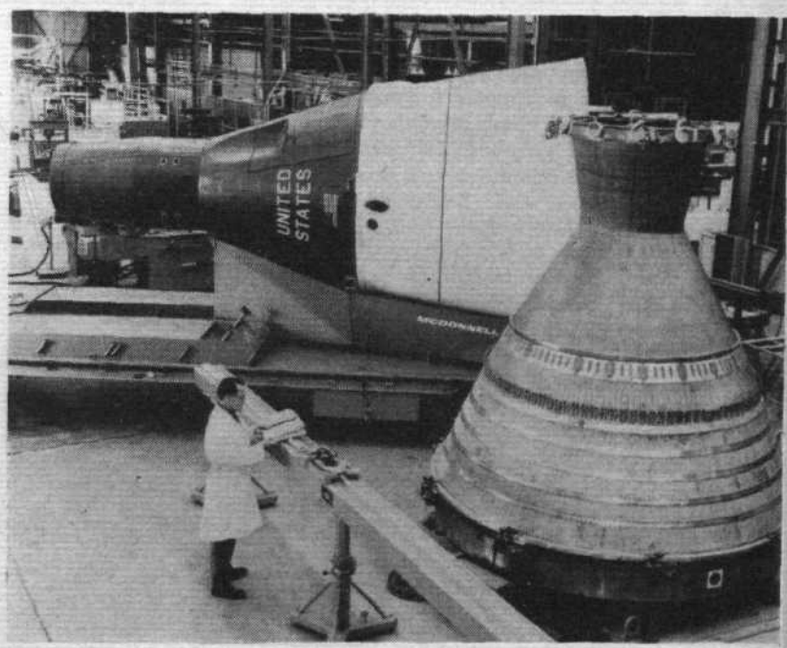
The prototype structural assembly and the interconnection harness fabrication was started at Westinghouse following successful testing of the dynamic test unit. Fabrication of the interconnection cabling system for the prototype was almost completed when reports were received of a tendency of cadmium surfaces to produce fine whisker growths under vacuum exposure. As a result, it was necessary to delay fabrication of flight model interconnection systems for some weeks pending receipt of gold-plated connectors.

The prototype experiments and subsystems packages of Ariel 2 were fabricated simultaneously with the prototype structure and interconnection system. Since these packages were derived from three sources (Westinghouse, United Kingdom and the Goddard Center), considerable scheduling difficulties arose when attempting to dovetail their "ready date" with that of the prototype structure for integration.

Subsystems tests for Ariel 2 consisted of two types, design qualification or prototype-level tests and flight-acceptance-level tests. Subsystems fabricated for the prototype spacecraft or engineering test units fabricated for design approval were subjected to higher test levels than those subsystems fabricated for the flight spacecraft.

To be concluded

Intended to provide high-energy, upper-stage propulsion for advanced and post-Saturn launch vehicles, the Aerojet-General M-1 liquid-hydrogen rocket engine is designed to develop 1.5 million pounds' thrust. Here an M-1 nozzle, 17ft in diameter, is compared for size with a two-man Gemini spacecraft at the Aerojet plant in Sacramento, California



Soon to become part of Britain's arms build-up in the Malaysian - Indonesian theatre is the Commando ship HMS "Albion" which a few days ago began trials after a long refit—her first since she was converted from a light fleet carrier in 1962. Seen about to turn for landings-on during the ship's full power trials are two Wessex 5s of 848 Sqn, embarked in "Albion"

DEFENCE

Malaysia Warms Up

WHEN THE COCK CROWED on New Year's Day, Indonesia had not succeeded in dismantling Malaysia with its "confrontation," but military operations had considerably increased and the threat of concerted attack and military retaliation on Indonesia itself loomed large. Though not yet formally announced to the UN, Indonesia claimed to have decided to leave the United Nations, because Malaysia was elected to the Security Council. Malaysia appealed to the UN for help.

