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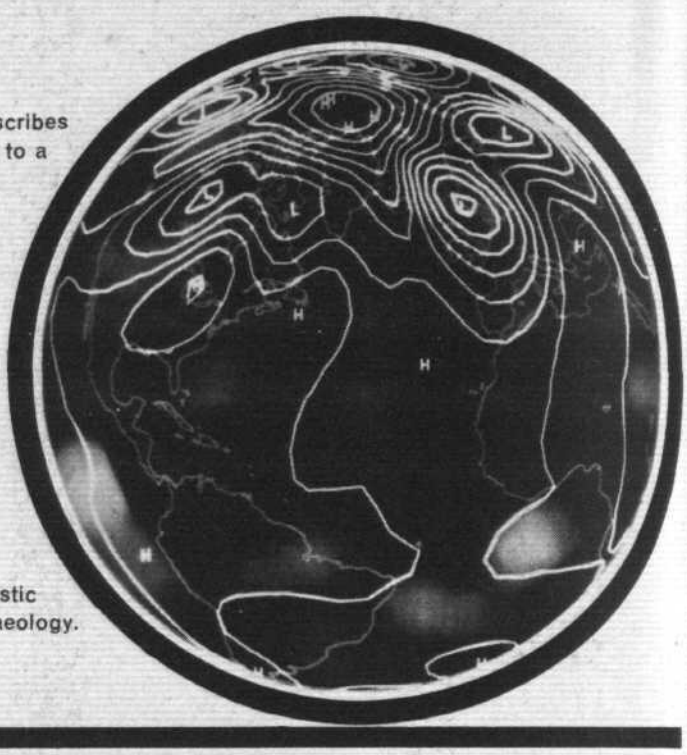
COMPUTER SIMULATION OF THE ATMOSPHERE

The behaviour of the atmosphere can be simulated in increasingly refined detail by numerical models in high speed computers able to cope with data covering the whole globe. Dr. Warren M. Washington, NCAR, Boulder, Colorado, describes the model which can produce simulated weather in the form of a cine film.

Computer generated model of the Earth's atmosphere, showing regions of high and low pressure



GROWING EMBRYOS IN THE LABORATORY

Dr. D. A. T. New, Physiological Laboratory, Cambridge University describes techniques he has developed to grow rat embryos in an artificial womb to a stage where the main organs have begun to form.

A SOVIET APPROACH TO THERMONUCLEAR FUSION

In their attempts to harness the energy of thermonuclear fusion, Soviet physicists at the Kurchatov Institute have produced the densest and hottest man-made plasma. Dr. Michail Romanovskii explains how they have achieved this.

ACOUSTIC HOLOGRAPHY

The high frequency sound waves used in acoustical holography can penetrate an object's surface to pre-determined depths. Dr. A. F. Metherell, McDonnel Douglas Corporation, California, explains how reconstruction of such holograms yields extremely realistic 'X-ray' pictures for medicine, underwater research, geology and archaeology.

NOVEMBER ISSUE

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New Deal for British Air Transport

In the next few weeks words which could profoundly influence British air transport will be put to paper. For a year now Sir Ronald Edwards and his committee have been asking questions. Appointed to inquire into the future of British civil aviation, now so important to the national economy, they have interviewed nearly everyone who is anyone in the business—in Britain, Australia, Canada, France, Germany, Holland, Sweden, Switzerland and the United States. Asking questions is easy. Now they have to find the best answers for Britain.

First Sir Ronald and his team have to define the central problem. This is the division of British air transport into two worlds, one State-owned and the other privately owned. All the conflicts which have bedevilled the industry stem from this political division. For many good reasons BOAC and BEA were given, after the 1939-1945 war, the monopoly of British air services. The problem since has been to reconcile this monopoly with the development of the independents.

The trend, which cannot sensibly be arrested, has been for the private airlines to compete more and more with the corporations. Almost every new route licence has been a battle between corporations and independents. The competition has been healthy, up to a point. Unfortunately, the licensing system is so protective towards the State-chosen instruments that it has created an industry of overprivileged and underprivileged. This is bad for economic stability and for safety.

There we have the heart of the matter and the reason for the Edwards Committee. Talk about mergers—between the corporations or among the independents—is merely irrelevant to the main issue. The Edwards Committee has to answer the question: Is national competition on international routes ("dual designation") desirable? To argue that no other country except America has dual designation is defeatist. Britain is the second-largest air-transport country in the Western World, with enormous bargaining powers and airline potential. Fares on European routes would not be so high if there were real competition, and if the debilitating pooling rings were subject to audit. Foreign airlines and Governments (other than the US) would no doubt object to dual designation; but they could only insist that the total British share should remain the same.

As for the means of regulation, what is needed above all is a strengthened, really professional licensing board independent of Ministers and the Civil Service. The Air Transport Licensing Board should be given full responsibility for economic regulation (and perhaps renamed the Air Transport Board). Its authority and staff should be extended to cover policy, international fares and—under the Foreign Office—traffic rights. It should monitor changes of ownership, pooling agreements and statistics. The Minister should delegate to the strengthened board his statutory responsibility for BOAC and BEA. Appeals against board decisions should be to a judicial court, on two grounds only: errors in law, or genuinely new evidence. Better operating statistics should be collected and published, including detailed independent-airline costs; and statistics should be in standard form modelled on the proven ICAO and CAB systems.

Such reforms would simply be a projection of past trends. Nothing would change suddenly. There would be no dual designation, except perhaps UK-US, for years. We would not expect to see independents like British Eagle or BUA as strong as BEA or BOAC for many years, if ever. But their striving to be so in an environment of equal opportunity and equal obligation would be the best guarantee of total British air transport service, safety, expansion and efficiency in the years ahead.

WORLD NEWS

Jaguar Goes Supersonic

The prototype Anglo-French Jaguar supersonic fighter and advanced training aircraft has flown supersonically and, by October 16, had already logged 14 flights since it first flew on September 8. Test crews are currently achieving up to three flights a day in an accelerating test programme, a remarkable performance with a new airframe/engine combination.

Last week Jaguar was flown for the first time by Mr J. L. (Jimmy) Dell, chief test pilot of BAC's Preston Division, who took the aircraft beyond Mach 1 during his first flight from the flight test centre at Istres, near Marseilles.

Both Bernard Witt (chief test pilot of Breguet Aviation) and Jimmy Dell are enthusiastic over the performance of the aircraft and its handling characteristics. High-speed control is said to be good and the aircraft has been flown down to about 100kt.

Four hundred Jaguar aircraft are on order for the British and French Governments. Sepecat, the Anglo-French company formed by BAC and Breguet for managing Jaguar, is currently conducting a vigorous sales campaign throughout the world. In particular, Jaguar is on the short list for the Japanese strike aircraft requirement.

F-111 Cancellation Cost

The dollar cost to Britain of cancelling its order for F-111s is likely to be about £25 million, plus some additional cost in the UK as a result of cancelling equipment contracts placed with British firms. This was stated in a written Parliamentary answer on October 14 by the Minister of State, Mintech, Mr J. P. W. Mallalieu.

He had been asked by Sir William Robson Brown (Con. Esher) to state "the past and future cost to this country" of the F-111, and "having regard to the fact that this aircraft is now grounded by the United States defence forces and unacceptable to the United States Navy," to declare that "there is no liability on Her Majesty's Government to pay compensation of the order of £50 million for the cancellation of the contract."

Mr Mallalieu said that the contract for the purchase of F-111s, "placed on our behalf by the US Government, included a standard clause about the payment of termination charges in the event of cancellation. These charges we are contractually bound to pay. Our negotiations with the US authorities have not yet been completed, but the dollar cost of cancelling the F-111, including expenditure already incurred, is likely to be about £25 million."

F-111s Fly Again

USAF F-111s, which have been grounded since last September, are now being flown again, but are to be modified to reinforce their wing structures. Until this modification is carried out, the aircraft will have manœuvre restrictions imposed upon them.

MRCA Still Hangs Fire

Britain and Germany are now very close to defining the operational role for the advanced combat aircraft MRCA according to Mr Denis Healey, the Defence Minister. Speaking at a Press conference in Bonn earlier last week, after a two-day meeting of the NATO nuclear planning group, Mr Healey described the project as "by far the most important defence project that any European country is likely to spend money on in the next ten years." He went on to say that the multi-role aircraft was the acid test for Europe on weapons production, since no similar venture of comparable size was in sight.

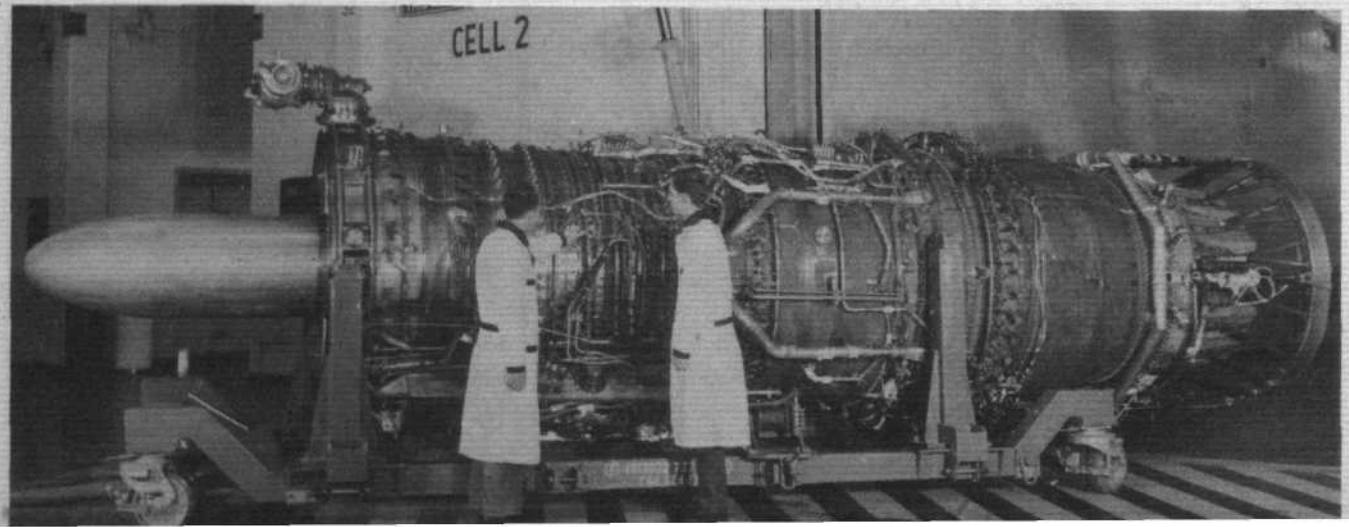
From a technical viewpoint, one aspect which has caused delay in reaching agreement has been that of the British requirement which represented the most complex project of the various European needs. It is understood that Britain has now adopted a more conservative approach in order to narrow the difference, and that the RAF is reasonably happy with the compromise. Mr. Healey went on to say that no decision had yet been taken on whether a variable-geometry layout should be adopted, but such a configuration would have substantial economic and operational advantages.

Of the countries involved in the consortium—Britain, West Germany, Italy, Holland, Belgium and Canada—only the last-named has a requirement (for an intercepter) which is not aligned closely with the existing project.

Notwithstanding Mr Healey's optimism, the question of industrial organisation has so far been hardly touched upon, and it is still the major difficulty to be overcome. The problem is the nomination of the country for technical leadership of the project. Germany's argument is that, as the major customer—she will need 600-700 aircraft to replace her consortium-built F-104Gs by 1975—she should be so nominated. Britain's case is that only she possesses the demonstrated technical and project management ability to encompass successfully a project of this magnitude. Mr Healey gave a hint of compromise here when he said that Britain recognised the legitimate desire of the West German Government to develop its aircraft industry. He also indicated that some concessions might be recognised because, whatever design was formulated, Rolls-Royce would be the dominant engine contractor.

Time is now running out for Germany. While MRCA, because of its multi-national nature, is the most political aeroplane yet to be intiated in Europe, a decision to proceed must be taken by spring or early summer next year in

Top thrust *Last month the General Electric (USA) GE4 prototype turbojet for the American SST was run on test at a thrust of more than 63,200lb—making it the most powerful in the world.* *See story on page 635*



First of the Package Deal *The first production Sud-Aviation SA.330 flew recently for the first time at Marignane. It shows a number of changes from the pre-production aircraft, which have been flying for some time; notably, the addition of a stabiliser on the tail-rotor boom. Westland contributes much of the structure for the SA.330, which is the first of the three helicopters in the Anglo-French package deal*

order that the aircraft can be introduced into the GAF by 1975 or, at the very latest, 1976. No such problem exists for Britain, whose strike equipment will still be in good shape at this time: Harrier (close support, RAF deliveries 1969-1970), Jaguar (medium support, RAF deliveries 1971-1973) and Phantom (multi-role, RAF deliveries 1968-1970).

Meanwhile, last week's Press contained speculation on a revival of Anglo-French relations following the visit to the Istres flight test centre of two British officials (one from MoD, the other from Mintech) to see the Dassault Mirage G variable geometry demonstrator. M Marcel Dassault is reported to have said that the two representatives had discussions with Dassault officials about a possible collaboration agreement. The visit was described by Whitehall as "A response to an invitation from Dassault for a routine demonstration."

Dassault recently concluded an agreement with LTV for the "sale" of VG expertise to the American company, which is one of the firms tendering for the USN carrier air patrol aircraft known as VFX. With the emergence of this agreement, it is difficult to see Britain as other than junior partner in any new agreement with Dassault.

Mintech and BAC

The Minister of Technology, Mr. Anthony Wedgwood Benn, said he had "no comment to make" when questioned in the Commons on October 14 about the appointment of Sir Reginald Verdon Smith as new chairman of British Aircraft Corporation (*Flight*, October 10). Mr Benn had been asked by Mr J. Barnett (Lab, Heywood and Royton) whether it was not "a gratuitously offensive and stupid action to appoint a chairman of BAC whom the Minister himself had dismissed from all public offices?" adding: "How can he now expect the sort of co-operation that is needed to create a viable industry?"

When Mr James Corfield, the Opposition's main aviation spokesman, then asked whether the Minister would bear in mind that there were inevitably feelings about personalities between the Government and industry, Mr Benn stated: "If the question is to be broadened out into one of relationships between the Government and the industry, I think that the new arrangements on post costing and equality of information will reduce the risk of a repetition of some of the episodes that we have had in the past."

Rohr-Mintech Talks

Exploratory talks between Rohr Corporation of California and the Ministry of Technology, about the possiblity of the American company acquiring a shareholding in Short Bros of Belfast (*Flight*, October 17), were held in London on Monday and Tuesday of last week, October 14 and 15. No decisions were reached, though the corporation is now apparently considering the possibility of acquiring a one-third share in Shorts, with Mintech and Rolls-Royce, rather than a controlling interest.

RAF Under-Secretary

Lord Winterbottom, who in last week's Government changes became Under-Secretary of State, RAF, was formerly Mr Ian Winterbottom, Labour MP for Nottingham Central, 1950-55. He was previously Parliamentary Secretary, Ministry of Public Buildings and Works.

His predecessor as RAF Under-Secretary, Mr Merlyn Rees, has become Under-Secretary, Home Office.

Domestic Routes: ATLB Gloomy

A warning that, if it became necessary to cure revenue shortfall on UK domestic services by further tariff increases, the situation on these services would deteriorate is given by the Air Transport Licensing Board in its report for the year ended March 31, 1968, published this week. The board says that unless there is a strong recovery in domestic traffic there is little chance of BEA meeting the interest charges attributable to these services, and that it might have to transfer some of the capital employed to more profitable operations. On the

SENSOR

Northrop will fly an F-5 with a carbon-fibre main spar next year. The F-5 already has a small section of wing leading-edge made of continuous carbon fibre, and was recently flown with a boron/epoxy composite main undercarriage door. The firm is also interested in research towards advanced new composite materials for high-temperature supersonic structures.

Boeing's airbus is being designed for approximately the same range bracket as the A-300 but with stretch for the medium-haul requirement now being met by the initial versions of the DC-10 and 1011. Among the airlines that could make up a sufficient go-ahead order for Boeing are Braniff, Continental, Western and National. All three American manufacturers put the broad medium-range market at more than 1,400 aircraft by 1980. Boeing's design is likely to be a twin with third-engine stretch. Pratt & Whitney is proposing a new large engine for this and later applications.

Douglas is offering a long-range version of the DC-10 for service in 1973 (gross weight 475,000lb with 43,600lb-thrust CF6) with a 1974 version at 490,000lb gross using 45,600lb-thrust engines. The latter would carry up to 92,000lb payload over a still-air no-reserves range of 3,700 miles, or a payload of 30,000lb over a full-tanks range of over 6,000 miles. To maintain airport pavement loadings there will be a third main leg located on the centreline.

Douglas do not visualise an all-freight or QC version of the DC-10, which has been optimised for the all-passenger role. Instead the company sees a possible need for a new type (the DC-11) based on a similar wing and tailplane but with an entirely new fuselage and possibly with four engines. The DC-11 could have a payload in excess of the operating weight empty.

Varig favours the Trident 3B for the Rio de Janeiro-Sao Paulo shuttle.

Automatic flight control systems envisaged by both Douglas and Lockheed for the DC-10 and 1011 respectively are aimed at Cat 3 approval on main certification in 1971. Both companies plan quadruple systems with separate monitoring of individual units to bring a major improvement in the speed of pinpointing failures. It is assumed that direct-lift control by wing spoilers will give the necessary improvement in the spread of touchdown point and speed for Cat 3 on short runways. Both companies are already making provision for replacing the triplicated vertical gyros by low-cost inertial platforms that are more suitable for long-range overwater application. Automatic overshoot and take-off attitude indication will be standard, with easy development to automatic take-off.

subject of price competition the board says that even if this were in the public interest—which, on balance, it does not consider to be the case—its present legal obligations to set out a domestic tariff would preclude such a policy.

USAF Accept First Production TF39s

The first four TF39 production turbofan engines for Lockheed C-5A Galaxy development have just been accepted by the USAF for the Lockheed/GE test programme. Production TF39 engines will be "retrofitted" in development C-5 aircraft later this year. Prior to acceptance of production engines, 24 YTF39 prototype flight-qualified engines were delivered on schedule in June 1968, for installation in flight-test Galaxies.

Two C-5 aircraft have flown to date for a total of more than 35 hours and YTF39 engine operation in all C-5 flights has reportedly been flawless.

During flight No 7, the engines were shut down individually and successfully restarted in flight at an altitude of 10,000ft and an airspeed of more than 200kt IAS. All starts were unassisted windmill attempts taking within 25sec to 30sec from time of initiation. In addition, the inboard thrust reversers were operated in flight for the first time. All reversers were deployed and stowed and operation was normal.

The 41,000lb-thrust TF39 first went on test in December 1965, and by October 10, 1968, total test time had exceeded 9,800hr of which 273hr were on flight test.

Round-the-world Belfast

The first round-the-world flight to be made by a Short Belfast was recently completed in a total flying time of 88hr. The aircraft, operated by 53 Sqn, Air Support Command, covered 27,000 miles and averaged 310 m.p.h.

Commanded by the Squadron CO, Wg Cdr J. G. Spottiswood, the Belfast left its base at Brize Norton, Oxon, on September 29 and returned on October 9. Conceived as a crew training excercise, the flight was used to carry priority freight on many legs, including a $500,000 consignment of F-4 Phantom spares from the United States to Britain. The route was via Muharraq, Bahrein; Changi, Singapore; Guam; Honolulu; Sacramento, California; Offutt AFB, Nebraska; New York; and Gander, Newfoundland. The longest leg, the 4,150 miles between Muharraq and Changi, was flown in 13¼hr with a ten-ton payload.

Carbon fibres: a Design Challenge

A competition open to industry and Government on the uses of carbon-reinforced plastic fibres is being sponsored by the British journal *Design Engineering*. Its purpose is to stimulate ideas on applications of this material in all aspects of engineering. Three prizes —£150, £100 and £50—are being offered, donated by Morganite Research and Development, and Courtaulds. The competition is open to all readers of *Design Engineering* and to workers in the existing c.f.r.p. industry, including Government departments, and applicants should write for entry forms to the journal, quoting Design Challenge 2a, at Summit House, Glebe Way, West Wickham, Kent.

A digest of an article on carbon-fibre reinforced plastics which appeared in the September issue of *Design Engineering* is featured on pages 669-670.

Parliament

When Government establishments have played a major part in developing a new material, at what point should their effort give way to that of commercial enterprises? This was the crux of the problem presented to the Select Committee on Science and Technology general purposes sub-committee last Thursday, October 17.

In this case the material was carbon fibre, which is very much in the news at present: an article on pages 669-670 of this issue of *Flight* summarises the history of its development; see also Sensor and a news-item above.

It came under the purview of the SCST for two reasons: in addition to a major preoccupation with defence research, the committee considered it should look at one or two other subjects. Carbon fibre presented itself as one because of its topicality and because Government research establishments and private industry have both been involved. Additionally one company concerned had been upset by a newspaper article in July of this year which it considered prejudiced negotiations it was then undertaking with an American corporation for a sales agreement, by suggesting that UK companies were not making enough progress and were encountering technical difficulties.

Carbon fibre research in the UK has an impressive cast list: the Royal Aircraft Establishment at Farnborough and Atomic Energy Research Establishment at Harwell; and the National Research and Development Corporation, which acts as a link between Government research and private enterprise and has licensed three companies to produce carbon fibre—Rolls-Royce, who have used it with great success in their RB.211 with which they won the Lockheed 1011 order, Courtaulds and the Morgan Crucible Co.

It was the last-named concern which brought the matter to the SCST's attention, suggesting that now that a process had been established, Harwell should stop producing it in favour of companies which could put it in the market place. As Morgan suggested in a memorandum presented to the committee: "It is no longer necessary for Mintech R&D resources to plan further work in the area of improving carbon fibre manufacture technically or economically, since this is adequately within the resources and competence of NRDC's licensees."

It was for this reason that last Thursday the SCST sub-committee members —Mr Arthur Palmer (chairman), Mr David Price, Mr Airey Neave, Mr Eric Lubbock and Dr Ernest Davies—had a two-hour session, the first half with a Morgan Morganite team and the second with representatives from Mintech, to whom the SCST had submitted questions on the article previously mentioned.

The Morgan team, Mr J. Walker, Dr A. W. Edward and Dr J. Saunders, were closely questioned as to the part their company had played and how they were indebted to the Ministry of Technology. While paying tribute to pioneer work done at RAE and AERE and admitting that the company had received substantial financial assistance, and had taken advantage of the graphite furnaces at Harwell, Mr Walker insisted that the important thing now was "getting the material from R&D to the market end." He suggested that further work at the processing end was not so important.

He was sharply questioned by Dr Davies and Mr Lubbock, who both considered that practical objections to Harwell carrying on with carbon fibre production had not been put forward, though Mr Walker insisted that there was no point in Harwell continuing to pursue it. Both the committee and the company, however, agreed that there was still some reluctance in industry to use the new material.

The Ministry was represented by Dr G. G. Macfarlane, Controller of Research, and Mr J. Knox, Head of Materials, with Mr J. C. Duckworth of the NRDC. Dr Macfarlane explained the Government's position and said that the Ministry had put a contract on Harwell and had also approached Morgan Crucible Co and encouraged them to come into the business. As for the future, Mr Duckworth commented that they were at the stage when the scientists at Harwell had made a very good contribution and he hoped they would have a part to play in the next stage. When Mr Lubbock observed that Morganite had said there was duplication, Mr Duckworth said that the company would go into production with Whittaker Corporation of Los Angeles, with whom they had made a sales agreement.

Referring to the contest between boron fibres and carbon fibres, Dr Macfarlane said that the Ministry had decided that carbon fibres were "a much better proposition."

All three of New Zealand National's Boeing 737-200s have now been delivered and services were started at the beginning of last week, October 14. The first 737 for the airline reached Wellington on September 18 after its delivery flight from Seattle

AIR TRANSPORT

Background to Boeing's SST Re-think

DURING THIS MONTH the Boeing SST Division is conducting top-level negotiations with the engineers and administrators of its major partners (such as General Electric with the engine, and Northrop on the fuselage) about the fundamentally revised design which is to be presented to the FAA on January 15. Boeing has not made any further public statement since those which were published in *Flight* for September 26 (page 47) and October 3 (page 519) after Mr T. A. Wilson, the company president, confirmed earlier rumours that the most highly favoured design was now a fixed-wing delta of moderate sweepback plus a conventional tailplane. Boeing's resolve to say nothing before submission day is confirmed by *Flight* staff writer Neil Harrison, who has this month been visiting all the transport aircraft manufacturers on the US West Coast in preparation for this journal's Commercial Aircraft Survey to appear on November 21.

The only firm thing about the SST design and its objectives is the choice of a Mach 2.7 minimum cruising speed—a decision which some observers consider is setting the company an unnecessarily high technical hurdle. On the other hand even the primary obligation to build a "money earner" is being studied in the broadest context.