British forces have been considerably strengthened by further battalions flown from Britain on a tenuous carpet of over-flying agreements. Indonesian regular formations were moving threateningly, possibly to replace the "volunteers" so far employed for incursions. British naval strength is being increased by the carrier *Eagle*, which had generator trouble at Mombasa, and by a missile destroyer. Javelin interceptors and Commando carrier *Albion* and maintenance ship *Triumph* were standing by. Bloodhound Mk 2 surface-to-air missiles are already emplaced near Singapore to counter Indonesian bomber and stand-off bomb strength and to defend V-bombers already in the area. Other V-bombers in Britain were put on stand-by for Malaysia last week. Australian measures to improve their defence and infrastructure have already been reported.

A minor aggravation has been unserviceability in the Army Air Corps Scouts' Nimbus engines, with Bristol Siddeley working hard to improve overhaul life for Malaysian operating conditions.

While threat and counter-threat are mounted, Britain's most potent weapons are being brought into the field, but the fact remains that Indonesia possesses weapons which potentially match or out-match them. Naval missiles particularly pose a serious threat to large warships operating in confined waters with only sea-to-air defensive missiles. A new but not entirely plausible vehicle-borne missile was displayed in a recent Indonesian parade (see picture).

Yet Indonesia's actual fighting power is problematical. Many of their weapons are deprived of spares or not properly maintained, but could well be used even once with shaming effectiveness.

One of the main results of this particular confrontation may be to show just what weapons Britain really needs and just how right or wrong the past years' defence policy has been, if indeed there has been one.

Para-dropping Stratocruiser

A REAR-LOADING PARA-DROPPING CONVERSION of an ex-PAA Boeing B.377 Stratocruiser has been completed for the Israeli Air Force by Israel Aircraft Industries, at Lod Airport, Israel. Although the military version of the Stratocruiser has seen widespread USAF service as the C-97 and KC-97, this is the first time that the big, four-engined transport has had a rear loading, vehicle-carrying capability.

The entire conversion was designed by IAI and the machine is now undergoing strenuous testing. Apart from the rear doors and ramp, extra side doors have been introduced for paratroop dropping and a further door has been introduced in the front fuselage. The interior arrangement includes folding side benches and centre seats, a monorail cargo hoist and provision for stretchers. The cockpit layout has been redesigned.

It is believed that a number of other ex-airline Stratocruisers are to be similarly converted for the Israeli Air Force.

Luftwaffe in Portugal

THE FIRST POST-WAR German Air Force base on foreign soil has been inaugurated at Beja, south-west of Lisbon, Portugal. Installations for a training base are nearing completion. German Air Force F-104G pilots are already being trained under contract by the USAF at a base in the US.

Displayed in Jakarta during the Indonesian armed forces' 15th anniversary parade, these two missiles are mounted on simple stands, have three fixed wings and fixed motor nozzle and are probably dummy unguided bombardment weapons

First hovering flight, with flaps not deflected, was made at Dallas on December 29 by the Vought-Hiller-Ryan XC-142A. Following the first flight with 10° wing tilt, several other flights were made with other deflection angles before the present VTOL programme started

programme in China, said Dr Cheng, was physicist Dr Chien San-chiang, a Sorbonne graduate and a one-time associate of Mme Curie.

Death of Lady Tedder

LADY TEDDER, the wife of Marshal of the RAF Lord Tedder, died suddenly on January 3 after a cerebral haemorrhage. Lady Tedder was particularly honoured throughout the RAF as the founder of the Malcolm Clubs, in Algiers in 1943, where she married the then Sir Arthur Tedder, Air C-in-C, Mediterranean. In 1959 she and her husband successfully fought and reversed an Air Ministry decision to close the Malcolm Clubs.

Bidding for NADGE

IN PARIS LAST WEEK the final seal was set on a new international electronics consortium which will compete for contracts, worth £110m, for a new NATO Air Defence System.

Known as NADGE (NATO Air Defence Ground Environment) the system will provide the most up-to-date forms of radar, communications and data-handling facilities capable of giving the earliest possible warning and the fastest possible reaction to attack by supersonic aircraft. It will also speed the feed-back of information and will provide a comprehensive integration of the NATO early-warning chain, the Hawk/Nike surface-to-air missile network and F-104G Starfighter squadrons in NATO.

The members of this consortium are Hughes Aircraft; Compagnie Francaise Thomson-Houston; Marconi; Selenia; Hollandse Signaal-Apparaten; and Telefunken. Contracts for NADGE are expected to be awarded this year. Competition will come from a five-member Anglo-Franco-US consortium formed last year, comprising AEI, Elliott, Litton, CSF and ITT.

Heap Big Iroquois Contracts

THE US ARMY has ordered a further 720 Bell Iroquois helicopters under a $98,517,345 contract placed with the Bell Helicopter Company late last month. The contract is for 149 nine-seat UH-1Bs, the US Army's standard utility helicopter, as used in South Vietnam, and for 571 of the stretched fuselage 14-seat UH-1D version. Both are powered by the Lycoming T53-L-11 1,100 s.h.p. gas-turbine engine. Deliveries are to begin late this year and be completed 12 months later.

The UH-1 series has gained adoption by all US armed Services, the UH-1E being used by the USN and USMC and the UH-1F by the USAF. A USAF contract for a further 55 UH-1Fs to bring total acquisition to 106 machines was placed shortly before the new US Army order. Powered by a GE T58-3 shaft turbine delivering 1,325 s.h.p., the 11-seat UH-1F supports USAF missile sites throughout the continental USA. To be built (as are the US Army machines) at Fort Worth, the second batch of USAF Iroquois is to be delivered between December 1965 and November 1966.

Two More GW Destroyers Ordered

THE ROYAL NAVY placed orders for the seventh and eighth County-class guided-missile destroyers last week with Fairfield Shipbuilding, on the Clyde, and Swan Hunter on Tyneside. Total value of the two orders is about £15m.

Four County-class vessels are already in service and two more, *Glamorgan* and *Fife*, have been launched and are now being completed. The two new ships will be equipped with both Seaslug Mk 2 and Seacat ship-to-air weapons, and will each carry a Wessex ASW helicopter. They will have steam and gas-turbine propulsion.

Chinese Nuclear Rockets in 1967?

A LEADING US SPECIALIST in Communist Chinese affairs, Dr Chu-yan Cheng, forecast in *US News and World Report* recently that China would become a rocket-armed nuclear power in 1967. Dr Cheng said that China's rocket programme was led by Dr Chien Hsueh-sen, who until 1955 worked in the United States. Dr Chien graduated with an MSc degree from Massachusetts Institute of Technology and later took a doctorate in aeronautical engineering at the California Institute of Technology.

Leading the parallel nuclear weapons

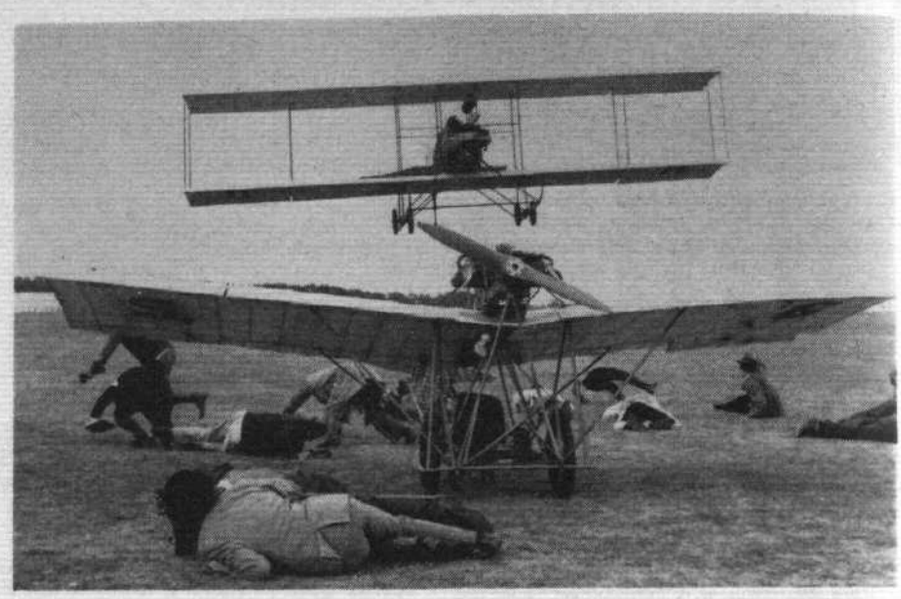
Hughes Aircraft has received a $9,568,350 order for Hipeg rapid-firing 20mm gun pods from the US Navy. The Douglas A-4 Skyhawk above is firing three Hipeg pods with a combined output of more than 12,000 rounds per minute