The problems of designing an SST to show a significant improvement on subsonic economics does not get easier. In the past four years the basis for operating-cost comparisons has gone down in three distinct stages. First the DC-8-60 series pointed the way to a 15 per cent reduction in seat-mile costs compared with the first-generation long-haul subsonic turbofans; then the entirely new Boeing 747 and Lockheed L-500 showed how a considerable increase in size, allied to new high bypass turbofans, could bring another 10-15 per cent gain in seat-mile costs; now the airlines are being shown three-engined aircraft for all but the very longest over-water and trans-polar routes, and these aircraft promise an even lower level of seat-mile costs with the added advantage of not offering quite such a dramatic increase in size as is represented by the 747.

But minimum seat-mile cost is not the whole story, and Boeing is studying the fundamental question of the elasticity of demand for the speed of the SST—or just how much more would passengers be prepared to pay in order to have their journey times halved. Premium fare levels of up to 15 per cent are being considered. Just how big the Boeing SST will turn out is not so easy to guess at this stage—but it will be a big aeroplane. The range requirement is fixed for the initial production version (if not for the prototypes) by the essential objective of being able to fly from all the various European capitals to New York, and for the need to have built-in range-growth potential for Europe-US West Coast and non-stop US-Japan. Boeing certainly does not consider itself restricted to designing within the potentialities of the previously selected General Electric re-heat turbojet; but there is no question at this stage of the engine requirement being thrown open to fresh tenders by other manufacturers.

There can be little doubt now, in view of the subtle changes of emphasis in the balance between economic and operational objectives and by going to a more conventional design, that Boeing will soon be able to make a strong case to the FAA for an early go-ahead on prototype construction. Development in the field of advanced structural materials might bring forth something worthwhile within the period being talked about and so make the aerodynamically preferred variable-geometry wing design a feasible proposition. But at this stage it looks as though the conventional arrangement is the more predictable. Whatever Boeing shows to the FAA in January it will need to be good if the Administration is to be sufficiently impressed to recommend that the nation should invest a lot of money in the project. The traumatic experiences of the past year have not exactly enhanced the value of the SST concept to Boeing, the FAA, or the financially-minded public.

One of the NAMC YS-11As for VASP of Brazil in a new colour scheme which has a medium-blue cheatline, with white and black edging, and the VASP lettering now bolder in black. The fin and rudder are medium blue and white. This picture of JA8699 was taken at Tokyo last month; an earlier one of the same aircraft taken at Tokyo late in July showed a different styling

AIR TRANSPORT...

THE NEW MERCURE PROJECT

LAST week Marcel Dassault announced in Paris that his company is working on a new short-haul 130-passenger transport called the Mercure, which will be powered by two Pratt & Whitney JT8D turbofans. Financially the project is to be funded 20 per cent by Dassault and 10 per cent by Fiat in Italy. M Dassault said that the proposed French budget for civil aviation in 1969 totalled Fr.970 million (£82 million) and he understood some Fr.60 million (£5 million) were likely to be allocated for the Mercure during next year. This would be a first step towards finding the remaining 70 per cent of the development costs of the Mercure, all of which was likely to be funded by the French Government.

There is as yet no definite confirmation that the money will in fact be made available but it was understood in Paris that the project was quite likely to go ahead. Given the green light a prototype could be flying within two years, M Dassault said. A Mystère 20 has recently been flying with leading and trailing edge high-lift devices on its wings to improve its short-field performance. It seems quite likely that the Mercure will benefit from some of the research work now being conducted on this aircraft.

SELF-INSURANCE PLAN HARDENS

THE establishment of an airline-owned corporation to provide insurance cover in all traditional aviation fields was recommended last week at a meeting in London sponsored by the International Air Transport Association and the Air Transport Association of America. This meeting, under the chairmanship of Mr Floyd D. Hall, chairman and chief executive of Eastern Airlines, was one of a series held since January this year. Sir Giles Guthrie, who retires at the end of the year as chairman and chief executive of BOAC, has agreed to make himself available to serve as chairman of the board of the proposed organisation.

This organisation, together with the insurance market, would provide the increased insurance capacity which appears to be necessary in the coming years. A general outline of the plan is being sent to representatives of the insurance market. Membership of the proposed organisation would be open to all interested air carriers, and not restricted to ATA and IATA members. The majority of the members of these two associations are expected to be initial participants. Lausanne, in Switzerland, is at present considered to be the most suitable place for the organisation to have its headquarters, and where it is expected to be incorporated.

Outside assistance has been engaged in the selection of a director-general, who will set up and administer the nucleus of the corporation. Before the organisation can become effective various government approvals will be necessary. As one of the primary aims of the organisation is to provide insurance coverage in the era of mass air transport, which will start with the appearance of the Boeing 747 late in 1969, it is obviously desirable that operations should start as soon as possible. The London meeting set a tentative target date of mid-1969 for the establishment of the organisation. Future developments will continue to be monitored by the small IATA/ATA steering committee which was initially charged with responsibility for examining the feasibility of the project.

More -320Cs for SAA Two more Boeing 707-320Cs have been ordered by South African Airways for delivery in the second half of 1969.

More 737s for Lufthansa Two more Boeing 737s have been ordered by Lufthansa, bringing the eventual fleet total to 28—19 of which will be -100s and six -200Cs.

BOAC has Options on more 747s With 11 Boeing 747s on firm order, BOAC also has options on five more—though, according to the airline's engineering director, Mr Charles Abell, speaking recently in Seattle, the present orders should meet the requirements for the airline until the end of 1973.

Another F.28 Sold The German inclusive-tour charter operator, Lufttransport-Unternehmen (LTU), has converted its option on a second Fokker F.28 Fellowship to a firm order. The F.28 is due to be certificated next month and deliveries will start almost immediately with the first going to LTU.

Leasing Corporation Buys More 737s The GATX-Boothe Corporation, the aircraft-leasing organisation, has confirmed an order for another five Boeing 737-200s for delivery at the rate of one a month from next January. They were originally on option for Frontier, who cancelled them (see also *Flight* for September 19, page 434).

Olympic's Super-Frelon In the first ten weeks of service (July 15 to September 23) Olympic Airways' Sud SA-321-F Super-Frelon logged 400hr, carrying 7,500 passengers and nearly 25 tons of cargo. The helicopter, which is on lease-sale to Olympic, has been used on summer-season scheduled services between Athens and the islands of Skiathos, Mykonos, Thira and Chios.

Eighth DC-8-63 for KLM Another DC-8-63 has been ordered by KLM for delivery in August next year. This, to be registered PH-DEH, is a replacement for the DC-8-50 which was destroyed by a hangar fire on June 29, and will bring KLM's -63 fleet to eight. Of these, four have already been delivered; the fifth is due for delivery next December while the remaining two will follow in July 1969 and February 1970 respectively.

An Islander a Day

ONE ISLANDER EVERY WORKING DAY is Britten-Norman's target for 1969 and 1970. Thirty-three aircraft have been delivered so far, and another 30 are due to come out of the new Bembridge assembly hangar by the end of this year. Subcontracting Islander assembly and physically moving production to the British Hovercraft Corporation—after 20 aircraft had been built—has caused some headaches, and in fact the programme agreed last spring is about 12 aircraft behind. Some problems still remain, but Britten-Norman are under no illusions about the wisdom of the deal; they simply do not have the capacity or experience to handle the logistics of production on the scale now demanded. The new line is coming "on stream," and everything should be running smoothly and regaining schedule within a few weeks. Output is already one aircraft every three days.

BHC manufacture the entire aircraft in their East Cowes factory with the exception of the flaps and empennage, which are made by C. F. Taylor at Christchurch. Assemblies are carried by road the half-hour journey to Bembridge for erection and final assembly. Flight-testing is done by B-N. The assembly floor is rented to BHC. A three-storey office section is occupied by B-N's bought-out equipment stores, accounts, product-support; Islander design and drawing offices are moving in this week. The assembly hangar has capacity at any given time for ten aircraft in the erecting stage, two in the paint shop, and two or three on flight test.

All but nine aircraft in the 1969 programme have been sold, with deposits in the bank. B-N can see another 250 a year (at least) in the early 1970s. All but one of the existing 20 customers have already re-ordered in the light of operational experience. Serviceability record has been partly responsible for this—one customer has operated 3,000 schedules with only one day's "down time" through unserviceability—but there is no doubt that the Islander's main appeal is the amount of revenue it earns for its operators.

Progress towards production in Rumania is going well, and the first aircraft—assembled from British-supplied components—is expected to fly next August. All Islanders built by the Rumanian "second-source" factory will be sold by Britten-Norman.

The challenge and the hope, which will tax B-N's salesmen and BHC's production men to the full, is 2,000 Islanders by 1980, or £50 million-worth excluding spares.

Two new Islanders are under development, one supercharged and one stretched. The "turbocharged" prototype was seen at Farnborough with its Roll-Royce Continentals; the long Islander is also flying, though no pictures are available. The familiar dilemma of timing a product-improvement so that it does not distract attention from the existing product is apparent here. The prototype Islander is now flying with a stretch of 30in in front of the wing to accommodate another double seat. The existing rear fuselage has been modified to take another double chair also, and another door on the starboard side. The baggage compartment is now further aft, with its own hatch. Total passenger capacity is increased by four—to 12 passengers plus pilot and co-pilot.

Further modifications have to be made before the long Islander can be fully developed and offered to the market, however. A variable-incidence tailplane will be tested, and larger wheels will also be added to take the increased weight. An optional long-range underwing-tank system is also being developed for all Islander models, to widen the market appeal of the aircraft. Price will be about $78,000 (£32,000) compared with $62,000 (£26,000) for the standard aircraft.

The prototype long Islander is being fitted with eight-cylinder normally aspirated 400 h.p. Lycoming engines, probably in the spring. A supercharged version—probably with Rolls-Royce Continentals—is also envisaged. Eventual pattern could be two basic Islander airframes, one standard and one stretched, with unsupercharged Lycoming engines or, for high and hot operations, supercharged Rolls-Royce Continental engines.

Although the technical success of the Islander has been apparent for all to see, this is only now—after four years—being transformed into financial success as income in the form of delivered aircraft begins to overtake expenditure on development, production engineering and the massive investment in bought-out equipment—especially in items like engines and undercarriages. Designing a brilliant aeroplane which everyone wants to buy is difficult enough; getting it out of the hangar at the rate of one a day requires exertions that both Britten-Norman and BHC can feel relieved to be getting behind them.

Footnote A group left Bembridge, IoW, in a BN-2A Islander last week for demonstrations during the British Trade Week in Bucharest. The aircraft was demonstrated first in Italy and is based this week at Baneasa Airport, Bucharest, where it arrived last Sunday, October 20. The visiting group included Sir Mark Norman, who is in charge of the Rumanian contract, and Mr Brian Partridge, sales manager. Mr Ken Mills, who had travelled to Bucharest earlier, has been appointed by B-N and BAC (Weybridge) as senior engineering executive (Rumania) for the two companies.

Turk Hava Yollari's DC-9-10, TC-JAA "Topkapi," seen recently at Zurich Airport. Turkish Airlines are strongly possible buyers of up to seven BAC One-Eleven 500s

AIR TRANSPORT . . .

EVALUATING THE AMERICAN SST

AN extensive evaluation of Boeing's latest SST proposals will start next month, though Boeing has until January 15 to provide all the relevant data. Most of the work will be done at Seattle by more than 100 people from the FAA, NASA and the Department of Defence. Dr Raymond L. Bisplinghoff, head of the department of aeronautics and astronautics at the Massachusetts Institute of Technology, is to be chairman of the technical committee which will assist the FAA in the evaluation. A member of the technical advisory committee is Dr Arthur E. Raymond, retired senior vice-president, engineering, of Douglas. Although a full-scale evaluation was made of the competing Boeing and Lockheed designs three years ago, the procedure was not in the original SST contracts between the FAA and Boeing. It was added last winter when the decision was made to re-examine the design.

QUIET-ENGINE PROGRAMME

A REQUEST for proposals has been issued by the US National Aeronautics and Space Administration which will result in a programme to build two experimental turbofan engines which can operate at a noise level at least 15 to 20 decibels lower than that of the current engines which power such aircraft as the Boeing 707 and DC-8. Proposals for the "quiet engine" programme are to be submitted to NASA's Lewis Research Center, Cleveland, Ohio, by November 18. A contract is to be awarded some time early next year.

Specifications for the turbofans were written at Lewis with the assistance of Allison and Pratt & Whitney, and McDonnell Douglas has been studying the feasibility of integrating the quiet engine with the DC-8. Wind-tunnel tests are in progress and are to be concluded early next year. The programme will set out to reduce two major sources of engine noise, interaction of the jet exhaust with outside air and the noise created by the fan.

With an engine of high by-pass ratio like the advanced technology turbofans developed by Rolls-Royce, exhaust velocity is reduced without thrust loss, and noise created by interaction of the jet exhaust with outside air is directly related to exhaust velocity. With this source of noise reduced, fan noise becomes dominant. NASA says this noise can be reduced by increasing the spacing between rotor and stator blades, reducing the fan tip speed and by correct selection of the number of blades.

By designing an experimental engine with the fan mounted on a separate shaft, NASA hopes to gain a better understanding of how fan noise is produced without disturbing other elements of the engine. After the test programme which the contractor will conduct, one of the engines will be overhauled and taken to Lewis for further tests, including operation of the engine in an acoustically designed nacelle to assess its performance as installed in an aircraft.

NEW DATA ON THE FELLOWSHIP

AS part of the Fokker F.28 Fellowship development programme the original maximum take-off weight of 56,700lb is being increased to 62,000lb. This weight increase is possible with virtually no modification or empty weight increase and will enable the operator to take full advantage of the F.28's extended-range capability. Handling qualities turned out to be favourable enough for the predicted c.g. range to be extended to 17 per cent m.a.c. forward and 37 per cent m.a.c. aft. The extended range will increase loading flexibility for the operator and will be certificated during the course of next year. The three pre-production Fellowships have now almost completed the scheduled 1,000hr flight test programme. This schedule has been aimed at obtaining the type certificate from both the Dutch authorities and the FAA by the end of 1968. Flight trials have shown that the F.28 has attained or bettered all design expectations, Fokker says.

Latest weights, loadings and performance data for the F.28 include: manufacturer's empty weight, 30,807lb; typical operating weight empty, 33,800lb; typical payload, 13,800lb; max zero fuel weight, 47,600lb; max take-off weight, 62,000lb; max landing weight, 54,000lb; standard fuel capacity, 16,982lb; max cruise altitude, 30,000ft; max cruise speed, 458kt TAS at 21,000ft; approach speed, at max landing weight, 1.3Vs, 114kt EAS; balanced field length, max take-off weight, SR.422B, ISA at sea level, 4,950ft; required landing field length, max landing weight, SR.422B, at sea level, 4,210ft; range, ISA, no wind, with max recommended thrust, 60 passengers at 200lb each, 1,010 n.m.

BOAC PILOTS AGAIN DISSATISFIED

THERE has been so little progress, according to BALPA, in talks with BOAC on the points in dispute which precipitated the BOAC pilots' strike in June that pilots have decided to take more protest action starting on November 1. Instead of a restriction of co-operation campaign, or a strike, the pilots will refuse to fly more than the "average" 45 hours per month —a figure given by BOAC in productivity statements. Scheduled duty days of more than 10½hr will not be accepted either.

The moves are intended to spur BOAC into producing some sort of settlement on the pay and hours dispute without directly involving passengers in inconvenience. Under long-term consideration is a scheme whereby all pilots resign from the corporation en masse, and then offer their services as free-lances—negotiating individual contracts.

The moves have been sparked off by the fact that the current talks, under Prof Wood of Sheffield University, had a tentative aim of agreement by October 31, a date which BALPA felt acceptable in June, but now says is completely unattainable.

MORE SKYSERVANTS FOR THE USA

AN additional 30 Dornier Skyservants have been ordered by Butler Aviation of New York to supplement an earlier order for 22. This 12-seat STOL feeder is already operating regular air-taxi shuttle services between Washington's three airports and recently inaugurated the new STOL runway which has been built at New York's LaGuardia Airport as part of the programme to reduce congestion in the area.

The new order brings the total sales for the Skyservant to about 70 aircraft. At present, production at Dornier's Munich plant is at the rate of four a month, but this is to be substantially increased by the end of the year to cope with the predicted rise in demand. The US company alone, for example, expects to sell between 50 and 100 aircraft a year from about 1970 onwards.

Il-14 Crash On October 11 a Ceskoslovenske Aerolinie Il-14 crashed after take-off from Prague Airport. All three of the crew and 11 passengers among the 37 on board were killed and ten seriously injured.

Six-city Link One of the two companies within British Air Services, Cambrian Airways, has introduced Viscount flights serving six major centres in the UK—Liverpool, Manchester, Bristol, Cardiff, Guernsey and Jersey. Through flights, timed for the business market, will operate over the network on three days a week.

Bank Acquires Loganair The share capital of the Scottish air charter company, Loganair, has been acquired by the National Commercial Bank of Scotland, Capt D. McIntosh, managing director, will continue as chief executive with his present officers and staff. Loganair operates the inter-island Orkney services and has scheduled services from Glasgow to the Western Isles of Scotland.

Not so Serious The trouble which caused the British Air Ferries Bristol 170s to be grounded last week at Ferryfield, Lydd, turned out to be less serious than was at first feared and all should be back in service before this issue appears. They were grounded after a crack was found in a rear-fuselage subframe during a major overhaul. An ATL Carvair was temporarily deployed from Southend to handle the slack-season traffic while all but one of the five 170s were grounded.

A Grumman Goose operated by Antilles Air Boats, which operates scheduled services in the Virgin Islands, being refuelled at the Christiansted, St Croix, terminal. The one and only Vought-Sikorsky 44A flying-boat, which is operated by the airline, was pictured in our issue of September 19, page 433

Should the Airbus be a Twin?

THE TECHNICAL COMMITTEE of the International Transport Workers' Federation, after listening to the points of view expressed by Sud-Aviation and "after long and careful deliberation," have decided that twin-engined airbuses will be less safe than their multi-engined counterparts. Mr Brian Hampson, spokesman for the flight engineers' technical committee of the ITF, says that Sud-Aviation admits the design of the European Airbus A-300 will be inferior on at least three counts—overshooting in the landing configuration will be "difficult" on one engine; an engine failure will be "a serious problem" and will require the use of separate emergency check lists; and the restrictions on the use of reverse thrust will be more severe than on three- or four-engined designs.

In his original paper, analysing the two-engined airbus, Mr Hampson commented first on the Sud-Aviation statement that "operating costs on the proposed short stages would be substantially lower, for the same degree of flight safety, than those of a three-engined design optimised for the same stage lengths." Taking jet transport accidents in each of the years 1966 and 1967 he uses his statistics to suggest that it is twice as likely for a twin-engined aircraft to be involved in a fatal accident as for a four-engined aircraft; twice as likely for a twin-engined aircraft to be in an accident which involves fatalities, as a three-engined one; or conversely, twice as dangerous to fly in a twin-engined as a multi-engined jet. The loss of only one twin-engined airbus would cause more than half the fatalities which have been the annual total of previous years.

Sud-Aviation replied that the statistics used did not indicate specifically if the powerplants had any bearing on the accidents. Suggesting that the conclusions Mr Hampson had drawn were of no significance, the Sud-Aviation representative, M Jean Pradal, said the figures quoted by Mr Hampson referred to the number of aircraft and not to the number of flying hours, or more characteristically to the number of flights (landings or take-offs made).

The Sud-Aviation sales brochure on the A-300 says that the twin-jet aircraft is to have the same level of safety as the three- or four-engined model. Mr Hampson points out that nowhere in the brochure are mentioned the operational aspects of the aircraft concerning safety. He says that in the event of engine failure in a twin-engined aircraft 50 per cent of the power is lost whereas in a four-engined aircraft only 25 per cent is lost. Sud-Aviation suggests that this is inaccurate—a four-engined aircraft with two engines not functioning is in a much less favourable condition than a twin with one engine not functioning. Without going into FAR and BCAR regulations it is sufficient to say that generally a twin-engined aircraft would be able to execute a take-off or accelerate-stop with an engine failure in good conditions with sufficient margin. Sud says that this also makes the twin relatively more powerful than a three- or four-engined aircraft. Because of this it is able to clear obstacles more easily on take-off or overshoot without an engine failure.

Problems of yaw have nothing to do with the number of engines, M Pradal said. The loss of an outboard engine of a four-engined aircraft gives a much larger yaw than the loss of an engine nearer the c.g. of a twin. While agreeing with this, Mr Hampson pointed out that in the four-engined case the righting moment by reducing power on the opposite side to the failure is greater and therefore safer.

Sud-Aviation says that an engine failure has no effect on the main systems of an aircraft except some shedding of secondary electrical loads and a reduction of certain margins on the hydraulic supply. There are not even automatic change-overs, as suggested by Mr Hampson, and if there is an APU it is there for other reasons. Mr Hampson says, however, that all modern four-engined aircraft, following the failure of one engine, suffer from some system redundancy and require some recovery action to be initiated, so he considers the ITF contention in this respect to be proven.

Commenting on the question of reliability, Mr Hampson says that there are doubts about the ability to design an autopilot system which could operate satisfactorily in cruise with one engine failure. If such an autopilot were available it is doubtful if it would operate in an autoland capacity in this situation. Sud-Aviation's reply to this was that the operation of the autopilot is unconnected with the number of engines

functioning. If it is not desirable to land in conditions necessitating automatic landing with a failed engine, this is not because the automatic pilot is unable to do it, but because of poor overshoot performance. Flying restrictions for twins do exist, but have nothing to do with punctuality—either the route permits the use of twins or it does not. Success of the Caravelle, DC-9, Boeing 737 and BAC One-Eleven shows that these restrictions can hardly be crucial.

Mr Hampson refers to the brochure statement that the A-300 is to be certificated for operation by a two-man crew, but that provision is to be made for those airlines who wish to do so to carry a third crew member. He says that the larger the aircraft and the more passengers it carries, the more complicated are its systems. In the past, aircraft have had to be modified for operation by two pilots and one engineer, after starting life as two-crew aeroplanes—an unsatisfactory, lengthy and costly situation. Sud-Aviation denies that complication of systems necessarily increases with size of aircraft and says that the twin formula does not complicate the systems, but reduces the number of instruments to be looked after, and working circuits are identical. M Pradal said that two- or three-crew operation was a subject of controversy, but suggested that the current trend was towards two pilots with a third man capable of helping the other two at any time.

The brochure says that the twin-engined design was chosen purely for reasons of economics. Mr Hampson says that the main reason for the decision to build the A-300 with two engines would be because a lot of time and money had already been spent on the engine, which had originally been designed for a larger aircraft. Although a twin-engined design will be cheaper to build because the engine is available and marginally cheaper to operate and service, the real reason for the A-300 being built would be political and the risking of people's lives for a political ideal cannot be accepted in this context.

Sud-Aviation's reply to these comments was that they are purely controversial and not worthy of comment, but Mr Hampson says that although the airbus consortium cannot be held responsible for the arguments themselves, they do have some responsibility for not recognising that their choice would precipitate such arguments. The ITF therefore, he said, holds its criticisms to be valid.

BEA'S BIG BRITISH BUY

WHEN the second BAC One-Eleven 500 was handed over formally to BEA, and named at Farnborough on September 18 (see the issue for September 26, page 476) the airline was taking delivery of its 243rd British aircraft in 22 years. This, Sir Anthony Milward says in his column in the *BEA Magazine*, works out at nearly one a month. The total number ordered so far is 294; thus, in a period of about 25 years, BEA will have invested nearly £300 million in the British aircraft industry.

"It is interesting to note," Sir Anthony continues, "that the investment up to 1961 was £100 million; so the escalating cost of re-equipping with new jet aircraft is clearly seen. It is vital that we should make the best use of these expensive aircraft if we are to remain a commercial airline. With our average one-way fare of only £10 it requires a lot of passengers and a lot of utilisation to provide a satisfactory return on the capital we invest in each aircraft."

BEECHCRAFT 99 UTILISATION

FIGURES supplied by 18 commuter airlines operating the Beechcraft 99 indicate that more than 10,000hr have been flown in the five-month period since the type went into service. These operators have fleets accounting for 29 aircraft. Commuter Airlines, which has seven 99s, logged 9.5hr utilisation per day for its busiest aircraft. Air Wisconsin flew 7hr a day with one of its two Beechcraft 99s and Midstate achieved the average utilisation of 9.5hr a day. Nationwide Airlines achieved the highest utilisation with 11.9hr per day, and air taxi operators were logging 2½ to 3hr a day.

BAC'S THREE-ELEVEN SURVEY

DETAILED reactions to the proposed new 200/220-seater BAC Three-Eleven "in principle and in engineering detail" from key operators all over the world are the main objectives of the top-level technical and sales teams which left Weybridge earlier this month, as briefly reported in *Flight* last week (page 596). Mr G. E. Knight, chairman and managing director of the Weybridge division of BAC, said that his company was not interested in producing academic and probably unreal market survey reports and getting terribly excited about them. Mr Knight said he wanted to be able to see a minimum initial sale of 50 aircraft to at least three operators, to be followed by another 150 to 200 aircraft during the 1970s.

The BAC teams will in the space of a month visit 20 countries. Each team is led by a Weybridge director and includes specialists from the design office. Mr Knight is due to take an active part in a number of the Three-Eleven presentations which the teams will make. The deputy managing director, Mr J. Ferguson-Smith, and the technical director, Mr E. E. Marshall, will also be taking part. Some 25 senior executives are involved and shortly the Weybridge division will have nearly 200 people working on the Three-Eleven.

Under present design philosophy BAC contends that there is a requirement from the mid-1970s onward for a short/medium-haul aircraft with double the capacity of the present generation of 100-seater aircraft. It should have a wide fuselage to match the "spacious" trend in new longer-haul projects and should use new technologies, especially in engines, to reduce noise and operating costs.

BAC is reported to expect to finance the Three-Eleven partly itself, partly by subscription from major subcontractors to the programme and partly with some Government launching investment, returnable on a pro-rata basis with each Three-Eleven that is sold. This is thought to be a more favourable basis than that proposed for the previous BAC Two-Eleven project for which BAC found it necessary to ask for large development loans from the Government. BEA has said its future fleet requirements could include 20 such aircraft at least, and the Three-Eleven specification will be studied to decide if this aircraft would be suitable.

BOOKING 747 SEATS ALREADY

EVEN though the 747's first flight in service is still more than a year away, Pan American is already looking for passengers who want to fly on one of the first services. The airline has been sending out individually addressed invitations to reserve seats on services to London, Paris, Rome, Frankfurt or Tokyo. PAA's first service will, it is expected, be flown on or about December 17, the date of the Wright Brothers' first flight in 1903. At the same time the airline has been taking double-page advertisements headed: "The world's first 747s have orders to report to the world's most experienced airline. Reservations, anyone?"

CONCORDE'S FIRST FLIGHT

ON the day (October 14) on which we went to press with last week's issue, Mr Anthony Wedgwood Benn, Minister of Technology, said in the House of Commons that the Sud-built Concorde 001 was expected to fly towards the end of December or early in January. He added that the Filton-built 002 would fly about six weeks afterwards. He confirmed *Flight*'s comment last week (page 594) that the programmes for the identical prototypes "are phased for testing purposes to begin with 001 and go on to 002" and said that he was "not prepared to seek to interfere" with this programme, which had been laid down by the manufacturers. Speaking of the effects of the long first-flight delay, he said that "time is money and any delay tends to impose extra costs." But he added: "It does not follow that the delay in the first flight will be reflected in equivalent delays throughout the period. In fact, we believe that the in-service date will not be greatly affected."

Air Transport continued on page 641

We've an extra 130 shaft horse power tucked under our wings.

Skyvan now has the Garrett AiResearch 331-201 turboprop engines.
That's 715 shaft horse power each, for take-off and cruising.
Gives you a clean lift even from an airstrip at 5,000 ft. above sea level.
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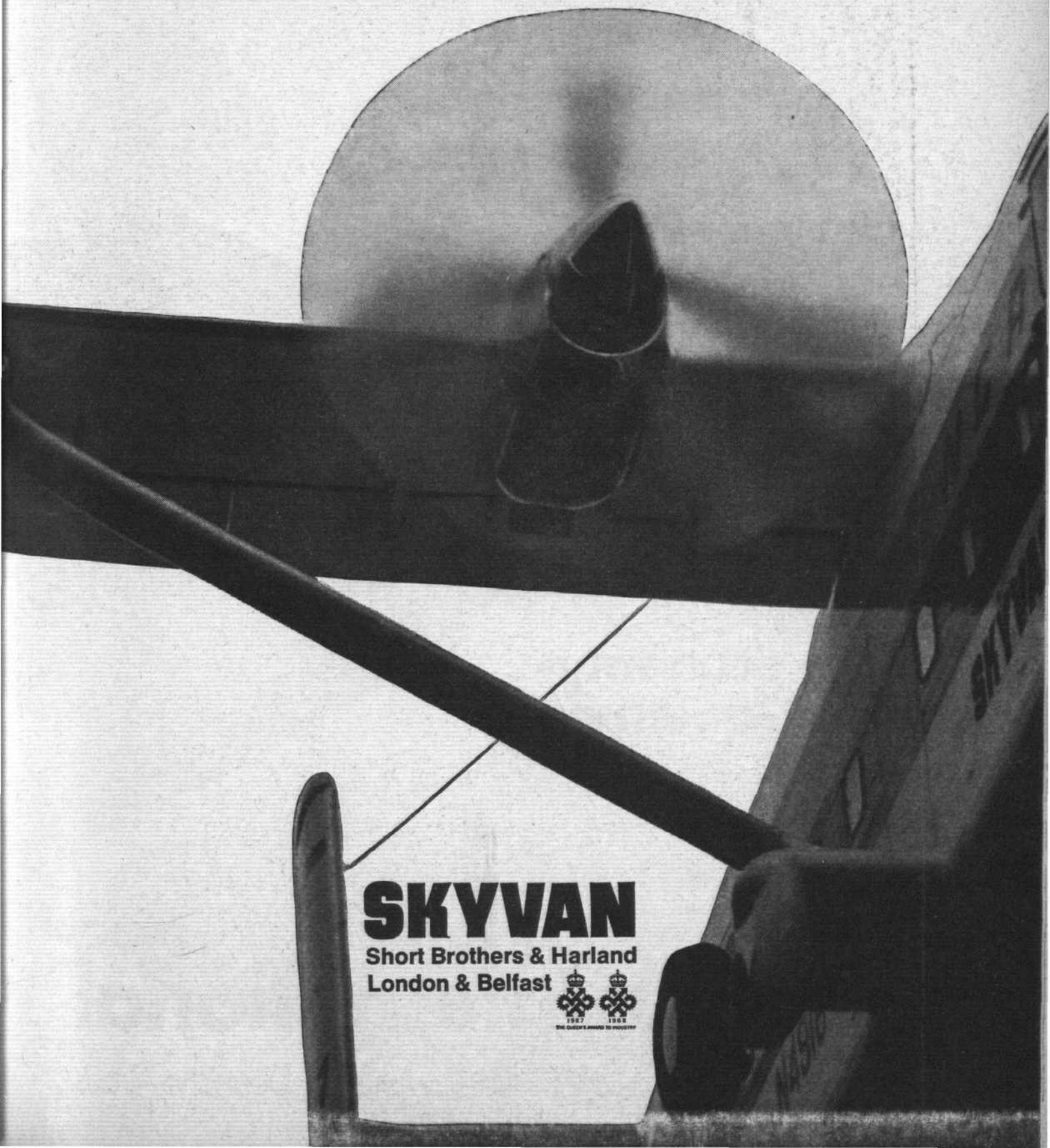

This is the start of something big

In 1973, the first of the A-300 European Airbuses is scheduled to come into service. They will do so because a 250-300 seater is the only way of coping with the passenger traffic that by that time will have doubled. Moreover, the Airbus is the only aircraft of that size designed to fly at maximum profitability over short- and medium-haul stages.

What makes the A-300 revolutionary is that it is likely to be the most popular aircraft ever with passengers.

The Airbus offers new spaciousness for one thing, with more room and comfort than the most luxurious of today's jets.

Its Rolls-Royce RB 207 engines will make it quiet, quieter than today's jets. And that will be a blessing to people on the ground as well as to passengers.

More remarkable is the exceptional efficiency of the Airbus and its engines which will enable operators to peg fares at today's levels. And technical delays will be reduced to a mere 1%—twice the reliability of current aircraft.

A.300-economy-comfort-quietness

A-300

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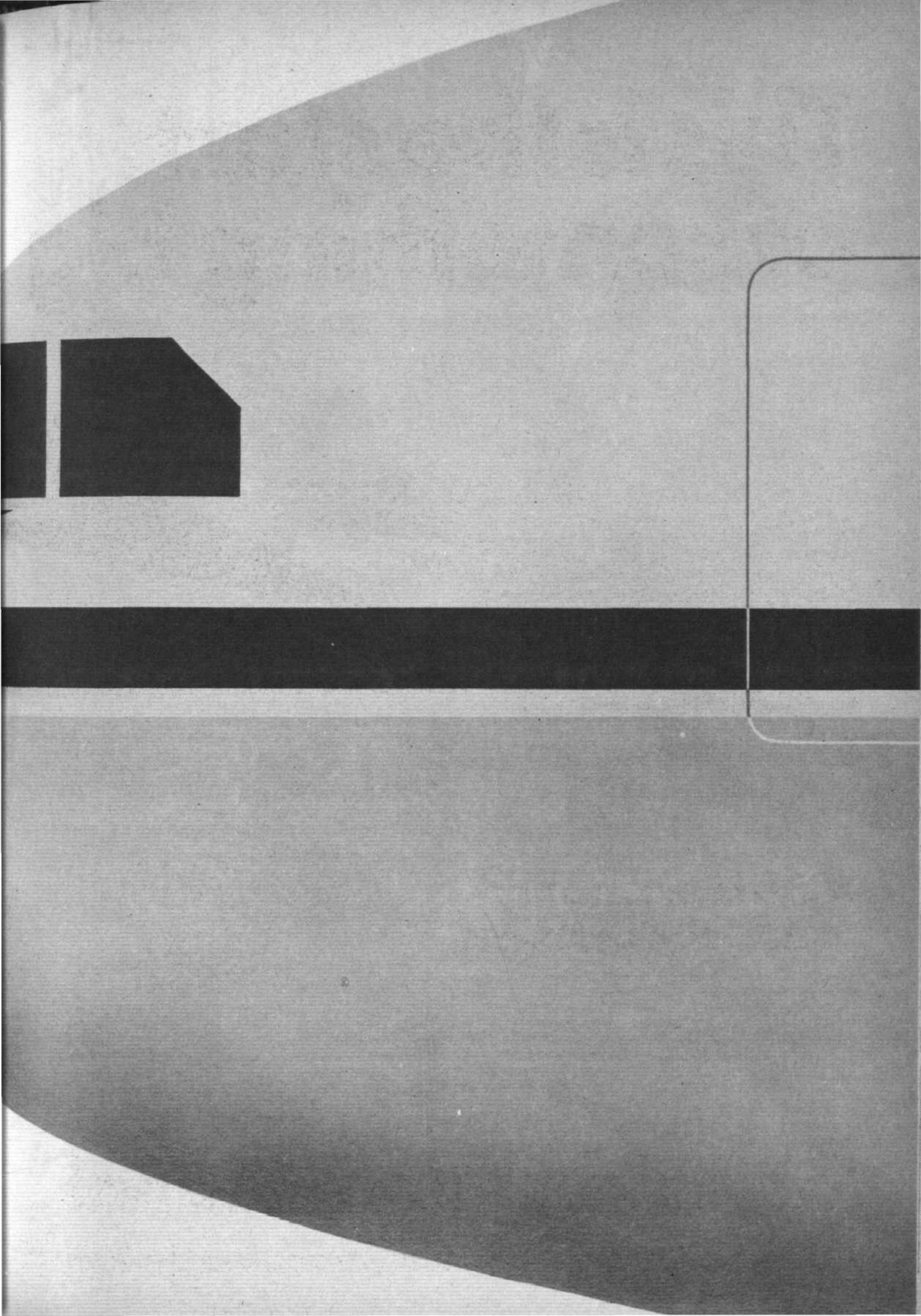

The Freedom Seeker

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About the quickest way to rise above the earth-bound traffic is inside a new Cessna F-150. It leaves the ground at 60 mph, cruises at 117 mph. And operating costs per mile are lower. But here's what owning a new F-150 really means . . .

More freedom weekends. The 400 mile-away fishing, skiing or festival weekend is no strain in a F-150. Because you own it, the cost of renting (and down-time charges) doesn't reduce your travel funds. Remember, two can fly for the price of one.

New freedom in '69. New inside and out, the Cessna F-150 has many improvements. A bigger panel with more room for a wider range of electronics. New ignition key starter. More leg room. New door seals, quieter cabin. And much more.

The extra pleasure of flying freedom is made possible by these Cessna F-150 advance design features:

HIGH-STABILITY WING for better control in rough air. PARA-LIFT FLAPS for optimum lift on quick takeoffs, slow flight and short field landings. LAND-O-MATIC GEAR for controlled shock absorption on landings, better directional stability on the ground. TWO DOORS as standard equipment. OMNI-VISION, 360° visibility of exclusive wraparound cabin window design. QUICK-SCAN INSTRUMENT PANEL with basic "T" arrangement of flight instruments and open-view control wheels. CUSHIONED POWER for quiet, smooth performance. 1800 hours between overhauls.

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More people buy Cessna airplanes than any other make

IATA MUNICH 1968

The four-day annual general meeting of the International Air Transport Association, the 24th in the series, opens next Monday, October 28. In this article IATA's former director general discusses objectively some of the criticisms which have been levelled at the association and the problems faced during the quarter-century of its existence, Means for helping the smaller airlines are examined in the article which follows on page 643.

What's wrong with IATA ?

By SIR WILLIAM HILDRED

WHAT IS WRONG with IATA? A good question. What is wrong with the United Nations? They are both run by human beings. Nothing run by human beings can be perfect. It can only do its best and look out for remedial faults, whether they hit you in the eye by personal experience or are brought to notice by a critic.

What was IATA asked to do, and how far has it fallen down on its job? IATA's founders and its Act of Parliament gave it three jobs—to promote safe, regular and economical air transport for the peoples of the world; to foster air commerce and study its problems; to provide means for collaboration among the air transport enterprises and to co-operate with ICAO and other international organisations.

Twenty-four years later it can be said that international air transport is safer than it was, though not yet safe enough; more regular than it was; and cheaper than it was. You can now fly the Atlantic for 3½d per passenger-mile. This is cheaper than US domestic travel, cheaper than intra-European travel and domestic UK travel. It has consistently studied the problems connected with air transport—financial, legal, technical, traffic and medical problems, problems of Government, public and agency relations. It has kept abreast of the technological problems of successive types of equipment and engines. It is closer than a brother to the Government organisation ICAO and is on the closest terms with international bodies such as the Universal Postal Union, the International Telecommunications Union, the World Meteorological Organisation, the International Atomic Energy Agency and the World Health Organisation.

I mention these *seriatim* because they, like IATA, are part of the international complex of effort which has grown up over the past few years, receiving a great impetus in 1945 when the United Nations Charter, based on a draft made by China, the USSR, the UK and the USA, came into being. In the light of today's events, it is worth looking at the four conspirators who made that draft.

Before looking for faults, it may be said that, broadly speaking, IATA has fulfilled its assignment—so far. When I first heard of the proposal to form IATA my initial question was: "Would it last?" An unknown number of international airlines, backed or frustrated by an unknown number of governments, were to get together and, amongst other things, unanimously agree on a worldwide pattern of passenger fares and cargo rates. There were many other things in the traffic field that they were expected to agree—e.g. worldwide conditions of carriage and uniform documents of carriage without which international air transport could not have got to first base. But the fares and rates complex was the first essential and the most important.

In November 1946, when IATA was less than a year old, Mr Wayne Parrish, one of its sternest and most objective critics, said that the real significance of the second annual general meeting was the bare fact that the association had continued to hold together. In a world torn by conflict and the deep wounds of war, it was encouraging that IATA members had resolved their differences, shown that decisions were compromises, and that no operator or group of operators could dominate. And this was written before the third a.g.m. in 1947, when the chairman of the composite conference at Rio, Mr. Gordon McGregor, stunned the membership into unanimous agreement on a hundred resolutions which still today form the basis of the commercial traffic structure of international air transport.

So far I haven't set down what is wrong with IATA but you cannot register faults without some idea of the start of the thing, its objective and its early difficulties.

At the start IATA was very careful about money. It had to be. No one knew how long it would last or whether it would give value for the membership dues. The early executive committee, as well as two of the senior officials, were a treasury-minded lot. One year, very early on, the secretary of one of IATA's leading committees put in a budget for his section which was a honey. It had been prepared at short notice and slipped past any preliminary examination of the treasury. Further, the secretary, in order to be helpful, had put a copy of it under the bedroom door of each of the members of the executive committee who looked after finance. When I had read it, I emerged somewhat hastily from my room. As I did so, bedroom doors along the hotel corridor opened and faces, betraying agitation, fury and alarm, appeared. Some grey, some choleric, some nearly blue: and a rectifying session was installed on the spot. Possibly it was a mistake to be so consistently treasury-minded in matters of finance and today a more affluent and easy style is called for. I'm not sure.

At any rate the infant IATA had to watch its step: it had critics in its own ranks, criticism from agents, from some of the Press, criticism from governments, and its hold on life in the early years was insecure. So it had to be careful—perhaps unduly careful. The American CAB only approved the vital traffic conference machinery for one year after the

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Anglo-American Bermuda bilateral agreement—one of the foundation stones of international air transport, of IATA and of much besides. That one year approval by the CAB of the traffic conference machinery reminded me of the man who met someone he disliked at a New Year's party. His friend said: "Go on, go and wish him a happy New Year." So he went over and said: "I wish you a happy New Year—but only one." In other words—drop dead.

Another fault which was perhaps characteristic of its early years was a somewhat defensive attitude towards governments. In working out its relationships with others, IATA had to remind itself that it was only a trade association, that it had to stand on its own feet and mind its own business. In particular, that each member had its own government behind him and it was each member's job to keep his own government informed. And governments varied in their attitude towards IATA. Some were content to leave matters to their own operator, some were indifferent, some were extremely interested and would have easily become involved. We decided that we would never be summoned by a government to wait upon them and explain our actions or our intentions. We would go along if we were invited; but an invitation was different from a summons. And perhaps this created the impression that we did not love governments: and to that extent we were perhaps mistaken. But we never forgot that governments had the last word; and we loved them.

And another mistake may have been the attitude in the early years towards the Press. But again the executive committee took the view that IATA's public relations job was to give full information to its own members and possible future members. They had little use for creating an image (I think that is the going word today) with the Press. They believed that IATA should concentrate on its job, keep in closest touch with its own members and not spend members' money on too much tub-thumping in the papers. But today it is customary to work hard at creating an image and to that extent IATA, earlier, may have to some extent fallen down. We did our best to make clear to the meanist intelligence that we were not a cartel. But today we are described in Anthony Sampson's *Anatomy of Britain* as the most formidable cartel in the world. Too bad.

Another mistake, perhaps, was in relations with agents. I took the view that agents were people who were offered a fixed commission for doing a professional job for airlines. I did not think it was necessary or expedient to have too much to do with the private affairs of agents provided that they met the stiff requirements of the agency agreement and agency resolution. Here I was inclined to be stiffer than the executive committee who, being in close touch with their traffic and sales organisations, realised that agents were responsible for 60 per cent of their bookings and that they were to be treated with every consideration. I believe today a more permissive attitude is taken and that the agents (who number some 18,000) will play a closer part in IATA matters. Here again we possibly made a mistake in being a little aloof, although, as in the case of governments, we felt that each airline should look after its own agents and represent IATA to them, and them to IATA.

IATA has made mistakes in the past but that does not necessarily mean there is anything much wrong with it. Various ways have been sought to mitigate the agony of over-long traffic conferences but their length flows from the determination of each delegate to fight his own corner and get the ensuing compromise nearer to his heart's desire.

And incidents like the long and ridiculous argument about North Atlantic sandwiches, the obstinacy which held up closed fares for weeks because of a rooted dislike of in-flight entertainment, the wrangle about sleeper surcharge, the constant trouble about 014A, the use of subsidiaries to run charters, the discount selling of tickets when business is not so good, the quarrels about seat pitch in tourist class, the self-defeating complexity of cargo rates—these things were mistakes, but they all flowed from the desire of delegates to protect their own interests and to fight for them to the last.

The panegyrics of Prime Ministers, Ministers of Transport and other dignitaries at annual general meetings were pleasant to hear and the real value of IATA is not in doubt. But a hard look for faults in an international body of all colours, creeds and ideologies is a good and necessary astringent—a catharsis and a challenge.

When all is said and done, let the introduction to the *Book of Common Prayer* have the last word, if you will pardon the expression: "There was never anything by the wit of man so well devised or so sure established which in continuance of time hath not been corrupted." IATA's job is so vital to the world that the human beings, who will hereafter run it, must see that IATA isn't.

So far it has always been impartial as between large and small, black and white, public and operator, government and government. Its impartiality and its unanimity roles are two of its sure foundation.

The Host Airline

THE NATIONAL FLAG CARRIER of the Federal Republic of Germany, Deutsche Lufthansa, the host airline for the 24th annual general meeting of IATA, began operations, initially over a domestic network, on April 1, 1955. But its pre-history began nearly 30 years before that date. The original Lufthansa was founded on January 6, 1926, and its winged crest originated with its predecessor, Deutsche Luft-Reederei, which started a primarily airmail service between Berlin and Weimar on February 6, 1919. The first services of the new Lufthansa, with Convair 340s, were followed on May 15, by the first external service to London, and on June 8 transatlantic operations were started with Super Constellations.

The formation of the new Lufthansa was primarily the work of Prof. Gerhard Höltje and Hans M. Bongers—who founded a trade advisory organisation, the famous Bongers Bureau, where the initial plans were drawn up. Both were, like Dr Kurt Weigelt, now honorary president of the airline, members of the pre-war Lufthansa. A preparatory organisation, known as Luftag, was formed in January 1953, to decide on such matters as the types of aircraft to be bought and the selection of flying staff. On August 6, 1954, the name Luftag was changed to Deutsche Lufthansa. When services were started the Federal Republic had not yet been given sovereign air rights, but the Allied High Commission granted special permission for domestic operations.

Prof Gerhard Höltje, who, as chief executive of the host airline, takes over the presidency of IATA, joined Lufthansa in April 1932. When the pre-war Lufthansa was closed down in 1945 he remained in touch with air transport by working as an engineer for the USAF at Berlin's Tempelhof Airport. In May 1951 he was one of the men who prepared the way for the revival of the airline, taking charge of technical matters with its predecessor, Luftag. Since the re-formation of Lufthansa he has been a member of the three-man executive board

Since then Lufthansa's growth has been as rapid as might have been expected—with traffic increasing from about 10 million revenue tonne-km in the first year, to 175 million in 1960, and 795 million in 1967. After operating on a subsidy basis through the first ten years—with the biggest losses in 1961, when the jet capacity was, as for many other airlines, too great—Lufthansa began to reach profitability in 1963-64.

"It is the new, longer-range aircraft, operating extended sectors, which can economically offer the lowest seat-mile costs . . . It is no longer a feature of smaller carriers that they use older equipment." LAN-Chile's Boeing 707-320B at New York Kennedy soon after delivery to the airline from Lufthansa last year

The Problem of the Small Carriers

By J. W. S. BRANCKER

THE POINT WAS MADE QUITE FORCIBLY at the last IATA annual general meeting that more attention should be devoted to the problems facing the smaller IATA airlines. This is indeed quite a natural attitude and, although it may not have been very strongly voiced before, there must be many carriers with the idea at the back of their minds. It is of course quite simple to pay lip service to the problem and to ensure that, within the structure of the association, the smaller carriers are given every opportunity to make their opinions heard and their views felt, but this of itself does not really solve the problem and it is necessary to examine some of the factors which control it.

Historically, it is worth remembering that until fairly recently it was extremely difficult for a small country to start its own national airline. This was partly due to the fact that expertise was not only in short supply but that it was concentrated in the larger and richer countries. It was also partly due to the fact that, except in a few rather rare cases, regular operations were not economically self-sustaining and consequently depended on subsidy for their existence. Few of the smaller countries were in fact able to bear the expense of anything in the nature of a major operation, nor at that time was there a great deal of political or social urgency to do so.

For these reasons, many small companies, some now very big indeed, were in practice started with the assistance of larger carriers. This action was not wholly altruistic because the major operator, in return for providing technical and financial assistance, expected the local carrier to act as a feeder line and to bring him traffic which might either not have travelled at all or would have gone by one of his competitors. While this idea worked to some extent, and was probably of mutual benefit to all concerned, it was not a situation which could hope to last for very long.

The smaller companies which had been brought into existence primarily to operate short feeder routes soon began to want a more prominent place in the scheme of things and were quite naturally anxious to take part in trunk-route operations when these were not too expensive, and when the financial risk could be limited by pooling agreements. The picture which emerged, therefore, was one in which the smaller carriers were in limited competition with the airlines they were intended to help. Subsequent political developments, bringing with them the emergence of a number of new independent national States, has accelerated progress along these lines.

Furthermore, the need for technical assistance from major carriers was reduced because aircraft themselves became more reliable and it was possible after the war to hire most of the expert assistance which was required without the necessity of going to another carrier. Quite naturally, the smaller national carriers were not content to operate only regional services and wanted to show their flags on the main air routes of the world.

The aircraft itself had become a very much more economic vehicle and consequently long-range operations did not demand quite such massive subsidies as formerly, although they did need a fairly large input of capital. But at this stage the main routes were already fairly thickly covered by the operations of the major carriers, many of whom felt that they had grandfather rights to the traffic moving on all sectors, and had paid fairly heavily for earlier development. Furthermore, although less expensive than before, operations were not exactly profitable, and potential traffic was relatively light, so that, once the post-war surge had died down, there was more than enough capacity.