Third prototype Breguet Atlantic back at Toulouse after successful completion of armament trials. Aéronavale trials are now beginning, factory space has been expanded and 40 are on order for France and Germany. A second batch of 40, for France and the Netherlands, has been laid down

Straight and Level

TEN years ago the world's airlines started ordering big jets. Boeing had a 707 actually flying; the Douglas DC-8 was only paperware, not due to fly for three years. Yet many airlines chose Douglas, even though it meant getting delivery a year or more later.

Ten years later the blind faith is reversed. Boeing have a brochure with 737 in stylish letters on the cover. Douglas have a DC-9, in the form of hardware, due to fly in a month's time. Yet many airlines are choosing to wait and see how the 737 turns out.



Just how low can you get?—No 10

A still from the forthcoming 20th Century Fox film "Those Magnificent Men in Their Flying Machines." Replicas of the Demoiselle and the Eardley Billing biplane, and some actors who weren't acting

● An engine firm I know asked an airline to rivet its trade-name plaques on to the engine nacelles. The idea was that all the passengers would spend five or six hours at a stretch looking out of the window at the nameplates.

A splendid idea, said the airline. Shall we say £500 per engine? The engine company was a little taken aback. After all, was it not a privilege to have its name on view?

Anyway, the offer was accepted. When you work it out on a captive-reader-impact basis, or whatever the advertisement industry calls it, £500 per engine over the ten-year life of the aircraft is pretty good value. And good revenue for the airline.

I am trying to arrange for this week's Straight and Level to be displayed on the inboard side of BOAC's VC10 wing fences. It's just a question of how much the corporation is prepared to pay for the privilege.

Problem: How do Hawker Siddeley Dynamics stop birds fouling-up their work in a hangar at Whitley?

Answer: Plywood owls, of course

● The other night I dreamt I was walking along a critical path through Target Forest. With me was a young man, who kept asking pert questions about the Belfast and C-141, Super VC10 and 707-320B, Trident 1E and 727, TSR.2 and TFX, and one or two other pairs of rivals. Every now and then we passed a man with an axe.

At length we came to a clearing. Behold, there were a dozen One-Elevens, a group of Kestrels, some RB.162s, a Pegasus, an HS.125, a Skyvan, a number of other items of equipment, and the sun was shining on them.

● It must have been in 1958 that de Havilland's sales people first suggested to their management that the Dove should have a swept fin and American engines. Hindsight and the Riley Dove 400 done by Jack Riley—an American—have shown that the de Havilland salesmen were right.

You can't really expect to do much better than sell 550 of a basically unchanged aircraft over 20 years; but a re-styled Dove with the US engines could have added perhaps another 200 to the DH Chester production score over the past five years. It is speculation. But if I were a designer I would listen to those salesmen next time. One of them was Jack Riley, de Havilland's Dove distributor in the USA for many years.

● To get what you want you must always have something to give away. Some of the new Ministry officials responsible for British traffic rights do not seem to appreciate this elementary bargaining ploy. And I would say from my experience that the private airlines are better at it than the State corporations.

Why, somebody asked, was a certain British airline proposing to schedule at the same times as its foreign rival, and with a more attractive aircraft? Was this not asking for trouble?

Yes, it was indeed. It caused a lot of trouble. In the end the airline climbed down—in return for the traffic rights it wanted, of course—and switched its schedules to different days. Which were the days it wanted in the first place anyway.

● Letter from a reader:—

"Dear Sir,—Would you like an article about the general manager of a British aircraft firm who in his spare time is a wrestler known as Hassan Ali Bey, The Terrible Turk with the Truculent Sneer? Yours faithfully etc."

Naturally I wrote back and said yes, of course. The Terrible Turk turns out to be Mr Dennis Dawson, 42, general manager of Didsbury Engineering Ltd, Manchester.