The major carriers, having been in operation for a number of years and having secured a very appreciable share of the total traffic available, were able to mount relatively high frequencies and, consequently, were in a strong position to meet any new competition. This must always be one of the major problems encountered by the smaller carriers. Without the very considerable financial resources necessary to establish equality of frequency, getting a reasonable share of the market is inevitably difficult. In fact, the competitive situation must always favour the larger operator. This is not so much because of the ability to produce somewhat lower seat-mile costs by operating a larger fleet of aircraft, but also of the fact that a large volume of traffic and, consequently, high annual revenue figures make it possible to spend very much more on sales and advertising than the smaller carrier with his limited operation. There are certain routes, in fact, where limited frequencies cannot possibly stand the sales expenditure necessary to obtain a reasonable share of the market. It is significant, too, that in the case of the smaller carriers operating transatlantic services a very large proportion of their total advertising budget, in one case more than 50 per cent, is spent in the United States. This particular country presents definite problems and, in my opinion, there is a threshold of expenditure which must be passed before any real impact can be made. Some time ago I suggested that this figure was approximately $1 million per annum and I see that the same figure has been mentioned since. I suspect that the figure is higher now, except in special circumstances, although I appreciate that a number of carriers seem to survive effectively on less.

The sales problem is not so acute in other areas which may be served by small carriers, but the problem still exists to a greater or lesser degree. It must inevitably be difficult to win traffic from operators whose names have become household

"It would be difficult indeed to tamper with universal rules . . . but less harm would be done to competitors if smaller carriers were allowed . . . to be more generous in their production of such items as meals and drinks"

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words over a number of years, and whose services have attained a high degree of efficiency. Nor does the solution lie in any restriction of sales expenditure, which has been suggested as a means of improving airline economics, because this could only be done on a percentage basis and consequently might penalise small carriers more drastically than large ones.

Before going further in an examination of the difficulties which face the smaller carriers, and possible methods which might be used to solve them, it would be as well to find some kind of definition which can be used to decide what we are really talking about.

Some care is necessary in this respect because the international operations of some carriers are relatively small while they are, in fact, very large carriers indeed and certainly do not stand in need of any special assistance. Size, also, is a relative term in this context, so we might perhaps base the definition on the total number of international tonne-kilometres offered by a carrier expressed as a percentage of the world total—coupled with some limitation on the size of the organisation taking international and domestic operations together.

It is useful to note that, out of a membership of just over 100, 33 IATA airlines each produced in 1966 less than 50 million tonne-kilometres of capacity on regular international services. Collectively these 33 carriers provided less than 4 per cent of the total tonne-kilometre capacity generated by the total membership. But there are at least four carriers who can be withdrawn from this list because they either have considerable domestic services or, alternatively, have the backing of large non-scheduled operations, so cannot truly be considered small.

As this is a growing industry, many of the carriers in the 1966 list will have exceeded the figure of 50 million tonne-kilometres in 1969, but the proportion will remain much the same. Hence a small carrier can really be considered as one who produces less than this figure, with the qualification already mentioned. What is apparent, too, is that the total competitive impact of the small carriers may be very much less than that feared by the major operators, so there is less danger in giving them fairly generous treatment.

In some ways, the problem is similar to a small manufacturer trying to make a gap for himself in a very big industry. Here his domestic market may well be protected by special tariff barriers, but it must be emphasised that it is only the domestic market which can be treated in this fashion and consequently no similar system could be applied in the field of air transport where it is the international market which the small carriers are seeking to enter. In fact, carriers are already protected by cabotage restrictions against competition within their own territories.

It is easy, perhaps, to suggest that, because of these factors, smaller carriers should confine their activities to internal and regional services and should avoid the major international air routes, but this of course would in no way satisfy the political and social requirements of the countries concerned, however well-meaning such advice may be.

To some extent at least, protection is provided through bilateral agreements, but the degree to which this can be effective depends on a number of different circumstances which vary in every case. Although the form of these agreements tends to follow a standard pattern, each is completely individual in respect of the traffic rights which are granted. Brought down from the lofty pinnacle of diplomatic negotiations, they are in fact good examples of international horse-trading with each party doing its utmost to get what it wants for the smallest possible price in return.

Is this, perhaps, an area in which greater generosity might be shown by large countries, with fully developed major carriers, to smaller countries with less experienced and still-developing national carriers? Examination of this concept is worthwhile, but, before going further, two points must be stressed.

Firstly, this cannot be considered effectively in a regional context, although we will return to regional possibilities later, because almost every region contains both large and small carriers. It is true indeed that there are certain areas where there are groupings of preponderantly small carriers, but we are still faced with the fact that each bilateral agreement is reached separately. For many years now attempts have been made in South America to develop a bilateral philosophy which gave a degree of protection to local carriers, particularly in the realm of fifth-freedom traffic, against unlimited competition from carriers based outside South America. But many of the carriers enjoying this protection are far from small, and there is no special encouragement for developing organisations.

Revenue deprivation

The second point which must be made is that the present and future financies of even the major carriers are not so strong that they can afford to encourage any development which might deprive them of revenue. This needs some qualification. The economics of airline operation go sour primarily when planned capacity exceeds the traffic flow by too great a margin, so that the withdrawal of rights can prove financially painful to any carrier expecting to use them, and it would be difficult for any government, in negotiating a bilateral agreement, to accept conditions which imposed this fate on its carriers. But we are lucky to be in an industry where the overall volume of traffic available is expanding, so that the traffic carried by new operators is unlikely to reduce physically the traffic handled by existing carriers, although it may lessen their anticipated growth rate. In other words, if future capacity is planned in recognition of the share likely to be taken up by new carriers on any given route, the economic effects need not be harmful, although existing carriers may not be able to expand as rapidly as they had hoped.

But the question at issue, in the context of bilateral agreements, is whether a warmer place in the sun can be provided for smaller carriers through the process of bilateral agreements. Here there appear to be two courses open to further exploration.

One of these might be the application of predetermination of capacity in such a manner that a deliberate gap was provided in the pattern of third- and fourth-freedom traffic for the smaller carriers—and it is really this kind of traffic which we might consider first. In this sentence the word "might" must be stressed, because, apart from the fact that the principle of predetermination is very distasteful to some governments, it is by no means clear that this approach would be practical. If the predetermined capacity and frequency was held down to such an extent that traffic was unable to move on the airline of its choice and compelled to travel on the services of another operator, then this would not only be an unjustifiable restriction in the eyes of the public and would have an adverse effect on tourist potentials, but would lead to the unacceptable situation of actually reducing the revenue

earned by existing airlines. If, on the other hand, the capacity to be provided by either party was fixed generously, then the situation would be much as it is today, except for the fact that the system would be inherently inelastic and would be unable to take care of unforeseen traffic growth without inter-government negotiations and agreement. Moreover, negotiations would be made more complicated by the existence of transit services on which part of the capacity would have to be allocated to traffic moving to points beyond.

The only way in which this principle might be applied without severe drawbacks would be to accept some kind of flexible relationship between the frequencies and capacities offered by the airlines of each party. This might take the form of agreeing that the frequencies offered by one party should not exceed a prescribed figure until those offered by the other had also passed a certain figure, not necessarily the same. In order to avoid a perpetual imbalance, a time limit might be imposed after which each party would be free of any limitations. But even this method would be complicated, would lead to very prolonged negotiations, would be predicated to some extent on traffic forecasts which might not prove very accurate in practice, and would make it possible for one party to impede the natural development of the airlines of the other, if, for their own reasons, they did not wish to proceed so rapidly. It could, in certain circumstances, encourage inefficiency, and would leave countries accustomed to the multiple designation of carriers with the difficult task of having to set down artificial allocations of frequencies to their own carriers.

More liberal rights

It has, in fact, been suggested that capacities should be regulated by inter-carrier agreements reached through IATA. I fear that even if this approach were acceptable to all governments, which is more than unlikely, the task would prove altogether too formidable for any conference or series of conferences. If practicable and applied sufficiently far in advance—i.e., when aircraft were being ordered—such agreement might mitigate the general over-production of capacity, but it might in certain circumstances be more of a hindrance than a help to the smaller carriers.

Reverting to the context of bilateral agreements, an alternative concept might be to avoid the hazardous and complicated course of the predetermination of capacity, but for the nations with larger carriers to give more freedoms than they might be willing to do in normal circumstances, and ask for something rather less than complete equality in return. This might involve some sacrifice of principle, but not a great deal of cash. I have in mind the fairly liberal grant of third and fourth freedom points, together with fifth freedom rights which might mean a lot to a small carrier but not have a very major impact on a fully developed route network. This might be accompanied by more modest demands for fifth-freedom rights for their own carriers, where these greatly affected the third- and fourth-freedom traffic of the other party.

The concept presupposes that the smaller carrier concerned can grow in due course to fill a larger suit of clothes, and I see no reason why the imbalance of rights should be continued indefinitely. The revisions to take place in—let us say—three or four years, should be drawn up and accepted at the time the concessions are made, so that each party has a clear picture of what will happen in future, and bad feelings are avoided when a more normal state of affairs comes into being.

We must be clear that the success or otherwise of this idea must depend on the generosity of those countries who have rights to offer and are seeking rights themselves. It is an indeterminate approach, depending on goodwill, and it would be idle to pretend that it would be warmly welcomed by the larger carriers, who in the past have valued their fifth-freedom rights very highly. But it does seem to be the one practical way in which the bilateral system might be used to give temporary protection to the smaller carriers for the most critical period of their development.

Let us now examine the other methods more nearly related to the airlines themselves, which may meet the needs of the smaller carriers. They are, in fact, protected against price competitions on the part of larger carriers by the machinery of IATA itself. Nor can their special requirements be overridden or forgotten—or certainly should not be. They also get the benefit of the most advanced thinking in the industry from the work of the specialised committees. In fairness, it must be pointed out that much of this is provided at the expense of the larger carriers, who have produced the technical expertise and make their staff available. However, it must be faced that the benefits are also enjoyed by the major operators themselves, possibly even more so when questions of standardisation of procedures are under consideration. In this context it may well be that the smaller carriers feel they are being swept along in the wake of the big airlines, and compelled to accept, morally if not legally, procedures which do not take sufficient account of their particular needs or difficulties. Consequently, the apparent benefits appear in a negative light and membership of IATA involves the sacrifice of some degree of freedom for some degree of safety.

Much of this is inevitable in any association similar to IATA, but, quite apart from ensuring that their problems and opinions are given the same degree of attention as the larger members, which is essentially a question of organisation and care, some examination must be made of more positive methods of making sure that their interests are safeguarded.

Many years ago, "B"-class fares were approved by conference. These permitted what were essentially small carriers, then, to charge less than the agreed figures for flight on older aircraft over sectors which were also operated by trunk-route carriers using what was then very modern equipment. Is some up-dated system of "B"-class fares a device which should be examined again to see whether some system on these lines would remove immediate pressure and make survival easier? Here we are faced with an immediate and not very simple difficulty. Technical developments have produced a state of affairs where it is the new, longer-range aircraft, operating extended sectors, which can economically offer the lowest seat-mile costs. Even on shorter sectors, except where total traffic is very light and utilisation low, the newer aircraft types can operate more cheaply than obsolescent equipment, so that, if basic fares are set at the most favourable economic level for the public, it is unlikely that lower fares for older equipment can be gainfully applied on regular services. Furthermore, it is no longer a feature of smaller carriers that they use older equipment. Fare variations, moreover, unless tied to one of the more universally known conditions for lower rates, may merely add confusion without having any material effect on the revenue traffic carried.

There is also likely to be a considerable hostile reaction from other competitive carriers to differences in fare which are not very clearly tied to differences in the class of service offered and major differences of equipment. But, if we forget any question of preference in terms of fare levels applicable

"The smaller carriers do have an opportunity of filling this [personal contact] gap and attracting passengers who prefer being one of a few to being one of many." A scene at New York Kennedy during the July traffic pile-up

to smaller carriers, is there perhaps a case for relaxing the restrictions in their case, which govern the amenities made available to passengers, in order to let them express, if they wish, their own personalities more clearly? It would be difficult indeed to tamper with universal rules such as those covering baggage allowance and so on, but less harm would be done to competitors if smaller carriers were allowed to compensate for lower frequencies, etc, by being more generous in their production of such items as meals and drinks.

Again, such concessions need not be made on a permanent basis; the primary objective is to allow these carriers to establish themselves without too much pain, with the understanding that, once this has happened, they will be able to throw away their crutches and go along with the majority.

I have already mentioned the question of area grouping where circumstances make this advantageous, and perhaps this concept should be studied again with more emphasis on its use in the stimulation and protection of the smaller carriers. The first of such groups, the EARB, was established in Europe some years ago, with the defined objectives of ensuring a proper exchange of statistics, and carrying out joint studies of common problems. It was also intended to give unified airline advice to the ECAC and to consider the possible depredations of non-European carriers enjoying fifth-freedom traffic rights within Europe. Similar bodies have now been produced in the Middle East, Far East and recently in Africa. Although of a less formal nature, the operators in South America all take steps to exchange views on common problems.

Here a certain amount of care must be exercised. It would be unfortunate if development on these lines resulted in an IATA fractured on geographic lines. If there is one thing which air transport has shown, it is that the world is geographically one, and in the long run it would be a mistake to retreat from that concept. But if, by rationalisation and pooling when necessary, the smaller carriers can improve the economics of their regional operations, they will be better able to face the challenge of the longer and more difficult routes. Where this is politically possible, although not always easy, there is much to be said for joint operations in these circumstances, and one can point to a number of very successful examples—East African Airways, SAS and Air Afrique, among others. Such units cease very quickly to be small carriers, and can take their place effectively and proudly in the general world pattern.

But I must sound a warning against using area groupings too strongly as a defensive measure in the political and bilateral fields. This could easily prove an impediment to the proper and profitable development of air traffic and tourist traffic and could lead to retaliatory action ultimately harmful to all concerned. The objective must surely be to permit small carriers to take their rightful place in an expanding industry and not simply to try to preserve them by hobbling the competition.

There is perhaps one more step which might be taken within IATA to ensure that the views of small carriers are taken fully into account. While the co-ordination of the specific requirements of all carriers within certain geographic areas is certain to have a very much greater effect at traffic conferences than ideas set out by individual operators, there does seem to be a case for treating small carriers on a worldwide basis for more general issues. Might not IATA set up a small carriers council, consisting of some 16 representatives of carriers falling within this definition, which might meet once a year to discuss and to make known the special requirements of these carriers to the executive committee, the annual general meeting and, when necessary, to the composite traffic conference. This would at least provide an official sounding board and a channel for ideas which otherwise are in danger of being overlooked in the difficulties of settling major issues.

There is one particular channel open to smaller carriers which, if they exploit it persistently, must also contribute neatly to their success. It would, moreover, represent self-help of the right kind and would depend in no way on the generosity of competitors. However good their instructions the larger carriers are finding it unceasingly difficult to provide their customers with personal attention because there are too many of them. To some extent this is compensated for by rapid and reliable reservations systems and so on, but there is still the gap of personal contact. The smaller carriers do have an opportunity of filling this gap and attracting passengers who prefer being one of a few to being one of many.

But this does presuppose the employment of staff who are not only skilled but thoroughly experienced in providing the kind of service which selective customers expect. Staff may be fewer in number but they must be essentially better at their jobs than the employees of larger operators. And it must be clear that this standard must apply not only to cabin crew but to all ground staff with whom customers come in contact. It may not be easy, but it is a path worth following if the smaller carrier want a larger share of the cake.

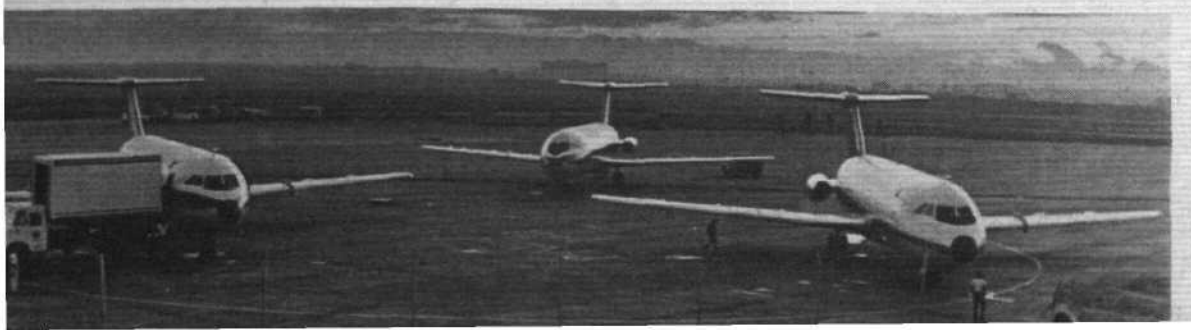
To summarise, I believe that one of the most important points in taking an intelligent attitude towards small carriers is the recognition, at all levels, that they exist. They certainly will not die or disappear because this might suit the bigger countries and the major operators. Furthermore, every route has two ends and it would be unfortunate for both the airlines and the public if protection took the form of restrictions and reprisals.

In my opinion, their particular needs cannot be met by a single universal procedure to be written down in black and white and considered to be law; what is required is an intelligent and reasonably liberal attitude on all fronts. While I believe that it would be impracticable to use predetermination of capacity as a useful protective measure, I think that the competitive position of smaller operators must be taken into account in reaching bilateral agreements. Special concessions can be limited in time, as can any special restraints on the rights accorded to major airlines.

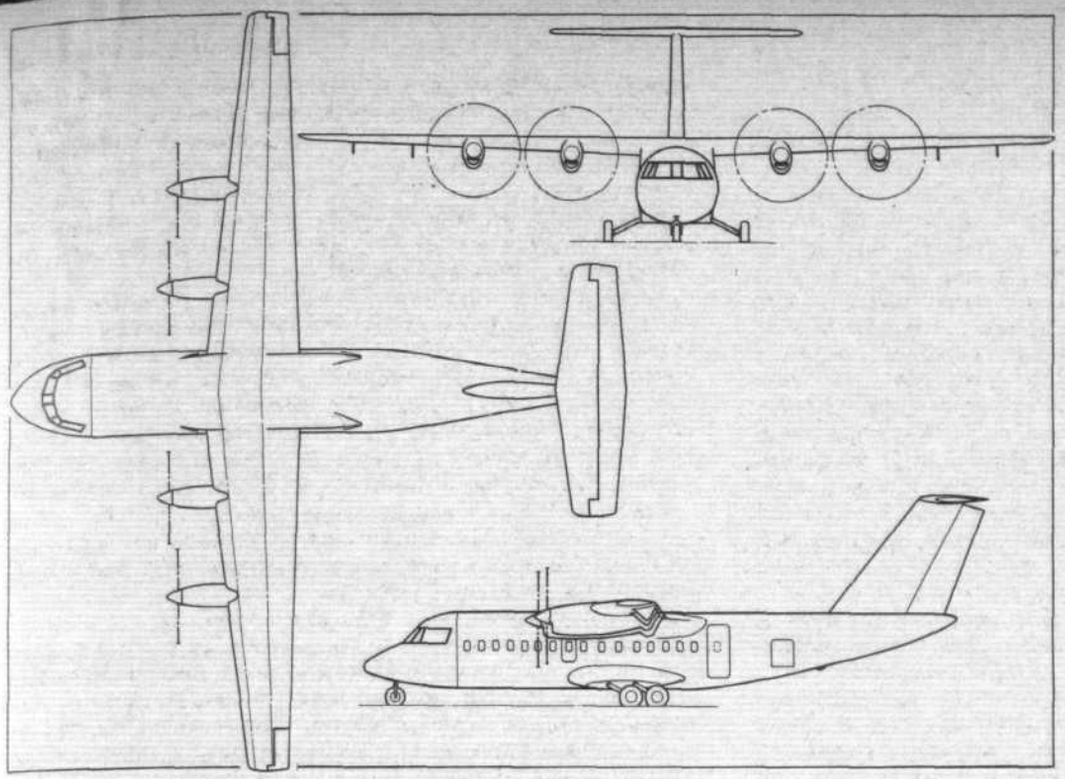
General fare concessions also appear to present difficulties, but there is probably some scope in the idea of permitting smaller, newer operators more freedom to follow their own inclinations in other directions on certain sectors and routes. To make sure that their special needs are appreciated by all concerned, I feel there is a good case for instituting a small carriers council in IATA where problems are discussed and brought to the notice of the appropriate committees and conferences.

And, finally, I think that the smaller carriers can help their own cause by using area organisations to rationalise regional operations and to provide the forum at which collective views can be produced for submission to traffic conferences and other committees. The possibility of joint operations should not be overlooked, particularly where this gives a stronger economic and competitive position.

Last and certainly not least, it must never be forgotten that some carriers, which appeared very small a relatively short time ago, are now certainly not so any longer—and are very prosperous besides. In other words, success is really there, and no one needs to be too downhearted.



The chairman of Philippine Air Lines and retiring president of IATA, Mr Benigno P. Toda, has long been a strong champion of the smaller airlines. Three of PAL's BAC One-Elevens are seen in this tailpiece picture



AIR TRANSPORT...

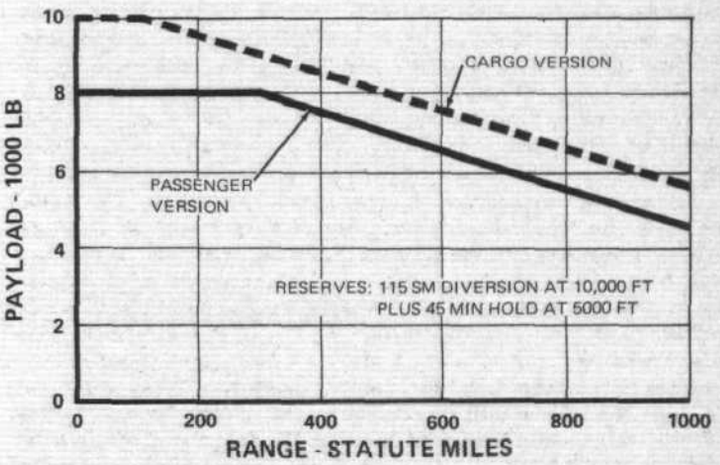
DHC's Four-engine STOL Project

EARLY next year the de Havilland Aircraft of Canada has to make a decision on whether or not to pursue its current new project, which is designated DHC-7. The company has issued a preliminary proposal for this four-engined aircraft which is described as a follow-on to the Twin Otter. Although as yet uncommitted to this particular configuration, the company could put the DHC-7 on the market in 1972 if the go-ahead is given.

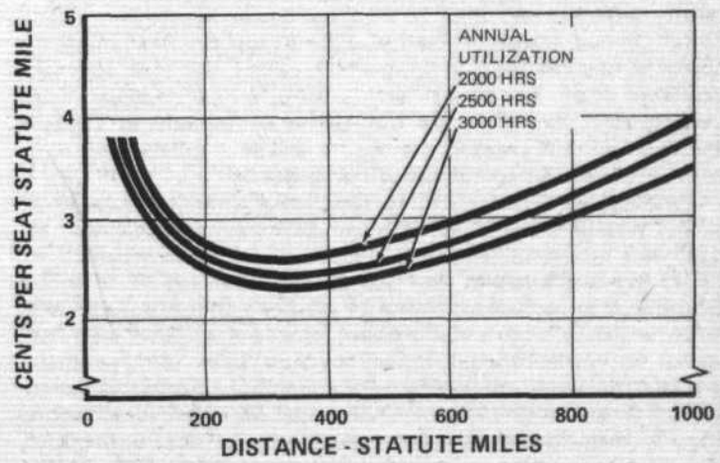
The company has been studying the possibility of building a successor to the Twin Otter for some time and has revealed some of its current thinking in the DHC-7 design. Increasing interest in STOL, as a means of alleviating air-traffic congestion and improving traffic flow in urban environments, has been a strong factor in influencing the concept of the new aircraft.

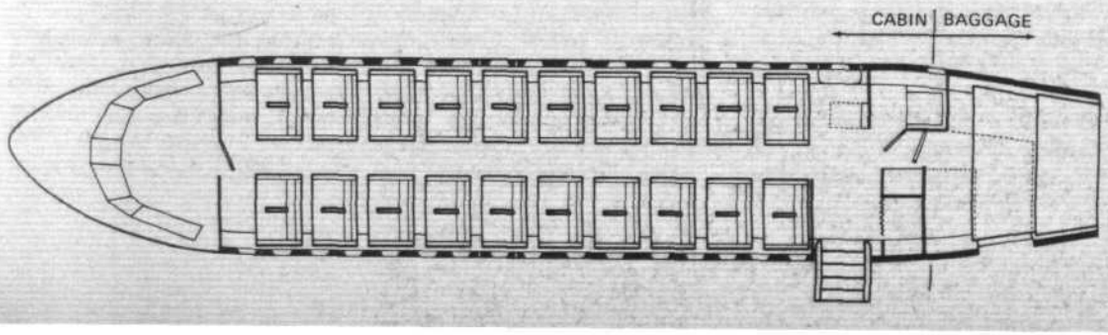
Launched as the "quiet" STOL airliner, the DHC-7 is to be designed to achieve a noise level of only 95 PNdb at a distance of 500ft—equivalent, the manufacturer says, to a "noisy kitchen." Two alternative turboprop engines are being evaluated at a take-off power of about 800 s.h.p. under sea-level 90°F conditions—the UAC Pratt & Whitney PT6A-50 and the Garrett AiResearch TPE 331.

Unfactored take-off and landing distances (at sea level, 90°F, gross weight 29,900lb, all engines operating) quoted for the design have enabled the company to envisage the use of small STOL airstrips close to terminal buildings at major airports, on top of city buildings, adjacent to small towns and cities where real-estate values are high and low noise levels are essential, and in small clearings alongside undeveloped working areas. The DHC-7, under these conditions, requires a take-



Payload-range and direct operating cost curves for the DHC-7 project





Standard 40-passenger layout of the DHC-7 with aft passenger airstairs

off ground roll of 1,200ft, or 1,600ft to clear 35ft, and a 650ft ground roll on landing, or 1,200ft from a height of 50ft. FAR Part 25 field size is 2,000ft, take-off gradient is 8½° (15 per cent), and approach gradient 7½° (13 per cent).

Standard interior arrangements are for 40 passengers. The cabin provides 76in headroom, 18in aisle width, and 32in pitch between the seats; it is fully air-conditioned and pressurised to a differential of 3.5lb/sq in. The baggage compartment is located behind the rear passenger airstair and entrance lobby and provides a volume of 250 cu ft. Racks facilitate sorting of baggage according to destination as it is loaded. Optional arrangements include an additional forward passenger airstair, and a passenger/cargo version with 29 passenger seats and a forward cargo compartment with a large forward cargo door.

The four propellers of the DHC-7 are designed for Beta control on the approach, and during landing and taxying. In this mode the pilot controls the pitch directly for responsive adjustment of the approach path and effective reverse thrust after touchdown. Dual 3,000lb/sq in hydraulic systems provide power for operating the brakes, nosewheel steering, flaps, spoilers and powered flying controls. Pneumatically operated rubber boots are fitted to the leading edges of the wing and tailplane. Propellers and windscreens are electrically heated. The fuel system comprises four integral tanks, two in each wing with single-point pressure refuelling. Tank capacity is sufficient for a range of 1,000 n.m. with IFR reserves. Primary d.c. power is provided by four 28V starter/generators of 250 amp capacity. Variable frequency a.c. power is used for electrical de-icing loads and for the fuel pumps. The simple fixed undercarriage has tandem mainwheels and a single steerable nosewheel. Stability in crosswind landings is aided by the wide track of the main undercarriage. Standard tyres are inflated to 75lb/sq in, but with optional oversize tyres this can be reduced to 45lb/sq in and the aircraft operated from unpaved runways.

Direct operating-cost estimates for the new aircraft are based on a review of actual operating experience with the Twin Otter and other turboprop transports. Trends from 1959 to 1968 have been projected forward to the year 1972. Calculations have assumed a fully equipped 40-passenger interior with IFR electronics and de-icing equipment. The crew would consist of captain, co-pilot and stewardess, and fuel cost would be at a rate of 10.5 cents per US gal. Airframe spares allowance would be 10 per cent and engine spares 25 per cent, with depreciation over 10 years to 20 per cent. Insurance rate is assumed as 3 per cent.

DHC-7 DATA

Dimensions: Span, 85ft; length, 70ft; height, 23ft 5in; wing area, 650 sq ft; mainwheel track, 14ft 6in; wheelbase, 31ft 5in; propeller diameter, 10ft 6in; cabin length, 400in; floor width, 86in; cabin volume, 1,600 cu ft.

Weights: Take-off, 29,870lb; payload (40 passengers and baggage) 8,000lb; fuel for 200 n.m. with IFR reserves, 2,900lb; operational weight empty, 18,970lb; empty weight, 15,700lb.

Performance: Max cruise speed, 235kt TAS at 5,000ft; service ceiling (three engines) 21,000ft; stalling speed with flaps, 58kt EAS; max stage length with 8,000lb payload, 200 n.m. (cruising at 5,000ft, fuel reserves include 100 n.m. plus 45min at cruise power at 5,000ft); max range (standard tanks, same reserves), 1,000 n.m.; en route rate of climb, ISA, sea level, 1,800ft/min (four engines) or 1,200ft/min (three engines); factored take-off and landing field length (including rejected take-off) ISA, sea level, 1,900ft, or 2,000ft on 90°F day; take-off climb gradient with take-off flap and power, 9.0° (16 per cent) four engines, or 5.5° (10 per cent) on three engines, ISA, and 8.5° (15 per cent) four engines, or 4.5° (8 per cent) on three engines, on a 90°F day.

TWO-AIRLINE SYSTEM EXAMINED

EVER SINCE the late Mr John Longhurst's *Nationalisation in Practise*—about the early years of the British airline corporations—was published in 1950, the impact of nationalisation on the airline industry has been a particular subject of study for those interested in the extension of public ownership in capitalist societies. It has also been fundamental, in many countries, to the growth of the airline industry itself.

Mr Longhurst looked at the background and initial development of BOAC and BEA in a period when there was no significant private sector in the UK airline industry. Although the industry has changed in this respect during the past 18 years, the fact that its future shape is now once again being re-examined (this time by the Edwards Committee) suggests that we are still groping our way towards a satisfactory long-term organisation for British air transport.

For this reason Mr Stanley Brogden's stimulating study* of the Australian airline industry is particularly well timed. He examines in considerable depth the historical factors which led up to the formation of the national owned TAA in 1946 and then explains very clearly how the Chifley Labour Government's intention to set up a nationalised monopoly airline was frustrated by constitutional difficulties and how the two-airline policy, originally quite unintended, emerged in its place.

Prof David Corbett in his *Politics and the Airlines*, published in 1965, argued the case for and against a "mixed economy" for air transport and reviewed accumulated experience in five leading air transport countries (including Australia) before concluding that it had strong arguments in its favour provided the growing irrelevance on nationalisation, as a basic political issue between Left and Right, was recognised and political pressures were prevented from interfering with healthy economic development.

Mr Brogden has been able to concentrate in his book, much more than Prof Corbett was able to do, on Australian experience, and this, combined with his intimate knowledge of the aviation industry, has enabled him to bring out much more clearly the important steps in the story since 1946 and the often complex technical influences on the main issues.

His treatment of the historical background is well-informed, although it contains a few errors. The Avro X was a version of the Fokker FVII/3m, not of the FVIIIB; although the DH.86 was a crucial technical miscalculation which had far-reaching consequences for the British aircraft industry, there were not five different types of all-metal airliner in production in other countries in 1933; the total production of DC-3 variants was 13,800, not 60,000; Ansett's Lockheed L.10 Electras surely cannot have averaged as much as 20hr per day.

ANA's gradual decline, from the 1941-46 period (when it made an alleged £3 million profit on a total revenue of £10.4 million) to the time in 1957 when the shipping interests behind the airline completed their withdrawal from the enterprise, is graphically explained. Ansett then came in, just in time to save the two-airline policy from complete failure. Since then, TAA's technical initiative, which had been so significant for the first ten years, has passed to Ansett-ANA and, although the industry has continued to set an example of efficient, safe and profitable operation, Mr Brogden shows how, in many respects, competition has become entirely artificial. Policy, so ably administered by Sir Donald Anderson and his department, seems to be over-preoccupied with maintaining levels of profit in the private sector sufficient to enable it to survive against TAA's several advantages.

One is left with the impression that the Australian system has much to commend it as a model for what might be attempted in the UK. However, some of the obvious weaknesses of Australia's airline policy—which Mr Brogden frankly exposes—must clearly be avoided if a really dynamic, yet stable, "mixed economy" industry is eventually to be achieved.

P.W.B.

**Australia's Two-Airline Policy* by Stanley Brogden, Melbourne University Press; the Cambridge University Press, 35s 6d.

Completely rebuilt at Coventry Airport, this Comper CLA 7 Swift G-ACTF is flying again for the first time in three years. Bill Woodhams, chairman of the Vintage Aircraft Group of the Popular Flying Association, rescued it "from a pile of firewood in the corner of a hangar." He hopes to fly it at Vintage Group functions next year

SPORT AND BUSINESS

Bad-visibility Accident The cause of the fatal accident to Cessna Centurion G-ASPO near Northampton on December 6 was the fact that, while turning at a low height in poor visibility, the pilot inadvertently allowed the aircraft to descend and strike the ground. This is stated in the Board of Trade report on the accident, published recently.*

The pilot had flown the 16 n.m. from a private strip to Cranfield, and he left Cranfield at 1657hr to return to the strip, which was illuminated for night landings. He did not, apparently, obtain a weather forecast before either flight. At 1700hr, just after his departure, the Cranfield ATC watch closed for the night. At 1710hr a controller at Sywell, which was closed, received a call from the pilot of G-ASPO to the effect that he could not locate the beacon on his landing strip. The controller received no impression that the pilot was in any trouble, and closed down the R/T at 1720hr. At about 1715hr a light aircraft was seen flying very low in heavy falling snow near the place at which the crashed aircraft was found the following morning. An aftercast gave the weather in the area at the time as rain and snow, with a ceiling of 700-1,000ft and a visibility of 600-1,200m.

Although the aircraft was reported missing at 2025hr, and although police cars searched the probable route and the BBC broadcast an appeal for information, it was not until 0930hr next morning that an air search revealed the wreckage.

The accident inquiry found that the pilot was inexperienced in night and instrument flying (he had flown 625hr by day and 9hr 40min by night, and he had had 10hr 50min Link trainer experience). The aircraft was equipped with VOR, ADF, ILS and DME.

On the flight to Cranfield, says the report, the weather had been good, and the pilot apparently expected little change for the return flight. "On this occasion he was extremely unlucky, and bad weather had unexpectedly entered the area from the north-west. . . . To encounter bad weather on a night cross-country flight can be particularly hazardous to pilots with limited night- and instrument-flying experience. Therefore it is always a wise precaution to 'check with the Met.'" Unable to return to Cranfield, it was likely that the pilot had been maintaining visual contact at time of the accident, while trying to decide his best course of action.

The report warns that area forecasts give only background information, and for cross-country flights more up-to-date information in the form of a flight forecast should be obtained. In the case in point, the morning's area forecast had not anticipated the weather deterioration.

**Report on the Accident to Cessna 210D Centurion G-ASPO near Rothersthorpe, Northampton on 6th December 1967.* HMSO, London; 2s 9d.

Diamant 16.5 Certificated The Diamant 16.5, second in the family of all-plastic sailplanes developed by the Swiss firm of Flug- und Fahrzeugwerke Altenrhein (FFA), has received its type certificate from the Swiss Air Office. Certification in other countries is expected to follow shortly. The designation 16.5 derives from the fact that the span of the sailplane measures 16.5m (54.2ft). The first member of the family, the 15m span Diamant 15, has been in service since April 1967, and a model with 18m span is also in the works. The length of all three models is 24.8ft, and all have a top speed of almost 170 m.p.h. All-up weight for the Diamant 16.5 is 770-900lb (depending on ballast), compared with 660lb for the Model 15 and 815-970lb for the Model 18.

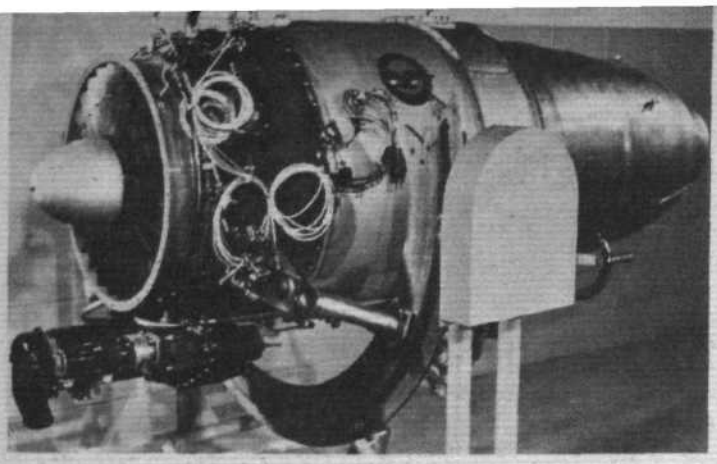
Elstree Still Busy Although the current surplus of commercial pilots in Britain is causing the London School of Flying, Elstree, to cut its commercial training by two-thirds, rumours that the school might close were emphatically denied last week by the managing director, Mr Robert Jaffe. He added that the private-pilot training side was busier than ever.

The run-down of the commercial side—described as a temporary measure—has meant redundancy for 18 of the 72 instructional staff. Negotiations have been going on for some time for a merger with another (unspecified) aviation company, in the interests of rationalisation.

The Popular Flying Association is arranging a charter flight to visit the Experimental Aircraft Association annual convention and fly-in next year at Rockford, Illinois. Initial seat cost has been quoted as £90 return but the organisers say this could be reduced if response is good. Those interested should contact the association at 2 Waldens Park Road, Horsell, Woking, Surrey.

Bahamas Treasure Britain's new air racing champion, Robert Ranscombe, from the Isle of Man, is to enter the Bahamas Flying Treasure Hunt on November 12. With all expenses paid, the trip is a prize accompanying the Bahamas Flying Trophy donated to the Royal Aero Club by the Bahamas Ministry of Tourism. Some 125 private pilots, mainly from the USA, will compete for the £10,000 prize—a plot of land on the islands. Piper is to provide a Cherokee for Mr Ranscombe, and Lord Kildare, managing director of CSE Aviation, is to provide the fuel.

Mr Ranscombe was presented with the new trophy by Mr S. N. Chib, Bahamas director of tourism, at a reception in London last week. Capt R. B. Damon of the Cinque Ports Flying Club is another entrant for the treasure hunt.



Flight development is continuing satisfactorily of the UAC JT15D turbofan, which is to be the powerplant of the Cessna Fanjet 500. It is also scheduled for installation in the Sabreliner 60, and possibly the Dassault Falcon

SPORT
AND
BUSINESS

CESSNA'S NEW BREED OF BUSINESS JET

TEN YEARS and 1,100 military jets after starting initial studies of the corporate market for turbine-powered aircraft, Cessna has come up with a design that promises to be the first of a completely new generation. There seems little doubt that by the introduction of its new Fanjet 500 (briefly described in *Flight* last week, page 610) which was formally unveiled in mock-up form at the recent National Business Aircraft Association convention at Houston, Texas, Cessna will open up a new and lucrative executive-jet market that will be quickly seized upon by rival manufacturers.

This small and relatively low-cost (target price $590,000 or about £246,000) six-passenger design is intended as a progression from the sophisticated and pressurised piston-engined twins such as the Cessna 421, now being widely sold. It is designed, however, with less demanding airfield and economic requirements in mind than the current range of business jets.

Although its basic price is similar to the current figure for the Learjet 24 (which excludes cabin furnishings) and is only $5,000 (about £2,080) less than the Jet Commander, in terms of its guaranteed 1972 cost it should then be the cheapest jet on the market. At the moment, it is just about three times the price of a fully equipped Cessna 421, to which it will have a similar capacity, wing loading and landing characteristics.

Handling qualities are also designed to be similar, so that the Cessna Fanjet can be operated with roughly the same level of pilot experience as something like the 421. Good low-speed qualities and short-field performance (balanced field length is 3,350ft) are inherent in the virtually straight wing, which is similar in section and construction to that of the Cessna T-37 jet trainer. The Fanjet 500, however, is far removed from Cessna's earlier business design study based closely on the T-37 and known as the Model 407.

Electrically operated single-slotted flaps help bring down the minimum flight speed to an estimated 79 knots, and with the hydraulically operated upper wing spoilers, permit a typical landing distance of less than 2,000ft to be achieved. Take-off safety speed will be about 8kt higher than in the Cessna 421 at 100kt CAS, but there will be little difference in approach speed at about 104kt.

Despite its low-speed emphasis, the Fanjet 500 has a design M_{MO} of 0.7 (V_{MO}=287kt CAS) not far removed from the present generation of bigger business jets. The range at maximum cruise thrust, too, is fairly close at around 1,085 n.m. with four people on board, or 682 n.m. with all eight seats filled. Total maximum fuel is 3,635lb, compared with the maximum gross of 9,500lb.

Power for the Fanjet 500 will be provided by two United Aircraft of Canada JT15D-1 front-fan twin-spool engines with full-length annular by-pass ducts. Initial take-off thrust is 2,200lb, by-pass ratio 3.2:1, s.f.c. is 0.504, and starting t.b.o. is 1,000hr. Only 50in long and with a diameter of 27.5in, the compact 480lb JT15D is installed in low fineness-ratio pods only slightly aft of centre on each side of the fuselage. This location should avoid the worst of the problems associated with rear-engined jets.

JT15D flight-testing has been in hand since late August, and the 50hr preliminary stage had been completed by the end of September. By that time, the first three engines had accumulated 500hr of test bed operation, and one had completed more than 270hr. Another 1,775hr had been spent on component rig testing. Beneath its CF-100 test bed, the first flight engine had run at up to 40,000ft and Mach 0.77, and had demonstrated an acceleration time of 3.2 seconds from flight-idle to take-off thrust. The engine development programme calls for flight-worthy prototypes (probably for the first Fanjet 500) by 1969, and for civil certification and production by 1971.

This should match the Fanjet 500 schedule, which is for initial flight trials towards the end of 1969, roll-out of the first production aircraft by the latter part of 1971, and first customer deliveries by January, 1972. Sales are expected to reach 1,000 in the first ten years.

Examination of the mock-up at Houston resulted in an initial impression of Learjet cabin size and compactness. Precise dimensions are 204in from front to rear bulkhead, 59.2in in width, and 52in in height. Entry is via an integral air-stair door which will be power-operated, and the standard interior layout comprises a rear bench seat for three forward of the 61 cu ft aft baggage area, two individual seats with a narrow aisle in the centre, and a corner seat opposite the door.

Cabin cross-section is circular to facilitate pressurisation to a 7.5lb/sq in pressure differential for optimum operation up to 35,000ft. Construction is of fail-safe design, with multiple load paths and low working stresses, and the Fanjet 500 will be certificated to FAR Part 25 for transport-category aircraft. Wing structure comprises two primary spars, an auxiliary spar with three fuselage attachment points, and the usual ribs and stringers.

Advanced features, such as vertical read-out and digital presentation, are evident in the cockpit mock-up, which also indicated rather bigger windows than in previous small jets. Front screens are bird-proofed. Instrument layout, which makes use of colour coding and peripheral vision techniques, includes a master caution warning set-up and annunciator panel, although Cessna philosophy is to keep Fanjet 500 systems as simple as possible in keeping with the rest of the aircraft.

All flight controls, for example, are manual, except for an electric elevator trimmer, and fuel management of the integral wing tanks is confined to a simple ON, OFF and CROSSFEED selection for each engine. Turbofan output is planned to be measured by a direct reading of thrust.

Sales of the Fanjet 500 will be handled by a new marketing division of Cessna, operating independently from the company's present commercial-aircraft distribution organisation. While acknowledging that its ten-year development plans to enter the business jet field were realised by the development of the JT15D, Cessna is only too aware that the existence of this engine is likely to spark off another executive-jet race. In this, however, Cessna has more than a head start, with only Dassault at the moment presenting an immediate challenge with its projected jet Hirondelle, either JT15D- or Larzac-powered.

Britain will have to move fast if it hopes to get a worthwhile piece of this new market, but there is still no sign of the long-awaited go-ahead from Rolls-Royce for development of the BS.358 light turbofan project. Hawker Siddeley has been toying with the HS.137 small executive jet study, which exists at Hatfield in mock-up form, for some time, but only Handley Page has signified its early intention of providing a UK challenge. This would be a pure-jet version of the Jetstream, which according to the president of the International Jetstream Corporation in Houston allows for a 5ft fuselage extension and the installation of rear-mounted jet pods. J.E.F.

Business Aircraft at Houston

BY JOHN FRICKER

IT WAS QUITE CLEAR from the 21st annual convention of the National Business Aircraft Association, held at Houston, Texas, on October 8-10, that whatever plateau there had been in world-wide executive-jet sales over the past year or so, future market prospects are now being assessed as optimistically as ever. Current orders and deliveries for business jets in North America, Europe and elsewhere now total well over 1,000 aircraft, of which nearly 90 per cent are already in operation. Planned improvements in all the present variants of executive jets are designed to maintain their competitive appeal against the anticipated demand into the 1970s, while a completely new generation of mini-jets was ceremoniously inaugurated at Houston with the presentation by Cessna of its new Fanjet 500 (see the opposite page).

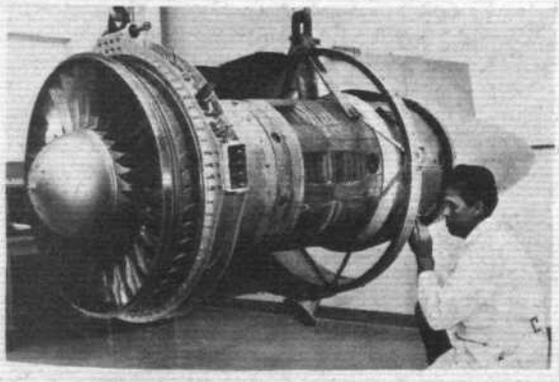
At the other end of the scale, a new trend in business-jet development was evident from the presentation by Boeing at Houston's William P. Hobby Airport of a magnificent corporate version of its 737 transport. This represented the current extreme of executive airliner adaptations evidenced at Houston by hardware or literature encompassing the Fairchild Hiller FH.227, the FH.228 (Fokker-built) and the McDonnell Douglas DC-9.

While new hardware is always one of the main attractions of its annual meeting, the NBAA is also concerned each year with discussions of wide issues of policy. This year a particularly difficult problem was presented for debate following FAA proposals to limit the movements of corporate and private aircraft at five major US airports (Kennedy, LaGuardia, Newark, O'Hare and Washington National) because of traffic congestion. Some limitation is already in effect, for example, at JFK, where a minimum movement fee of $25 (£10 8s) is charged for all non-airline aircraft, irrespective of size, during peak traffic periods in the morning and afternoon.

NBAA policy, as expressed in a nation-wide newspaper advertising campaign, is that general aviation should be accommodated at suitable secondary airfields whenever possible, but that some access must be maintained—particularly for business aircraft—to the major airports. The association decided at Houston that if all other means failed, it would seek a court injunction to prevent the FAA from extending restrictions on the use of the main US airports. It also refused to accept business aviation as a scapegoat for "alleged congestion problems."

To support this viewpoint, the NBAA has produced its own statistics, from daily records in the FAA control tower at Kennedy International, which show that general aviation movements there account for less than 6.5 per cent of the overall total. This compares with the claim by the Air Transport Association that general aviation comprised 55 per cent of the total activity at JFK between July 20-29 this year.

Whatever the true situation, it is obvious that improved planning and co-operation between the parties involved will



(Top) The Series 400 HS.125 at Houston. Main changes include a lower-drag fairing between the wing leading edge and fuselage. (Immediately above) Garrett AiResearch's new ATF-3 turbofan, which is believed to be the first three-shaft engine to run in the USA. (Right) With a body 12ft 4in wide to play with, the Boeing 737-200 Executive is the nearest thing yet to the flying boardroom

(Above) One of the five prototype Handley Page Jetstreams has been in the USA for several months on a demonstration tour with International Jetstream Corporation, which exhibited it at Houston. First US deliveries are expected before the end of this year. (Below) Production of the Garrett-engined Merlin 11B executive twin is continuing at the rate of four per month, and Swearingen expects to deliver a total of nearly 40 by the end of the year

SPORT AND BUSINESS

be required over the next few years, especially if the current FAA growth forecasts materialise. These envisage a 100 per cent increase in the present 110,000-strong US general aviation fleet within the next ten years, to nearly quarter of a million. Business-jet strength is expected almost to quadruple within the next five years, to a total of 3,850, and is forecast to reach 7,000 before 1979. By then, business jets are expected to outnumber airline jet equipment by 2:1.

To meet the challenge of the 1970s, most of the executive jets currently on the market are undergoing progressive refinement. Dassault, for example, is continuing flight development of its best-selling Falcon as a follow-on to the 1968 model, which introduced 4,250lb flat-rated CF700-2D turbofans, increased gross weight to 27,336lb, a step-up in M_{MO} from 0.85 to 0.88, and additional range. Main improvement in the Falcon 70 will be in short-field performance (700ft off balanced field length to 5,500ft) at a gross weight of 28,660lb, for which the necessary leading- and trailing-edge high-lift devices are already being flown in France. The required improvement in $C_{L\,MAX}$ has already been achieved with outboard leading-edge slats, which are now undergoing a refinement process.

Orders for the Falcon now total 200 from Pan American, which has options on a further 50, plus about 50 already delivered by Dassault to other customers. Up to the end of the NBAA show, some 157 Falcons had been delivered in all, including the 100th in North America (to Sangamo Electric in Houston, October 8). The US price for a fully-equipped Falcon, with furnishings and avionics, is around $1.4 million (about £584,000). Pan American has decided not to distribute Dassault's Hirondelle turboprop transport in North America, but instead will concentrate on the Falcon.