ROGER BACON

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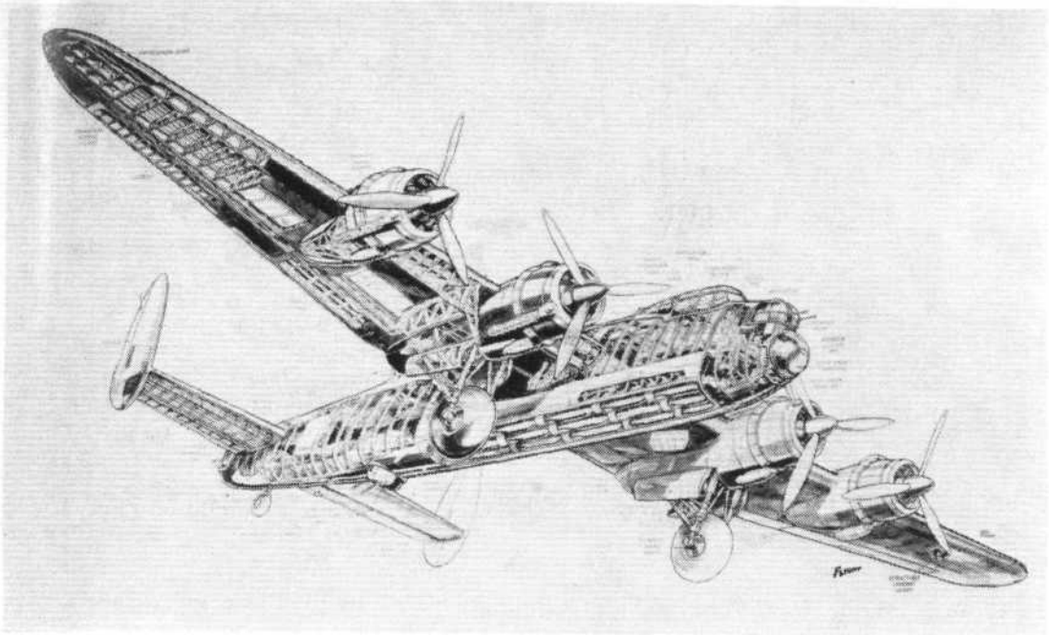

Avro Lancaster Mk 2 (miniature reproduction of a drawing originally printed across two pages)

Reproductions of many of the cutaway drawings of aircraft, engines and missiles which, executed by "Flight" artists, have been one of the most admired features of the journal for many years past, can be supplied in the form of photographic copies. A list of the subjects available appears below. Prices for a variety of print sizes are as those quoted for photographs at the foot of the previous page.

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Handley Page Victor
Hatfield Man-powered Aircraft Club Puffin
Hawker P1052
Hawker Hunter F.6
Hawker Sea Fury
Hawker Sea Hawk
Hawker Tempest
Hawker Typhoon
Hawker Siddeley types—see under original de Havilland names
Hunting Percival Pembroke
Hunting Percival Jet Provost
Ilyushin Il-18
Junkers Ju87B
Lockheed P-38 Lightning
Lockheed F-104 Starfighter
Lockheed C-130A Hercules
Lockheed 1649A Constellation
Lockheed Electra
Marcel Dassault Mirage III
Mig-15
Miles Master I
Miles Merchantman
Miles Student
North American X-15
North American P-51 Mustang
North American F-86 Sabre
North American F-100A Super Sabre
Northrop N156F Freedom Fighter
Republic F-105A Thunderchief
Republic F-105D
Scottish Aviation Twin Pioneer
Short SC1
Short Belfast
Short Seamew
Short Shetland
Short Skyvan
Short Solent
Short Sperrin
Southampton Man-powered Aircraft
Sud Caravelle
Tupolev Tu-114
Vickers VC10
Vickers Super VC10
Vickers Valiant
Vickers Vanguard
Vickers Varsity
Vickers Viking
Vickers Viscount 701
Vickers Viscount 802
Vickers Supermarine Spitfire I
Westland Lysander
Westland Wyvern
Zeppelin LZ 129 Hindenburg

AIR-CUSHION VEHICLES

Bell SKMR-1 Hydroskimmer
Britten-Norman Cushioncraft CC-1
Britten-Norman Cushioncraft CC-2/001
Britten-Norman Cushioncraft CC-2/002
Britten-Norman Cushioncraft CC-4
Denny D.2 Hoverbus
Vickers VA-2
Vickers VA-3
Westland SR.N1
Westland SR.N2
Westland SR.N3
Westland SR.N5

MISSILES AND ROCKETS

Atlas ICBM
Bristol Bloodhound
de Havilland Blue Streak
de Havilland Firestreak
Diamant
Emeraude
English Electric Thunderbird
Europa I—Blue Streak
Europa I—Second Stage
Europa I—Third Stage
Europa I—The whole vehicle
Fleet Ballistic Missile Submarine SSB(N)598 "Geo. Washington"
Minuteman
Redstone
Nike Zeus
Black Knight 2
Nord AA20
Polaris A3
Thor Mk 1
Thor missile site
USS "Ethan Allen" Polaris firing submarine
US/UK satellite Ariel
V-1

HELICOPTERS

Bristol 192
Fairey Rotodyne
Fairey Ultra-light
Hunting Percival P74
Saunders-Roe P531
Saunders-Roe Skeeter
Sikorsky S-61N
Sikorsky S-64
Sikorsky S-65
Westland Wasp
Westland Wessex AS1
Westland Westminster
Westland Widgeon

ENGINES AND MISCELLANEOUS

Allison V-12
Armstrong Siddeley Cheetah
Armstrong Siddeley Python
Armstrong Siddeley Sapphire
Armstrong Siddeley Screamer
Armstrong Siddeley Tiger
BMW801A
Blackburn Cirrus II
Blackburn Turbomeca Turmo 600
Bristol Centaurus
Bristol Olympus
Bristol Orion
Bristol Proteus
DB 601
de Havilland Gnome
de Havilland Goblin II
de Havilland Goblin test house
de Havilland Gipsy Minor
de Havilland Gyron
de Havilland Sprite
General Electric & Bristol Siddeley T-64
Jameson
Lycoming T55
Metrovick F3
Mikulin M209
Napier Eland
Napier Gazelle
Napier Lion XIA
Napier Nomad
Napier Oryx
Napier Sabre II
Rolls-Royce Avon
Rolls-Royce Conway
Rolls-Royce Dart
Rolls-Royce Dart installation in Herald
Rolls-Royce Derwent
Rolls-Royce Griffon 65
Rolls-Royce Kestrel Blower
Rolls-Royce Merlin
Rolls-Royce RB.162
Westland SR.N3 engine group
Elliotts Olympia 419
Peak 100
Slingsby Dart
Slingsby Eagle
Slingsby Swallow
Slingsby Sky
Slingsby T.49
HMS "Indomitable"

NOTE

Some of the drawings are annotated; others have key numbers with corresponding lists. Photocopies of the lists can be provided on request at a small extra charge.

TYPE 1500 MILITARY/CIVIL TRANSPONDER

The simultaneous use of common airspace by civil and military aircraft intensifies the critical necessity for more efficient A.T.C. systems. Secondary Surveillance Radar provides this improvement.

Civil Aircraft fitted with transponders already benefit from the advantages of such a system, as do the ground control stations. Military aircraft can now fit transistorised transponders embracing the entire range of performance features for operation in any A.T.C. Secondary Radar area in the world.

The Cossor SSR.1500 transponder is designed to meet the divers requirements inherent in civil and military operations.

The equipment reliability is extraordinarily high; yet the transponder is designed for continuous operation at temperatures up to +140°C and altitudes up to 100,000 ft.

It is extremely compact, weighing only 27 lbs, yet incorporates all military and civil modes (1, 2, 3/A, B, C and D), and functions in 2 and 3 pulse side-lobe suppression environments. The small size is achieved by unusually high component density; whilst retaining sufficient flexibility and accessibility for rapid maintenance.

The SSR.1500 complies with the requirements of Annex CCB. to 29/69 CANUKUS (military), I.C.A.O. Annex 10, and relevant sections of Arinc characteristic 532D.

COSSOR

COSSOR ELECTRONICS LIMITED (RADAR DIVISION),
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