Hawker Siddeley showed for the first time the new Series 400 version of its highly successful 125 business jet, which still wears the DH label in the US. Features of the Series 400, which was displayed by Atlantic Aviation as distributor, include an outward-opening integral airstair door, resulting in 38 cu ft more baggage space in the cabin, which also gains 9in in length from reduced door width; suppressed VHF, VOR/loc and ADF aerials for improved appearance; a redesigned flight deck; better sound-proofing; and a reshaped ventral fairing forward of the wing for reduced drag. Structural changes in the Series 400 wing allow for a 500lb increase in take-off weight to 23,300lb, enabling maximum payload to be carried with full fuel. M_{MO} is 0.755, and maximum range with reserves, 1,530 n.m.

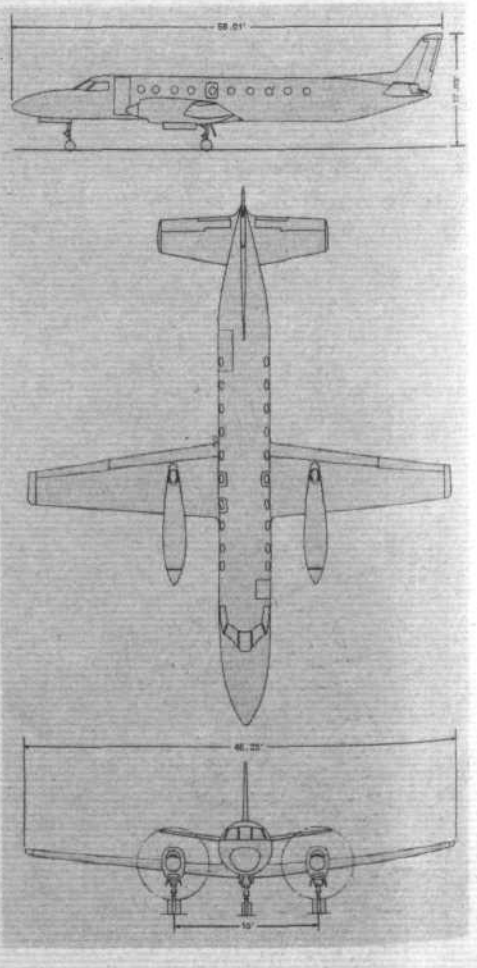
Box score for HS.125s ordered by early October totalled some 152, of which 90 were for North American customers. Basic US price of the Series 400 is $769,000 (about £320,000), or around $1 million (£416,000) equipped, depending on choice of interior layout and avionics.

In terms of business jets delivered, Gates Aviation currently leads the field with a total of 185 Learjets in service and 200 produced by the end of October. These include the original eight-seat Model 23, now replaced in production by the Model 24, and at least a dozen of the stretched ten-seat Model 25s. Recent improvements in the two current production Learjets include a reduction in FAA balanced field length under FAR 25 to 3,775ft for the Model 24, and 5,186ft for the Model 25. According to Gates, the Learjet 24 now has the shortest take-off requirement of any business jet, and can operate from nearly 3,000 airfields in the US. The new balanced field length for the Model 25 is said to place it within ten per cent of the runway requirements of al competitive business jets except the Model 24.

Further improvements in the smaller Learjet are expected from January 1 next, with the introduction of the Model 24B in production. The Learjet 24B (as reported in *Flight* last week) will have the 2,950lb GE610-6 turbojets of the Model 25 in place of the original 2,850lb -4 engines. Gross weight will increase by 500lb to 13,500lb, permitting up to three more passengers to be carried over long ranges. Various other improvements, in autopilot, anti-skid braking and all-weather equipment, will also be made. Equipped price of the Model 24B will increase to $790,000 (£329,000) compared with about $718,000 (about £299,000) for the earlier Model 24. Fully equipped cost of the Model 25, of which more than 20 should be delivered by the end of the year, is about $896,000 (about £373,000).

Continued on page 653

A three-view drawing of the Metro, the new joint Fairchild Hiller/Swearingen third-level airliner project



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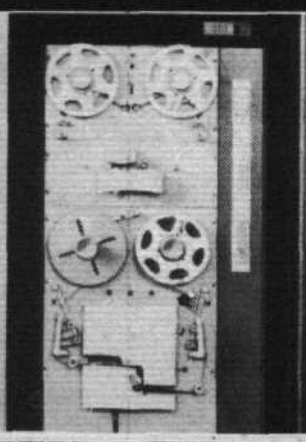
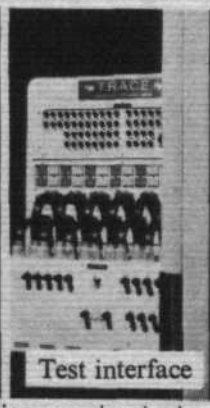



Unit under test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SPORT AND BUSINESS

Seen in front of the premises of the convention host organisation at Hobby International, Houston Executive Air Service Inc, are a Mooney Mitsubishi MU-2F and a Lycoming-powered Heron

As with the business jets competing with it, refinement of the Jet Commander is continuing alongside preparations to move the entire production line to Israel within the next few months, following completion in the USA of the 150th aircraft. Deadline for the move to Lod is January 1, 1969, and the first Israeli-built Jet Commanders are due to appear by July. Initially, the Israeli role will be confined to assembly, and US distribution will be unchanged through the existing four main outlets. Basic price is also expected to remain at its present $595,000 (about £248,000).

Development of the Jet Commander includes the installation of Fowler-type flaps on the 1121A, and the prospect of up-rated CJ610s for the 1121B and the projected Israeli 1122. The German HFB Hansa was also one of the business jets at Houston taking advantage of CJ610 development, and current versions are now using the 2,950lb -5 series engine to carry up to 12 passengers plus a crew of three, or 4,000lb of payload, for commuter operations. Production Hansas now have larger wheel brakes and heavy-duty tyres, and have a 5,500ft FAA balanced field length at 20,285lb gross weight.

Improvements now offered by North American Rockwell for its 10-seat Series 40 and 12-seat stretched Series 60 Sabreliners now include hydraulically operated thrust reversers weighing 160lb in all, which can reduce landing distances by up to 40 per cent on wet or icy runways. Both versions are now powered by 3,300lb Pratt & Whitney JT12A-8 turbojets in place of the earlier -6A engines, although NAR announced at Houston that the Sabreliner will be adapted to take the new Garrett AiResearch ATF-3 turbofan, in the 4,000-5,000lb thrust bracket. North American Rockwell has already placed orders worth $59 million (£24.6 million) with Garrett for the ATF-3, which can also be fitted retrospectively to all Series 60 Sabreliners.

First showing of the three-shaft ATF-3 at Houston revealed it to be an ingenious design, employing two axial spools supercharged by a centrifugal compressor at the rear of the engine. Compression ratios of 24:1 are thus achieved, together with a by-pass ration of 2.6:1, for a weight of 800-850lb. Cruise s.f.c. will be less than 0.7 at speeds of around Mach 0.8. Bench running began in May of the first two engines, and production deliveries are planned for 1970. The ATF-3 has integral thrust reversers, and is also being considered by Dassault for installation in the Falcon.

In standard form, the Sabreliner 40 sells for $1.145 million (about £477,000), fully equipped, compared with $1.285 million (about £535,000) for the Sabreliner 60. These prices exclude thrust reversers, which add $76,500 (about £31,900). To date, NAR has delivered 96 Sabreliner 40s and 30 -60s, with production continuing at about three per month.

Alongside the Sabreliner, Lockheed pioneered the US business jet field with its potent JetStar, which is still coming off the line at nearly two aircraft per month, with 125 completed to date. Since the 93rd aircraft, the JetStar has had JT12A-8 turbojets, and has a basic price of $1.65 million (about £687,000) or around $2 million (about £832,000) fully equipped. One of the latest customers is TWA, which has bought two JetStars for pilot training.

In the more exalted company of the costly business jets, Grumman now has 82 firm orders for its elegant Spey-powered Gulfstream II, at a cool $2.1 million (£875,000) per aircraft, without interior furnishings or avionics. More than 30 have been delivered to distributors to date for completion, at a rate of about three per month. Grumman is approaching the end of scheduled production of the turboprop Gulfstream I with the 200th aircraft, but may continue building this $1.3 to $1.4 million (£542,000 to £584,000) 12-16-seat luxury executive type on request.

For the present ultimate in business jet travel, of course, nothing is quite like the corporate Boeing 727-200, all $4.1 million (£1.7 million-plus) of which was on show at Hobby International. With 4,187 cu ft of cabin space to play with, the executive 737 lends itself to an unimaginable variety of interior layouts, and will lift a 5,000lb payload over more than 3,800 miles non-stop.

In the turboprop field, there were also many developments evident at Houston, which was attended, among other types, by Jetstream prototype G-ATXK. Shown by International Jetstream is currently talking in terms of about 40 orders, with- is normally used as a demonstrator from the Spirit of St Louis Airport, pending completion of type certification. International Jetstream is currently talking in terms of about 40 orders, without deposits, of the 65 aircraft to which it is committed, and first deliveries (to Sun Airlines of St Louis) are expected before the end of this year.

US cost of the Jetstream is around $450,000 (£187,500) basic, and predominant interest at the moment appears to be from third-level airlines. These are showing interest in a proposed growth version of the Jetstream, with Astazou XIVs up-rated to 940 e.s.h.p. and gross weight increased to 14,000lb. In addition to the 11 Garrett-engined Jetstreams on order, the USAF has an option on a further 300.

Having turned out 36 PT6A-20-powered Merlin IIAs and 23 TPE331-engined IIBs to date, using remanufactured Twin Bonanza wings and new pressurised fuselages, Swearingen Aircraft is now moving into the big time with a completely new turboprop design known as the Metro. Designed specifically for third-level or commuter airline operation, the Metro is being marketed by Fairchild Hiller, which will also undertake part of the construction programme.

Powered by two 840-895 e.s.h.p. AiResearch TPE331-303 engines, the Metro will accommodate 20 pasengers plus crew of two, and will cruise at 220-260kt, depending on required range, which will extend up to nearly 400 n.m. Take-off weight will be restricted to 12,500lb, and the Metro will have a field performance of less than 3,000ft. Prototype construction is in hand, and first flight is planned for May, 1969. Swearingen already has 15 firm orders for this $500,000 (£208,000) commuterliner.

Mooney is also marketing a stretched MU-2 next year, known as the MU-2G, with high-density seating for 8-12 people, and powered by 705 e.s.h.p. AiResearch TPE331-151A engines. To date, Mooney has sold more than 50 MU-2s in the USA, including 21 of the initial tip-tanked MU-2B (all delivered); 18 of the wet-winged MU-2D; and a dozen or so of the current MU-2F production model. This has similar powerplants to the MU-2G, in place of the 605 e.s.h.p. -25 engines of the earlier versions, increasing the cruising speed from 300 to 340 m.p.h. The MU-2F is claimed as the only turboprop in its class that can legally carry a full passenger load (seven-nine people), full baggage, full fuel and fly 1,550 miles within gross weight limits. US cost of the MU-2F, equipped, is around $372,000 (£155,000).

This compares with about $442,000 (£183,700) for the King Air, and an approximately similar price for the unpressurised Model 99 Commuterliner. Beech now has orders for more than 100 Model 99s, and expects to deliver more than 25 by the end of the year. A ten-seat executive version of the Model 99 was shown at Houston, priced at $460,000 (about £190,600).

Remmert-Werner is expecting good business with the Garrett-engined Short Skyvan, which is finishing certification flying at Phoenix, Arizona. The six or seven Skyyvans already operating in the US will probably be re-engined from Astazou to Garrett powerplants, and there is considerable commuter-airline interest in the new version.

More Sport and Business news on page 671

Letters

Beagle's Pup Production

SIR,—Hardly had I finished reading Doug Bianchi's unhappy letter (*Flight*, October 10) about Beagle "streamlining" when I was told of the latest "expansion" plans which for some peculiar reason require the sacking of 82 design staff. As Mr Peter Masefield has frequently told us that the Pup is a world-beater, and that is only the first of a whole range of Beagle types, I am at a loss to understand why a design-team capable of designing a world-beater is split up before producing more winners—or are they going to do this at Vero Beach?

It is rapidly becoming obvious that, unless Beagle pull their fingers out, the Pup and the British light aircraft industry (with the notable exception of Rollasons) will disappear into oblivion. During the last seven months Beagle have delivered about a dozen Pups. Perhaps Mr Norman Jones will provide the corresponding figures for the Condor? If Beagle can only manage to deliver two aircraft per month to civilian customers requiring virtualling standard production aircraft, what will be the delivery rate for any possible military order for a much-modified Pup? Assuming, of course, that an RAF contract is placed for the Pup as a subterfuge for injecting more of the taxpayers' money into Beagle.

Please, *please*, Beagle, get a move on with the Pup, and forget about those pipe-dreams of producing a stable-mate for the Basset. How about earning some dollars to pay for the dozens of Pipers, Cessnas and Beechs that Britain imports every month?

Reading, Berks E. T. WILSON

Noise-abatement Ideals

SIR,—Having read about Mr Masefield's call for "noise-abatement design" in the form of steeper approaches and climb-outs (pages 558-560, October 10), I was bewildered by the diagram of BAA's "idealised airport." Although each runway stretches less than half the length of a near-seven-mile-long airport, both approaches and climb-outs are mostly outside the boundary. Surely if the take-off runways were used for landings, and vice versa, then the first three miles of the climb and the last three of the appproach would be over the airport itself. Thus nobody living nearby would be flown over by aircraft at much less than 1,500ft.

Or is Mr Masefield, believing that noise abatement starts at home, worried about complaints from airport employees? Or—even less worthy thought—did somebody banjax the annotation of the runways on the diagram?

London NW3 GAVIN LYALL

Hawker Siddeley Hiatus?

SIR,—What has happened to Hawker Siddeley? All around them British companies are selling their civil aircraft like hot cakes: Handley Page the Jetstream, Beagle the Pup, Britten Norman the Islander, Shorts the Skyvan and BAC the One-Eleven. All these aircraft have sold well and continue to do so.

But Hawker Siddeley? The British end of the company can boast the 748, which has been in existence since 1960 and has had a constant battle against the very successful F-27/F-28 series and the now almost forgotten Herald. The Trident only seems to sell in quantity to BEA; this leaves the HS.125, which is again up against a great deal of competition. The Canadian end of the company, however, has its very-well-selling Twin Otter, which can hardly claim to have any British ingenuity built in. As for projects, there seem to be only the HS.136 and the Manchester equivalent, projects which have been talked about for a great number of years but seem no nearer hardware. So what is the company aiming at?

Buckhurst Hill, Essex G. W. STEWART-REED

Chin-on-chest Seating

SIR,—With reference to the letter from "Laser" (October 10), he will be interested, perhaps, to read—if he has not already read—a letter in the correspondence column of *Aviation Week* for October 7. One short extract will suffice: "The seats in Economy class [the writer complains] inflict excruciating discomfort because their upper part, above the height of the neck, tilts sharply forward so that the chin is pressed on the chest and the vertebræ of the neck are close to the modulus of fracture."

This is much the same complaint that "Laser" makes in the second paragraph of his letter. Not only on this specific point, but on the subject of aircraft seats in general, how heartily one endorses his opinions!

Dawlish, Devon W. H. BURBURY, *Wg Cdr, RAF (Retd)*

Hoskins' Hide-out Identified

SIR,—The early aeroplane depicted at the bottom of page 592 of *Flight* for October 10, the subject of Roger Bacon's humour that week, is of course, the Vendome monoplane of 1912 (French). Raoul Vendome built at least two types and the aircraft shown was known as the "military type." It was fitted with a 50 h.p. Gnome and weighed 440lb; beyond that I have no particulars.

How am I so certain? I happen to have the same picture.

Potters Bar, Herts A. H. CURTIS

SIR,—Roger Bacon's page in *Flight* for October 10 had a picture of an aeroplane, with outsize wheels, which he was unable to identify. It was known as the Vendome monoplane, and was French, of course.

It is unlikely that Hoskins would be hiding in it while in its folded form (or should I say "configuration" in these days?). The aeroplane flew about 55 years ago, and I should not think Hoskins was alive then.

Stroud, Glos R. C. MCLEOD

Hunter on Parade

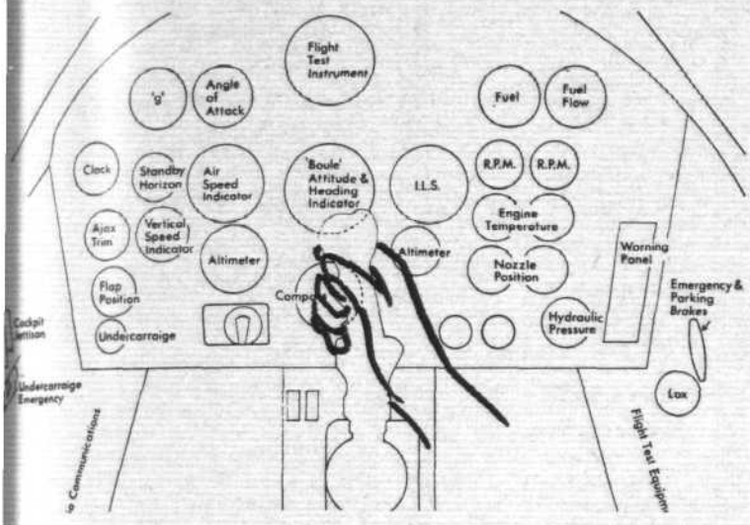
SIR,—I was very interested in the photograph (*Flight*, October 3), of the aircraft on Horse Guards Parade during Battle of Britain week, and I noted that the caption stated that a Hunter 6 was to be seen on display. This is incorrect, as it was in fact a Hunter F.4. WV398 (ex-7767M), previously with 20Sqn before going to 229 OCU. Later it went to the MU at St Athan, where I believe it is still kept. Thank you for publishing an excellent photograph of a very good collection of aircraft.

London N17 R. F. BUCHANAN

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

Hamfisted?

SIR,—Lovers of tradition will be pleased to see that the well-established British practice of hiding the compass behind the stick is being continued in the Anglo-French Jaguar trainer. Our representatives must have been very



skilful and persuasive in making the French agree to this practice.

I have added to the diagram from *Flight* of July 11 to show that even the slender, surgeon-like fingers of the average Gallic pilot will effectively obscure the compass heading. The steely RAF grip should make it even worse.

Singapore E. N. PALMER
Lt Cdr, RN

Refurbishing a B-25

SIR,—Seen in the accompanying photograph is the Mitchell N9089Z owned by the Historic Aircraft Museum at Southend and formerly used as the camera ship for the film *633 Squadron*. It has been fitted with a gun turret from a B-17, bringing it to RAF Mk III standard. Items still required are the original nose section, fuselage gun blister packs, waist gun assemblies and top fuselage deflector plates.

Work is, however, under way on re-spraying, as the photograph shows. When this work is completed the aircraft will bear the markings of HD368, with code A-VO of 98 Sqn, 2nd Tactical Air Force. The camouflage is of the period August 1943, when 98 Sqn was based at Dunsfold.

Southend-on-Sea, Essex L. P. MULLINS, *for Historic Aircraft Museum*

The Mitchell B-25 being re-sprayed at Southend (see letter above from Mr L. P. Mullins)

The Birth of Jet Propulsion

SIR,—The recent correspondence relating to the birth of jet propulsion has, I feel, highlighted a long-standing deficiency in the recording of engineering history which needs resolving.

Engineering developments (and I use this word deliberately as opposed to "inventions") have often been investigated initially by numerous engineers, sometimes of different nationalities, working independently and in total ignorance of each other's efforts. The basic layout of an aircraft gas turbine (whether for pure-jet application or to drive a propeller) was certainly clear to engineers other than Whittle, as Mr Hughes rightly shows in his letter (September 19). There was, however, much misunderstanding and underestimation of the extreme refinement of aerodynamic design required, particularly in the compressor and turbine stages. In this respect much credit for showing the way must go to the late Dr A. A. Griffith, whose classic report, *An Aerodynamic Theory of Turbine Design*, written in 1926 at the RAE Farnborough, stated for the first time the need for applying aerofoil theory to gas turbine blade design. Some subsequent wind tunnel experiments confirmed his predictions.

It is true that Griffith's early work was directed to the turboprop concept, but his theories had application to pure-jet layouts. If, as seems likely, the idea of using a gas turbine *for* jet propulsion had occurred to others before Whittle, then the work of Griffith and his associates assumes even greater significance.

To return, therefore, to the broad concept of engineering "invention." Can it thus be said that there are three types of claim which might be made? These would be: (1) For the first detailed suggestion for the application of a principle to a defined objective (e.g., Lorin, Roy, Whittle or some other claimant). (2) For the first statement of basic design criteria which ultimately make the objective possible (e.g., Griffith). (3) For the first conversion of theory into a practical prototype from which logical development can follow (e.g., Whittle).

To use, therefore, a current phrase—I'm backing Britain; at least in claiming for our jet engine development two out of my three criteria of "invention."

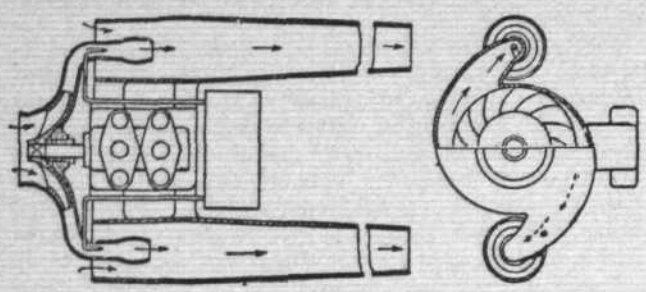
Farnborough, Hants CHARLES BURNET

SIR,—I was most interested to read the letter (October 3) from Mr Patrick Johnson, who must indeed be the very man who prepared the drawing for Sir Frank Whittle's first patent specification, a reproduction of which was published with my letter in the issue of September 19. Since coming across the paper by Maurice Roy, to which I drew attention (Letters, September 19), I have often wondered if Mr Johnson, as a trained patent agent and therefore familiar with the Patent Office Library, had ever seen the paper by Maurice Roy. Since this would be in the days before he became interested in jet propulsion or had even met Sir Frank, no doubt he would have just skipped through it at the most; but these may possibly have been some subconscious assimilation. The rest of the page containing the diagram referred to included eight other figures of variously more complicated arrangements, two of which were almost animal-like in appearance so that the whole page cannot help but impress itself upon the mind. Mr Roy evidently had a sense of humour!

Referring to Mr Johnson's claim that Sir Frank Whittle's efforts resulted in the first *successful* jet aeroplane, what was there technically unsuccessful about an aircraft which "flew . . . at over 500 m.p.h. a number of times" (He178), or "the first twin-engined jet-powered plane ever to fly—this happened on April 5, 1941, 40 days before the single-engined Gloster-Whittle E.28/39 jet aircraft flew" (He280), which outmanœuvred the FW190 in direct competition? [The quotations are from *He1000*, by the late Ernst Heinkel, published by Hutchinson].

I enclose another diagram, this one originating from a

LETTERS...



In the Harris patent of 1917 the compressor was driven by a two-cylinder piston engine (see letter from Mr P. Hughes)

patent taken out by a Dr H. S. Harris of Esher in 1917. Certain elements are common with Maurice Roy's scheme, and again one can discern a graphical resemblance. It is almost as if Roy had merely replaced the reciprocating engine by a gas turbine, and apart from eliminating the ejector ducts and straightening the back of the impeller, left everything else as it was. Even the elbow in the fuel injection pipe is the same. Perhaps this is indeed another stage in the geneology of the centrifugal turbojet.

Harpenden, Herts P. M. HUGHES

SIR,—Mr Patrick Johnson's letter (October 3) on the birth of the jet engine recalls an interview I had with the great Sir Charles Parsons nearly 50 years ago. Trying to get him off his pet subject—the provision of light, efficient artificial limbs for the maimed—I asked what had led him to invent the steam turbine.

"I did not invent the steam turbine," he said mildly, "I just made it work."

London EC4 ALAN TOMKINS

Song of Iraq

SIR,—May I, through your columns, thank those scores of readers who responded to my recent appeal for the words of the old Service song *Ballad of Suleiman?* It would be a monumental task to acknowledge each one individually, and would no doubt prompt the GPO to introduce even more postal class discrimination!

Preston, Lancs J. R. BUSHBY

The Colditz Prisoners

SIR,—I was much interested to read "The Colditz Cock" in your issue of September 26. Mr Latimer-Needham has written a most interesting article and I congratulate you on getting so able a person to write it for you.

Below is a list of names of people in the photograph as far as my memory goes. I still hope to fill in the gaps with help from Bill Goldfinch, Geoff Wardle and others. Unfortunately, neither Tony Rolt nor David Walker is in the photograph, as they had not at that time arrived in the camp.

Back row, standing on wall :—
(1) J. W. Best, RAFVR
(2) L. J. E. Goldfinch, RAFVR
(3) — Crawford
(4) C. H. S. Cope
(5) I. S. Price
(6) C. J. Elwell
(7) G. Scourfield-Davies
(8) — Flynn, RAF
(9) D. Bruce, RAF
(10) ——
(11) H. Bruce
(12) ——
(13) A. Cheetham, RN
(14) H. E. E. Barton
(15) W. A. Millar
(16) P. D. Storie-Pugh
(17) T. Elliot
(18) T. Catlow, RN
(19) J. F. Watton
(20) E. M. Harvey, RN
(21) M. W. Donaldson, RAF

Standing on ground :—
(44) ——
(45) The Rev. J. E. Platt
(46) ——
(47) ——
(48) R. Barnett, RN
(49) K. Lockwood
(50) C. Lewthaite
(51) G. M. Pemberton-How
(52) W. L. B. O'Hara
(53) — Moran, RNR
(54) D. J. Rogers
(55) W. Elstob, RN
(56) G. Keats, RNVR
(57) D. E. Bartlett
(58) G. W. A. Courtice
(59) R. V. Colt
(60) P. Dickenson, RAFVR
(61) V. Parker, RAF
(62) G. Romilly
(63) J. Yule
(64) A. Campbell
(65) — Middleton, RAF
(66) J. Zafouk, RAF

Sitting on wall :—
(22) Geoffrey Ransom
(23) A. Orr-Ewing
(24) M. B. Bissell
(25) R. J. Hyde-Thompson
(26) C. D. McKenzie
(27) G. Wardle, RN
(28) ——
(29) ——
(30) ——
(31) D. Van Rood, RAFVR
(32) E. Champion, RNR
(33) ——
(34) R. Harrison
(35) J. R. Boustead
(36) D. Gill
(37) W. T. Lawton
(38) R. H. Howe
(39) The Rev. R. G. Herd
(40) D. Halifax, RAF
(41) — Davis, RN
(42) R. R. F. T. Barry
(43) K. Milne, RAF

Sitting on benches :—
(67) H. A. V. Elliot
(68) ——
(69) W. F. Anderson
(70) R. A. Milne
(71) T. Kimber
(72) G. Stevenson, RAF
(73) D. Bader, RAF
(74) D. S. Stayner (senior British officer)
(75) G. A. D. Young
(76) ——
(77) ——
(78) D. W. A. Cleeve
(79) M. L. MacColm, RAF
(80) C. E. S. Lockett, RAF
(81) R. Holroyd

Sitting on ground :—
(82) D. Thom, RAF
(83) H. Gee
(84) N. C. Forbes, RAFVR
(85) T. Beets, RN
(86) — Ferguson
(87-96) Orderlies

Leominster, Herefordshire J. W. BEST

SIR,—In the article "The Colditz Cock" you invited identification of the officers on the photograph. Among the officers are the only two civilian PoWs at Colditz—Howard Gee (second right, front row, light coloured trousers) and Giles Romilly (nephew of the late Sir Winston Churchill) who is standing in the third row from the front, fourth from left end.

The story (and photographs) of Gee and Romilly can be found in the book *Colditz*, by Reinhold Eggers, on pages 38 and 65 respectively. This was my source of information; I have just read the book myself, and compared the photographs with those in the group photograph in *Flight*.

Pudsey, Yorks A. V. EVANS

The Colditz PoW group photograph referred to in two letters above

BRITAIN'S AIRLINE INDUSTRY

Company-by-company information on the scheduled and non-scheduled carriers

Traffic figures tabulated, pages 660-661, 662; air taxi operators, page 665; financial results, pages 665-666

Air Holdings Ltd was incorporated in 1961 as an investment holding company. Although it divested itself of some of its air transport interests during 1968, it remains the parent company of British Air Ferries. It is also the parent company of Airspray (EA), Airspray (Tanzania), Airwork Services, Aviation Traders (Engineering), Canaries Hotels, Exeter Airport, Fairways Travel & Ticket Agency, Leroy Tours, Lyons Tours, Olley Travel Service, Safe Air and Whitehall Travel. In 1968 Air Holdings ordered 50 Lockheed L-1011s and was awarded the franchise to re-sell them outside the USA. Shareholders are British & Commonwealth Shipping Co (Aviation) (45.9 per cent), Furness Withy & Co (20 per cent), P & O Steam Navigation Co (20 per cent), Broadminster Nominees (8.1 per cent), and Eagle Star Insurance (6 per cent).

Head Office: Portland House, Stag Place, London SW1. T: 01-842 9477.

Executives: directors, Sir Errington Keville (chairman), Sir Nicholas Cayzer (deputy chairman), R. L. Cumming (managing), Sir Donald Anderson, F. A. Bishop, J. A. MacConochie, Sir Brian Mountain.

Autair International Airways Ltd has expanded rapidly since it first started airline operations in 1960 as a development of the helicopter work started in 1954 by the company of a similar name. Autair is now a member of the Court Line group of companies and holds licences to operate a range of domestic and European scheduled services. The company's main base is at Luton Airport, where it has engineering facilities to carry out all maintenance and overhaul work on its own aircraft and, in addition, undertakes contract maintenance on the aircraft of other operators. From Luton scheduled services are operated to Blackpool, Carlisle, Hull and Tees-side. Summer services also link Hull and Jersey and Blackpool.

In 1968 Dundee was added to the domestic destinations served from Luton. Other new routes served to Amsterdam from Hull and Tees-side, to Dublin and Belfast from Tees-side, to Jersey from Carlisle, Dundee and Tees-side and to the Isle of Man from Dundee, Hull and Tees-side. A wide range of inclusive-tour services are also operated from Luton by Autair, and both passenger and cargo charters are regularly undertaken. Many of the airline's operations are in close association with Clarksons Tours. It is planned to introduce two One-Eleven 400s in spring, 1969, bringing the number of 400s operated to five, and to introduce five One-Eleven 500s in spring, 1970. An option has been taken on three further 500s. Autair's future policies envisage a growth in all its operations and it has managed to develop a route network linking centres not previously well served by air transport.

Head Office: North London Air Terminal, 202-204 Finchley Road, London NW3. T: Swiss Cottage 4425.

Executives: directors: J. R. Young; chairman G. H. G. Threlfall, deputy chairman; E. J. Posey, managing director and chief executive; W. H. Armstrong; T. S. Buxton, technical; Capt M. Rowan, operations; G. H. Bond; manager, administration, B. W. Davis; sales manager, P. C. Dorrington; chief pilot, Capt C. P. C. Dibley.

Employees: 500.

Fleet: three BAC One-Eleven 400s, three HP Dart Heralds, two HS.748s; on order, two One-Eleven 400s, five One-Eleven 500s.

Aurigny Air Services Ltd is a subsidiary of Glos-Air (see the list of air-taxi operators) formed early this year to operate services within the Channel Islands and to the French mainland. Its operating base is at Alderney Airport.

Head Office: Staverton Airport, Cheltenham, Glos. T: 045271-3385.

Executives: chairman, Sir Derrick Bailey; managing director, C. Poole; general manager, F. Morton; chief pilot, Capt H. R. Lane.

Fleet: three BN-2A; six BN-2A under delivery.

British Air Services Ltd is a company reconstructed in 1967 for the purpose of acting as holding company for BKS Air Transport Ltd and Cambrian Airways Ltd (*q.v.*). These two companies are wholly-owned subsidiaries of BAS; the issued share capital of BAS (£1 million in ordinary 5s shares) is 70 per cent owned by BEA, and the remaining 30 per cent is held by the former BKS and Cambrian shareholders (other than BEA). The purpose of this reorganisation was to improve the financial strength of BKS and Cambrian, while at the same time ensuring that their autonomy as two of the country's leading regional airlines was maintained.

Head Office: Seymour Mews House, Seymour Mews, London W1. T: 01-486 4736.

Executives: chairman and managing director, A. C. Ping.

Fleet: on order, two HS Trident 1Es for use by BKS.

BEA Helicopters Ltd was formed on January 1, 1964, to take over and expand the State airline's VTOL activities; it is a wholly owned subsidiary of the corporation. BEA Helicopters can look back on 21 years of helicopter development since the BEA helicopter unit was established in 1947. It was the extensive pioneering work

BEA has begun the introduction of its new livery, seen here on a Trident 2

A Super VC10 of BOAC over the English Channel. The airline is planning to extend VC10 services from the US West Coast across the Pacific next year

BRITAIN'S AIRLINE INDUSTRY . . .

of the unit which enabled the company to start off from the beginning with operations to full airline standards in all weathers as it does with its 26-seat Sikorsky S-16Ns. Present operations are centred on a scheduled service between Penzance and the Scilly Isles and contract charter work for oil companies working in the North Sea. In less than three years the scheduled operation has doubled the traffic to the Scillies, a route formerly flown by fixed-wing aircraft, and broken-even financially without any subsidy. The company has been successful in attracting winter cargo traffic to help reduce the effect of the very seasonal nature of passenger traffic between the Scillies and the mainland.

By using the S-61N the company has been able to offer a service to many oil companies. This work is conducted to full public-transport standards and four aircraft are permanently assigned to the North Sea operations. The company's main base is at Gatwick Airport, London, where there are engineering facilities and administrative offices.

Head Office: Gatwick Airport, Horley, Surrey. T: 01-283 8711.

Executives: chairman, Capt J. W. G. James; general manager, Capt J. A. Cameron; assistant general manager, Capt D. Pritchard; fleet manager, Capt D. Eastwood; secretary, R. D. Keefe.

Employees: 139.

Fleet: five Sikorsky S-61N, one Agusta Bell JetRanger.

British Eagle International Airlines Ltd can trace its origins back almost 20 years to the formation of Eagle Aviation Ltd in 1948. In that time, under the leadership of the present chairman, it has grown from a £100 company into a major international airline. In 1953 Eagle Airways Ltd was formed to operate scheduled services; the Cunard Steam-Ship Company acquired the entire share capital of this company in 1960. The name was then changed to Cunard Eagle Airways and Boeing 707s were bought for use on the North Atlantic route. However, the first appearance of Boeings in Eagle livery was of short duration as when BOAC-Cunard was formed in 1962 the new company took over Eagle's Atlantic services and also those of its Bermuda and Bahamas subsidiaries. The airline took on its present title in 1963 after Mr Harold Bamberg and associates reacquired 60 per cent of the company from Cunard. They recently bought Cunard's remaining 40 per cent interest. In 1963 Starways were taken over and became British Eagle (Liverpool) Ltd.

Present operations are centred on London Heathrow Airport where the company has a large base with engineering, training and administrative facilities. From London, domestic scheduled services are operated to Glasgow, Chester and Liverpool mainly with BAC One-Elevens. Other domestic routes are Newquay to Birmingham, Glasgow, Liverpool, London and Manchester and Liverpool to Glasgow. International routes from London go to Luxembourg, Stuttgart, Tunis, Djerba, Dinard, La Baule, Innsbruck, Pisa/Florence, Rimini and Perpignan. Frankfurt, Palma, Rimini, Ostend and Cork are served from Liverpool; Frankfurt, Ostend and Rimini from Manchester; and Palma is linked with Birmingham.

Inclusive-tour and charter services comprise a large part of Eagle's business. British Eagle's all-turbine fleet includes BAC One-Elevens, Viscounts, Britannias and Boeing 707s. The company operates long-haul inclusive-tour flights to Bermuda and Bahamas and to East Africa.

Head Office: British Eagle House, 50-51 Conduit Street, London W1. T: 01-437 6933.

Executives: chairman and managing director, H. R. Bamberg; deputy chairman, AVM Sir Patrick Dunn; chief executive/director, B. M. Williams; directors, N. Ashton Hill, F. F. A. Burden, Prof Roland Smith, H. P. Snelling, D. A. Haslegrave. General managers: marketing, N. Thompson; commercial, G. B. Greaves; scheduled services, S. E. Hoare; production, I. Grant; maintenance, J. Clacher. Planning manager, A. J. Tame; company secretary/senior solicitor, T. Keane; chief accountant, D. Beese.

Employees: 2,300.

Fleet: three Boeing 707s, five BAC One-Elevens, 14 Britannias, three Viscounts.

A Caledonian Airways Boeing 707-320C. The airline is developing transatlantic charter and inclusive-tour operations

Britannia Airways became the second European operator of the Boeing 737 this summer. The airline's first aircraft is seen at Dubrovnik

BKS Air Transport Ltd, a member of the British Air Services Group, operates a fleet of Britannia and Viscount aircraft on a network of scheduled services within Great Britain and to the Continent of Europe. Over 600,000 passengers and some five million kilos of air cargo are carried annually on scheduled services. The network comprises some 30 domestic and international routes. BKS also operates a network of inclusive-tour services on behalf of nationally-known tour operators to destinations in Italy, Yugoslavia, Portugal, Spain and other Mediterranean areas.

The company was founded in February, 1952, the name being based on the surname initials of the three founder directors, J. W. Barnby, T. D. Keegan and C. J. Stevens. In the early days BKS operated seasonal holiday services from the North of England, using DC-3 and Viking aircraft; charter flights also played an important part, with the company's aircraft frequently flying to points as far afield as Singapore, Calcutta, Karachi, Teheran and Malta. Trunk route operations were first started in 1959 when services commenced between London and Newcastle. Progressive route development has been maintained and the company's two trunk routes from London to Newcastle and Leeds/Bradford offer up to 2,500 seats daily between the capital and the North of England.

The maintenance of BKS aircraft is carried out by its associate company, BKS Engineering Ltd, which was formed in 1952 for this purpose. Routine maintenance is handled at line bases at London, Leeds/Bradford and Newcastle, and major checks and modifications are carried out at the main engineering base at Southend. Next year Trident 1E aircraft will be introduced on BKS routes, initially serving Newcastle and Bilbao from London.

Head Office: Hodford House, High Street, Hounslow, Middlesex. T: 01-572 0611.

Executives: chairman and managing director, C. J. Stevens; technical director, T. F. Taylor; planning and marketing director, F. D. Prescott; general manager, sales, J. B. Latto; general manager, commercial, G. W. Corbin; company secretary and personnel manager, H. R. Cleaver; operations manager, Capt T. W. Haythornthwaite; financial controller, J. J. T. Tuten; general manager, line services, C. E. Jackson; general manager, bloodstock and contract cargo, H. S. Spring.

Employees: 900.

Fleet: four Britannia 102, eight Viscount, one Ambassador freighter.

British Air Ferries Ltd, a subsidiary of Air Holdings (q.v.), operates vehicle-ferry, passenger and freight services from Southend and Lydd to points on the Continent. Services are operated to Rotterdam, Ostend, Calais, Deauville (summer only) and Le Touquet. Rail-air-rail services are operated between London and France, Holland and Belgium in co-operation with the national railways of those countries. Previously British United Air Ferries, the company's name was changed to British Air Ferries in September, 1967, when it became completely autonomous within the Air Holdings Group, separate from BUA with which formerly it had been partially integrated. BUAF stemmed from the amalgamation of two vehicle-ferry airlines, Channel Air Bridge and Silver City Airways. Channel Air Bridge had commenced operations from Southend in 1954 as a division of Air Charter, initially with Bristol Freighters and later Carvairs. Air Charter, together with Channel Air Bridge, was bought in 1959 by Airwork which, in the following year, acquired Hunting Clan; the new group which thus came into being was named British United Airways whose parent company, Air Holdings, was formed in 1961. Silver City had pioneered vehicle ferry services, and began flying—also with Bristol Freighters—from Lympne in 1948. It was bought by Air Holdings in 1962 and operations were integrated with those of Channel Air Bridge under the new name of British United Air Ferries.

Head Office: Southend Municipal Airport, Southend-on-Sea, Essex. T: 0702-49471.

Executives: chairman, L. A. Leroy; director and general manager, D. J. Platt; directors, J. Wiseman, E. N. Jennings, M. S. F. Mula (also chief accountant); operations manager, R. Langley; commercial/sales manager, J. B. McKelvie.

Employees: 460.

Fleet: Five Carvair, five Bristol 170 Freighter 32.

Britannia Airways Ltd is a wholly-owned subsidiary of Thomson Travel Holdings Ltd (Thomson Organisation). It operates exclusively on charter work and inclusive-tour holiday traffic to the Mediterranean countries. Also in the holding company are Sky Tours, Riviera Holidays, Gaytours and Luxitours,

Channel Airways' increasing jet operations are centred on Stansted, although the company's main base remains at Southend. Seen here is the airline's BAC One-Eleven

TABLE 1: SCHEDULED SERVICES, CALENDAR YEAR 1967

Operator	Aircraft miles (×1,000)	Stage flights	Aircraft hours	Passengers carried	Passenger miles (× 1,000)	Available seat-miles (× 1,000)	Passenger load factor (%)	Cargo carried Short tons	Revenue load ton-miles (× 1,000) Passengers	Cargo	Mail	Total	Available capacity ton-miles (× 1,000)	Overall load factor (%)
Passenger services														
BOAC	68,215	40,650	150,134	1,513,156	5,140,673	8,867,600	58.0	41,777	501,391	151,072	37,047	689,510	1,335,722	51.6
BEA	52,831	157,945	196,803	7,377,259	2,735,865	4,507,487	60.7	86,948	250,796	33,524	5,861	290,180	506,796	57.3
Autair	605	3 668	3,860	70,405	12,564	28,488	44.1	444	1,154	82	—	1,236	2,699	45.8
BKS	2,956	12,563	15,150	489,116	120,812	194,145	62.2	4,818	10,066	1,142	—	11,209	16,827	66.6
British Eagle	2,199	6,003	7,450	153,062	76,734	165,614	46.3	1,332	7,087	563	—	7,650	16,056	47.6
British Eagle (Liverpool)	839	5,390	4,350	173,172	30,753	58,005	53.0	1,758	2,722	302	—	3,022	5,528	54.7
BEA *Helicopters*	112	2,945	921	55,412	2,106	2,730	77.1	176	177	6	1	184	248	74.2
British Midland	1,329	6,493	6,882	173,956	43,402	85,751	50.6	2,125	3,787	491	—	4,279	8,074	53.0
BUA (CI)	2,531	17,938	14,871	501,213	81,936	136,557	60.0	4,084	7,211	618	28	7,856	13,745	57.2
British United	6,581	10,548	17,217	320,393	291,902	575,553	50.7	5,965	29,190	10,239	740	40,169	77,716	51.7
Cambrian	3,045	19,389	16,784	428,107	83,041	136,418	60.9	9,992	7,313	1,458	46	8,817	14,079	62.9
Channel	1,539	12,880	8,747	329,525	44,830	88,835	50.5	2,435	3,858	490	—	4,347	8,711	49.9
Dan-Air	454	3,041	3,249	45,643	9,843	19,964	49.3	220	855	42	—	897	2,193	40.9
Emerald	163	1,578	1,360	27,135	3,041	5,883	51.7	35	271	4	—	275	539	51.0
Manx	584	6,580	4,291	198,529	17,835	25,469	70.0	791	1,569	61	—	1,650	2,492	65.4
Morton	249	1,616	1,787	10,518	1,574	2,356	66.8	628	141	104	6	251	588	42.7
Skyways Coach Air	726	5,474	3,911	173,977	22,709	33,625	67.5	12	2,044	3	—	2,045	3,029	67.5
Total	144,959	314,702	457,777	12,040,578	8,719,620	14,934,481	58.4	163,541	829,632	200,200	43,729	1,073,557	2,015,042	53.3
All-freight services														
BOAC	2,363	1,766	5,482	—	—	—	—	11,611	—	44,909	18	44,927	90,249	49.8
BEA	1,841	4,505	9,670	—	—	—	—	42,489	—	11,772	325	12,098	21,143	57.2
British Air Ferries	7	19	47	—	—	—	—	108	—	43	—	43	58	74.1
British United	834	1,037	3,521	—	—	—	—	3,130	—	7,282	26	7,309	11,889	61.5
Morton	146	502	1,040	—	—	—	—	982	—	275	17	292	509	57.4
Skyways Coach Air	69	561	501	—	—	—	—	969	—	122	—	122	240	50.8
Total	5,260	8,390	20,261	—	—	—	—	59,289	—	64,403	386	64,791	124,088	52.2
Vehicle ferry services														
British Air Ferries	2,384	32,520	17,200	277,791	22,852	44,755	51.1	119,322	2,286	9,094	—	11,380	14,937	76.2
Total	2,384	32,520	17,200	277,791	22,852	44,755	51.1	119,322	2,286	9,094	—	11,380	14,937	76.2
Grand Total	152,603	355,612	495,238	12,318,369	8,742,472	14,979,236	58.4	342,152	831,918	273,697	44,115	1,149,728	2,154,067	53.4

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which together comprise the largest group of inclusive-holiday operators in the country, this year flying over 210,000 holidaymakers. Britannia Airways first commenced operations in 1962 under the name of Euravia and used Constellation aircraft. It was re-equipped with Britannias in 1964 and since then these aircraft have logged over 35,000 flying hours with the company and have carried over 600,000 passengers. The main areas served are Spain, Italy, Yugoslavia, Bulgaria, Greece, Turkey and North Africa.

Britannia Airways is the first charter company in Europe to introduce the Boeing 737. The first went into operation in July, the second in August, and a further three will be delivered by Spring of next year at a total cost of £18¾ million. In 1969 the company will operate five 737s and seven Britannias.

Head Office: Luton Airport, Luton, Beds. T: 0582-21461.

Executives: chairman, Sir Miles Thomas; deputy chairman, H. S. Scott; managing director, J. Sauvage; operations director, D. H. Davison; commercial director, R. B. Horlock; financial director and secretary, R. Muckleston; technical director, J. Little.

Employees: 700.

Fleet: seven Britannias, two Boeing 737s; on order, three Boeing 737s.

British European Airways Corporation (BEA) was established under the 1946 Civil Aviation Act "with a view to providing civil air services in various parts of the world, and, in particular, in Europe (including the British Isles)." It took over from the BEA Division of BOAC and later, in 1947, acquired the services, aircraft and staff of the Associated Airways Joint Committee (AAJC) which was made up of a number of UK domestic airline companies. The assortment of aircraft acquired by BEA at this early date included 21 DC-3s from BOAC and, from the AAJC, two DC-3s, eight Junkers Ju52/3Ms, 13 Avro 19s, 39 DH.89s, one DH. Dragon and one DH. Gipsy Moth. The first new aircraft operated by BEA was the Viking, which was introduced on the London to Copenhagen service on September 1, 1946. Since the Viking, a feature of BEA's development has been its constant enthusiasm for introducing new British aircraft produced to the airline's specification. In early 1952 the Airspeed Ambassador entered service as the company's first pressurised aircraft, and throughout its service this aircraft remained very popular with passengers.

BEA pioneered commercial turbine aircraft, first with two DC-3 freighters re-engined with Dart turboprops as part of the development of this engine for use in the Viscount. With the latter aircraft BEA inaugurated the world's first regular turboprop service in April 1953. At the peak of its use BEA had some 60 Viscounts in service. The worldwide success of the Viscount led BEA to draw up a new specification for the much bigger and faster turboprop Vanguard. By March 1962 these airliners were introduced into service. BEA's first jet airliner, the de Havilland Comet 4B, began regular scheduled operation in April 1960. Four years later the Hawker Siddeley Trident, made to BEA's requirements was introduced into service. The Trident 2, introduced into service in 1968, is a longer-range and higher-payload version of the first Trident and it is supplementing the Comets on longer routes. Also on order and in course of delivery are 18 of the stretched 500 series version of the BAC One-Eleven.

On August 16, 1968, BEA placed an order for 26 Trident 3 aircraft; this order, worth more than £80 million was the largest single civil order ever placed with a British airframe manufacturer. In June 1965 BEA became the first airline to introduce automatic touch-downs in scheduled passenger services. In November 1966, a Trident, fitted with Smith's fully-triplex automatic landing system, demonstrated the first fully automatic landing in dense fog. All BEA Tridents are being equipped with this system and the Trident 2 is the first airliner to have this equipment fitted on the production line. By 1970 BEA plans to have in day-to-day operation the first airliner to be fitted with standard equipment officially approved for automatic landing in dense fog.

Today BEA ranks as the western world's fifth largest airline in terms of the annual number of passengers carried. The company is the largest European operator, with a route network taking in nearly every major European city and including extensive operations to the Mediterranean and Middle East. Virtually all BEA's international services are operated within pool agreements with other European carriers and the airline has concentrated on increasing traffic by means of promotional fares.

The hub of BEA's network is Heathrow Airport, London, where there is a very large modern engineering base able to undertake all levels of aircraft maintenance including engine overhauls. Nearly a half of the company's effort goes into its UK domestic services, which were used by over three million passengers in 1968. Some international services are operated from the principal provincial centres on the network and there are engineering and crew bases in Manchester, Jersey and Glasgow as well as London. From Glasgow BEA operates a network within Scotland which serves 13 airfields.

Head Office: Bealine House, Ruislip, Middlesex. T: Viking 1234.

Executives: chairman, Sir Anthony Milward;

TABLE 2: SCHEDULED SERVICES, APRIL-JUNE 1968 (April-June 1967 in italics)

Operator	Passenger-miles (× 1,000)	Available seat-miles (× 1,000)	Passenger load factor (%)	Revenue load ton-miles (× 1,000)	Capacity ton-miles (× 1,000)	Overall load factor (%)
BOAC	1,112,094	2,193,173	50.7	153,063	321,441	47.6
	1,349,247	*2,416,789*	*55.8*	*179,293*	*355,147*	*50.5*
BEA	775,764	1,288,413	60.2	82,286	143,849	57.2
	749,500	*1,253,748*	*59.8*	*78,851*	*140,730*	*56.0*
Aurigny Air Services	57	93	61.3	5	9	55.6
	—	—	—	—	—	—
Autair	5,669	11,892	47.7	554	1,119	49.5
	3,339	*7,180*	*46.5*	*330*	*683*	*48.3*
BKS	34,626	62,937	55.0	3,218	5,374	59.9
	33,563	*54,923*	*61.1*	*3,069*	*4,610*	*66.6*
British Eagle	24,497	53,060	46.2	2,467	5,616	43.9
	20,002	*43,398*	*46.1*	*1,976*	*4,185*	*47.2*
British Eagle (Liverpool)	7,372	18,497	39.9	730	1,871	39.0
	8,110	*16,217*	*50.0*	*791*	*1,541*	*51.3*
BEA Helicopters	755	936	80.1	67	84	79.8
	678	*882*	*76.9*	*59*	*80*	*73.8*
British Midland	13,989	26,673	52.4	1,411	2,528	55.8
	13,354	*27,112*	*49.3*	*1,252*	*2,405*	*52.1*
BUA (CI)	20,866	37,637	55.4	2,017	3,674	54.9
	22,991	*41,473*	*55.4*	*2,181*	*4,099*	*53.2*
British United	76,084	159,381	47.7	10,721	21,281	50.4
	72,537	*146,029*	*49.7*	*9,913*	*19,952*	*49.7*
Cambrian	21,381	34,563	61.9	2,326	3,650	63.7
	23,553	*40,004*	*58.9*	*2,427*	*4,019*	*60.4*
Channel	15,298	29,286	52.2	1,464	2,632	55.6
	13,440	*28,096*	*47.8*	*1,273*	*2,592*	*49.1*
Dan-Air	2,339	5,715	40.9	216	651	33.2
	2,478	*5,404*	*45.9*	*223*	*581*	*38.4*
Manx Airlines	4,816	7,511	64.1	440	759	58.0
	5,196	*7,823*	*66.4*	*475*	*761*	*62.4*
Morton	779	992	78.5	146	213	68.5
	387	*571*	*67.8*	*64*	*179*	*35.8*
Skyways Coach Air	8,599	14,410	59.7	774	1,297	59.7
	6,861	*11,086*	*61.9*	*618*	*999*	*61.9*
Ulster Air Tpt.	171	698	24.5	16	64	25.0
	—	—	—	—	—	—
Vehicle Ferry Services						
British Air Ferries	5,670	10,613	53.4	2,442	3,159	77.3
	6,285	*12,799*	*49.1*	*3,236*	*4,290*	*75.4*

chief executive, H. E. Marking; personnel director, J. L. Grumbridge; financial director, C. A. Herring; supplies/services director, R. A. Spencer; operations director, J. W. G. James; traffic/sales director, P. C. F. Lawton; regional director (UK and Ireland), W. I. Scott-Hill; chief engineer, K. G. Wilkinson; secretary/solicitor, M. J. Lester; chief of public relations, W. Simpson; director medical services, Dr J. Graham Taylor.

Employees: 21,560.

Fleet: 22 Trident 1Cs, 12 Comet 4Bs, 19 Vanguards, 36 Viscount 800s, four Argosy 222s, two Herons; on order, 15 Trident 2s, 26 Trident 3s; on order or in course of delivery, 18 One-Eleven 500s.

British Midland Airways Ltd operates scheduled services from East Midlands Airport to Belfast, Dublin, Glasgow, Edinburgh, Leeds/Bradford and Jersey throughout the year. Summer-season-only services are operated from East Midlands, Luton, Cambridge and Gloucester/Cheltenham to the Isle of Man,

TABLE 3: SCHEDULED ALL-CARGO SERVICES, APRIL—JUNE 1968 (April—June 1967 in italics)

Operator	Revenue load ton-miles (× 1,000)	Available capacity ton-miles (× 1,000)	Overall load factor (%)
BOAC	10,086	20,406	49.4
	10,216	*20,572*	*49.7*
BEA	3,058	4,837	63.2
	2,825	*5,258*	*53.7*
British Air Ferries	32	44	72.7
	—	—	—
British United	1,445	2,333	61.9
	1,727	*3,086*	*56.0*
Morton	173	388	44.6
	—	—	—
Skyways Coach Air	51	66	77.3
	26	*60*	*43.3*

A Monarch Airlines Britannia seen at the Company's Luton base

TABLE 4: NON-SCHEDULED SERVICES

Operator	ALL NON-SCHEDULED CALENDAR YEAR 1967				INTERNATIONAL NON-SCHEDULED	
	Aircraft miles (×1,000)	Stage flights	Aircraft hours	Available capacity ton-miles (×1,000)	Available capacity ton-miles (×1,000)	Available capacity ton-miles (×1,000)
					April–June, 1968	April–June, 1967
BOAC	2,698	2,212	6,189	45,010	12,083	12,453
BEA	3,171	5,246	11,827	36,475	8,554	12,061
Air Ferry	1,688	3,076	8,534	17,534	4,184	5,031
Air London	10	42	66	7	4	—
Autair	1,231	2,915	7,039	6,179	6,404	1,409
BKS	847	1,026	3,147	7,614	1,654	2,367
Britannia	3,026	3,346	10,287	33,438	15,175	10,819
British Air Ferries	181	606	1,302	1,082	250	165
British Eagle	14,409	12,523	48,405	167,665	35,435	42,441
BEA Helicopters	212	2,733	1,676	430	11	—
British Midland	772	1,372	3,420	5,065	1,358	1,549
BUA (CI)	30	201	168	164	286	30
British United	8,513	9,359	23,799	91,161	18,123	25,676
Caledonian	4,213	2,929	13,676	50,435	18,549	10,751
Cambrian	1,319	3,315	5,792	7,042	1,705	2,029
Cardinal	19	94	130	12	—	2
Channel	2,694	4,854	10,448	18,119	5,754	5,624
Dan-Air	2,273	3,304	8,635	18,038	8,389	5,518
Emerald	2	13	17	8	—	1
Glos Air	—	2	2	—	—	—
Gregory Air Services	19	78	83	13	10	7
Invicta	991	4,141	6,223	6,957	1,814	2,175
Laker	2,614	2,611	7,079	23,013	8,612	5,662
Lloyd International	1,626	1,178	5,554	19,307	6,695	4,580
Loganair	71	1,036	487	38	—	—
Manx	59	316	444	196	34	32
Monarch	—	—	—	—	4,205	—
Morton Air Services	511	2,818	3,645	1,033	169	172
Northair	5	23	27	2	—	—
Skyways Coach Air	275	1,305	1,631	1,170	801	376
South West Aviation	—	—	—	—	5	—
Strathallan	53	427	465	369	—	2
Tacair	30	231	219	23	—	1
Tradair	11	8	36	74	—	74
Transglobe	2,597	1,803	8,342	31,236	10,859	7,849
Trans Meridian	498	325	1,961	7,653	3,358	2,626
Ulster Air Transport	—	—	—	—	7	—
Total	56,668	75,468	200,755	596,562	174,487	161,482

BRITAIN'S AIRLINE INDUSTRY . . .

Isle of Wight, Newquay, Barcelona, Palma and Ostend; other scheduled services are Luton to Dublin and Manchester to Ostend. Inclusive-tour and charter flying forms a large part of the company's business and mostly originates from the East Midlands, Manchester and Luton. The company also undertakes contract maintenance, flying training and aerial survey work.

Head Office: 78 Buckingham Gate, London SW1. T: 01-222 6564.

Executives: chairman and managing director, R. R. Paine; joint managing director, F. A. Marshall; commercial director, D. W. T. Sullivan; company secretary and financial director, Miss M. M. Ager; manager, commercial sales, T. W. Walden; manager, commercial service, J. W. Wolfe; manager, sales promotion, E. A. Mitchell; charter manager, D. Aldridge; general manager, flight operations, Capt T. Pike; chief pilot, Capt S. D. Fenton; general manager, engineering, D. H. Mattravers; chief accountant, S. F. Balmforth.

Employees: 430.

Feet: seven Viscounts, one DC-3.

British Overseas Airways Corporation (BOAC) was established in 1939 by the British Overseas Airways Corporation Bill which provided for the merger of Imperial Airways Ltd and British Airways Ltd. Through these two companies BOAC can claim direct ancestry to the earliest days of British civil air transport. The first BOAC flight operated in April 1940 and certain essential air services were maintained throughout the war. The company restarted services on a commercial basis during 1946 and the first such North Atlantic service operated on July 1 using Lockheed L-049 Constellations. The route network assigned to the company gave it complete responsibility for all British flag services to North America, the Middle East and the Commonwealth. Many of the routes were at one time operated by flying-boats, but this era ended on November 7, 1950, with the introduction of Hermes aircraft on the London to Johannesburg service, replacing the Solent flying-boats operating from Southampton. BOAC took over British South American Airways in 1949 to extend its influence to the southern half of the American continent.

In May 1952 BOAC introduced the world's first commercial jet service, using Comet 1s, on the London-Johannesburg route. The first service operated via Rome, Beirut, Khartoum, Entebbe and Livingstone. The Comet 4 was used by BOAC to introduce the first jet services over the North Atlantic on October 4, 1958. In 1960 a round-the-world jet service was introduced using Comets and Boeing 707s. BOAC's network is now one of the largest of any airline. Current operations centre on Heathrow Airport, London, where BOAC has its engineering base, training and administrative facilities. The all-jet fleet now consists solely of VC10s and Boeing 707s. Great efforts have been made recently to increase cargo traffic, including the purchase of Boeing 707-336Cs and the installation of automated cargo-handling systems. The Air Corporations Act of 1966 provided for the capital reconstruction of BOAC, including the introduction of some equity capital and this has helped to launch the airline on its present exceptionally successful financial period. Both Boeing 747s and SSTs are on order and these will provide greatly increased capacity for future expansion.

Head Office: Speedbird House, London Heathrow Airport, Middlesex. T: Skyport 5511.

Executives: chairman, Sir Giles Guthrie; deputy chairman, Keith Granville; associated companies chairman, Gilbert Lee; engineering director, C. Abell; director of planning, Winston Bray; senior general manager, David Craig; secretary, R. M. Forrest; financial director, Derek Glover; personnel director, John Gorman; flight operations director, Capt Frank Walton; commercial director, J. R. Stainton.

Employees: 20,657.

Fleet: 19 Boeing 707-436/465s, four 707-336Cs, 12 VC10s, 14 Super VC10s; three Super VC10s, 11 Boeing 747s are on order; eight Concordes, six Boeing SSTs are on option.

British United Airways Ltd became a wholly-owned subsidiary of BUA (Holdings) Limited in 1968. Its history goes back about 40 years. The company is based at Gatwick Airport, London, whence it operates a domestic jet network serving Belfast, Edinburgh and Glasgow and international services to three continents. Recently services have been introduced between Glasgow and Southampton, and Glasgow, Newcastle and Amsterdam. The airline was the first to order and operate the BAC One-Eleven, which it uses on the domestic and European routes, and also for services to West Africa. Scheduled European services operate between London and Amsterdam, Rotterdam, Gibraltar, Malaga, Palma, Ibiza, Genoa and Le Touquet (for Paris).

In 1964 BUA began operations from Gatwick to South America using VC10s; the service is now twice-weekly via Lisbon/Madrid, Las Palmas, Rio de Janeiro, Sao Paulo, Montevideo, Buenos Aires and Santiago. The VC10s also operate to East, West and Central Africa, including a non-stop flight to Entebbe, as well as to the Canary Islands (Las Palmas and Tenerife). BUA's all-freight services include the long-established Africargo service between Europe and Africa. The airline was a pioneer in the inclusive tour business and operates an extensive range of holiday flights; it also runs regular contract

BRITAIN'S AIRLINE INDUSTRY . . .

flights for the transport of service personnel to Germany. Transatlantic VC10 charter operations were commenced in 1968.

Head Office: Gatwick Airport, Horley, Surrey. T:01-283 8755.

Executives: chairman, Hon Anthony Cayzer; deputy chairman and managing director, A. E. Bristow; director, J. A. Thomson; sales director, E. F. Bates; administrative director, J. Bes; engineering director, W. A. Richardson; operations director, J. R. Sidebotham; director, W. B. Caulfield; general manager planning, A. T. Pugh; financial director, A. F. Nickalls; general sales manager, scheduled services, A. J. Lambert.

Employees: 3,200.

Fleet: three VC10s, ten BAC One-Eleven 200s, three Britannias, three Viscounts; on order, eight BAC One-Eleven 500s.

British United Island Airways Ltd is a wholly-owned subsidiary of BUA (Holdings) Ltd and commences operations on November 1 next, having been formed from a reconstruction of the short-haul and executive charter-contract operations of companies in the BUA group, principally BUA(CI), BU(Manx)A and Morton Air Services. The centre of operations is at Gatwick, although the company and its subsidiaries maintain engineering and traffic bases at Southampton and Blackpool and major traffic stations at Jersey, Exeter and the Isle of Man. BUIA operates an extensive network of short-haul scheduled services serving mainly the Channel Islands and the Isle of Man.

Head Office: Gatwick Airport, Horley, Surrey. T: 01-283 8755.

Executives: chairman, Hon. Anthony Cayzer; deputy chairman, J. A. Thomson; managing director, A. Bristow; technical director, W. A. Richardson; director, Maj J. R. Riley; general manager, L. B. Elwin; assistant general manager, B. Bedford; company secretary, H. Fost; operations manager, Capt B. Gardiner; engineering manager, W. Kerr; sales manager, R. Wyles.

Employees: about 600.

Fleet: seven Dart Herald, four Herons, four C-47 Freighters; on order, four Handley Page Jetstreams.

Caledonian Airways was formed in 1961. The company operates worldwide inclusive-tour, group and military charters; principal activities are group charters between North America and Europe. The airline is currently seeking licences to operate trunk-route trans-atlantic scheduled services. Its operations base is at Gatwick Airport, and its administrative headquarters is at Sussex House, Crawley, Sussex.

Head Office: St Andrew House, 141 West Nile Street, Glasgow C1, Scotland.

Executives: chairman/managing director, Adam Thomson; director sales/planning, Frank Hope; director marketing, John de la Haye; director economics, M. A. Guinane; director operations, Capt S. A. Calder; director finance, T. E. Boud; director projects, D. H. Walter; company secretary, H. C. Brilliant; directors, R. M. Gibson, L. Rose, I. Lawson; executive directors, I. Ritchie (sales), S. Williams (engineering), M. Vidockler, Capt P. W. Holt; vice-president (Canada), R. Norris; vice-president (Western USA), R. Farrell; sales executive (Eastern USA), R. Jackson; chief accountant, A. Barker; ground operations manager, J. S. Thomas; manager flight safety, Capt H. L. Lazelle; planning manager, A. Williamson.

Employees: 450.

Fleet: three Boeing 707-320C, four Britannias; on order, three BAC One-Eleven 500s.

Cambrian Airways Ltd is one of the oldest UK air transport operators, with a history dating back to 1935. Founded by Mr S. Kenneth Davies, the company has always been based on Cardiff.

The airline has always concentrated on serving South Wales, the west and north-west of England and in 1949 it obtained a licence to operate from Cardiff to Jersey and Guernsey. The first modern aircraft operated were DH Herons introduced in 1956, followed by two DC-3 Pionairs. An operating agreement was concluded with BEA in 1956 and in 1958 the State airline took a one-third financial interest in the company. Today Cambrian has scheduled services operating from Cardiff and Bristol to Manchester, the Channel Islands, Bournemouth, Southampton, Cork and Paris; and from London to Cork, Liverpool, the Isle of Man and Belfast. Cambrian is now a wholly-owned subsidiary of British Air Services (q.v.). Much of BEA's Irish Sea network was taken over in 1963 and services connect Manchester with Liverpool, the Isle of Man, Belfast, Cork and Glasgow. A large volume of inclusive-tour and charter traffic is flown by the airline to 30 different destinations in ten countries. In 1963 Viscounts were introduced and new bases were established at London, Manchester and Liverpool to cater for the expanding network.

Head Office: Glamorgan (Rhoose) Airport, Barry, Glamorganshire, Wales. T: 04467-331.

Executives: chairman, J. H. Davies; joint general managers, D. Davies and B. J. T. Callan; secretary, D. Moscrop; flight manager, G. A. Perrott; technical manager, R. H. Boutcher.

Employees: 570.

Fleet: 11 Viscount 700s.

Channel Airways Ltd originated in 1947 as East Anglian Flying Services. In 1962 Tradair became a wholly-owned subsidiary of the company. Scheduled services are operated from Southend, Stansted, Portsmouth, East Midlands Airport, Rochester and Ipswich. Places served are the Channel Islands, Ostend, Paris and Rotterdam. Extensive charter and inclusive-tour flights are also operated from Southend and Stansted. The company's two Tridents were introduced into service in June.

Head Office: Southend Municipal Airport, Essex. T: Southend 40334-6.

Executives: chairman/managing director, Sqn Ldr R. J. Jones; deputy managing director, B. F. Collins; executive director, Capt A. E. Hugo Parsons; director and general manager, A. E. Johnson; director and commercial manager, N. B. Armitage; director and technical manager, T. A. Atkins; general manager, flight operations, Capt J. R. Cook; director and assistant general manager, flight operations, Capt H. A. M. Pascoe; operations manager, Capt C. Mastin; sales/publicity manager, M. J. Steed; chief accountant, L. Mellish.

Employees: 450.

Fleet: two HS Trident 1Es, one BAC One-Eleven, 12 Viscounts, one HS.748, two Herons, one Dove; on order, one One-Eleven.

Dan-Air Services Ltd was formed in 1953 as a wholly-owned subsidiary of Davies & Newman Ltd, oil-tanker brokers of London. The airline's name stems from the initials of the parent company. The first aircraft to be operated was a DC-3, and Yorks were extensively used in subsequent years for work which included military cargo contracts. In 1959 the City of Bristol asked Dan-Air to develop scheduled flights serving the area, and as a result a daily service from Bristol and Cardiff to Liverpool and Newcastle was started, together with services to Norway, the Netherlands and Belgium. In 1959 the company took delivery of its first Ambassador, a type which today has flown over 10 million miles with the company. The airline progressed to jet operations in 1966 with the delivery of its first Comet. Charter and inclusive-tour flights are a major part of the company's business.

Head Office: Bilbao House, 36-38 New Broad Street, London EC2. T: 01-283 4288.

Executives: chairman, F. E. F. Newman; managing director, A. J. Snudden; joint secretaries, B. M. O'Regan and A. J. Brown; scheduled services manager, A. R. Loudon; commercial manager, R. A. Pigeon; chief pilot, Capt R. Atkins; operations manager, K. Balsdon.

Employees: 582.

Fleet: four Comets, four Ambassadors, one DC-3, one DC-7B/F.

Only British operator of the CL-44 is Transglobe, which has the first four of an eventual fleet of six in operation

The most beautiful birds in the world.

VC10s and One-eleven jets and the most beautiful hostesses to go with them. They *have* to be. When you're an independent airline you can't afford anything less.

Jets to Accra, Amsterdam, Bathurst, Belfast, Buenos Aires, Edinburgh, Entebbe, Freetown, Genoa, Gibraltar, Glasgow, Ibiza, Las Palmas, Lisbon, Lusaka, Malaga, Montevideo, Nairobi, Ndola, Palma, Rio de Janeiro, Rotterdam, Santiago, Sao Paulo, Tenerife.

The airline that has to be best

BUA

BRITISH UNITED AIRWAYS

Invicta Airways was formed in 1964 for the purpose of developing inclusive-tour charters in Europe. The company's activities have expanded on this basis, and now also involve worldwide cargo charter operations using specially converted DC-4s. The development of cargo activities is expected to be aided by the recent opening of a Midlands office at Coventry Airport.

Head Office: Manston Airport, Ramsgate, Kent. T: Manston 201.

Executives: managing director, H. C. Kennard; directors, operations and traffic, Capt P. J. Bruce-Souster, Air Cdre G. J. Powell, R. J. Barker; company secretary and chief accountant, M. G. Crisp; general operations manager, E. Harrison; general manager, commercial and traffic, L. McCracken; technical manager, P. W. D. Vine; sales manager, M. Harridine; chief pilot, Capt R. Rendall.

Fleet: two Viscounts, four DC-4s; on order, two Viscounts.

Laker Airways Ltd is an airline formed specifically to cater for IT operators and other such organisations which need to contract-hire modern aircraft. Laker aircraft are normally chartered on a wet-lease basis with Laker concerning itself with all aspects of the aircraft operations. The company is becoming an all-jet operator, and is disposing of its two Britannias.

Head Office: Gatwick (London) Airport, Horley, Surrey. T: Crawley 27181.

Executives: managing director, F. A. Laker; director, purchasing/services, C. Nunn; technical director, W. F. Townsend; operations manager, L. V. E. Atkinson; commercial manager, G. W. Forster; chief pilot, Capt A. Hellary.

Fleet: four BAC One-Elevens, one VC10, two Britannias.

Lloyd International Airways Ltd was formed in 1961. Initially the airline was based at Cambridge; it moved to Gatwick, and in 1967 to Stansted, where its offices and maintenance facilities now are. The company has always concentrated on the operation of four-engined long-range aircraft for both passenger and cargo charter. It has undertaken a number of large inclusive-tour programmes.

From its inception, Lloyd International has had links in Hong Kong and has flown to the Far East more regularly than most of its competitors. Recently, in association with the Ben Line, additional sales and promotional facilities have been developed on this route, with emphasis on air cargo. Two of the company's Britannia 300 Series aircraft have now been equipped with cargo doors and palletised freight systems.

The company is currently studying the performance and other characteristics of a variety of large jet aircraft.

Head Office: Lloyd House, Stansted Airport, Essex.

Executives: chairman, J. Ortiz-Patino; managing director, K. M. Macleod; assistant managing director, D. L. Willis; commercial and sales manager, N. A. Bamford; operations manager, D. M. Parlane; chief engineer, L. N. Monnickendam.

Employees: 145.

Fleet: three Britannias, one DC-4.

Loganair Ltd began operations as the Executive Aviation Division of Duncan Logan Construction Ltd; in 1962 the company began public transport operations, which now include third-level scheduled services, executive charter, light freight, air taxi and aerial photography operations. Daily scheduled services include the Orkney North Isles service, Stornoway-Benbecula-Glasgow and Glasgow-Oban-Mull. An air ambulance service is operated to some of the islands off the west coast of Scotland, and within the Orkney Isles. Recently the company was acquired by the National Commercial Bank of Scotland.

Head Office: Hangar 10, Glasgow Airport, Renfrewshire, Scotland. T: 041-887 1549.

Executives: managing director, D. McIntosh; chief pilot, K. E. Foster; chief engineer, W. Ramsay.

Fleet: one Beech 18, two BN-2A Islanders, two Piper Aztecs; on order: one BN-2A Islander.

Monarch Airlines was formed in June 1967 and commenced operations on April 5, 1968. The company concentrates on worldwide inclusive tours and charter work. It is based at Luton Airport. Airline Engineering, which is an associated company, maintains Monarch's aircraft and also engages in contract maintenance work for other operators. Monarch is currently studying various types of jet equipment, which it may introduce in 1970.

Head Office: Luton Airport, Luton, Beds. T: 0582-27151.

Executives: managing director, W. H. Hodgson; technical director, G. D. Peacock; chief pilot, A. J. Burridge; operations manager, H. S. Wyatt; chief accountant, M. Taggart; traffic superintendent, H. J. Gietelink.

Fleet: three Britannias.

Scillonia Airways was formed to operate scheduled and charter services in the west of England. Operations started in 1966 with a Newquay-Penzance-Scilly Islands service.

Head Office: No 6, 36 Buckingham Gate, London SW1. T: Tate Gallery 6358.

Executives: owner, K. B. Neely.

Fleet: four Rapides; on order, two BN-2 Islanders.

Skyways Coach Air Ltd has operated year-round coach-air-coach services between London and Paris since 1962. The airborne part of the route is operated with HS.748s and DC-3s between Lympne and Beauvais. An attractively low fare has generated heavy traffic on the route and a very high frequency of service operates. Paris is also served from East Midlands Airport; Clermont-Ferrand, Lyons, Montpellier and Vichy are included in the network. The company is 50 per cent owned by the State-owned Transport Holding Co.

Head Office: Lympne Airport, near Hythe, Kent. T: Hythe 66156.

Executives: managing director, Eric Rylands; secretary, G. Sykes; sales manager, S. Pugh; airport manager, R. Chadwick; planning manager, J. Clarke; manager, passenger services, J. R. Bodger; technical manager, J. McTaggart; chief engineer, D. J. Clark; operations manager, Capt R. Tapley; purchasing manager, K. Palmer; manager, France, J. Stergard.

Employees: 200.

Fleet: four HS.748s, three DC-3s.

South West Aviation Co Ltd was formed in 1966 to undertake executive, freight and general air-charter work. Once established at their base airport in Exeter, SWA acquired a branch office and hangarage at Lulsgate Airport, Bristol, and further facilities at Fairwood Airport, Swansea to complete a West Country network. In association with Westcountry Aircraft Servicing Ltd they are able to provide maintenance facilities at both Exeter and Bristol. As a forerunner of scheduled operations, SWA ran regular flights between Exeter and Gatwick Airport during the rail go-slow in June. An application for local scheduled services has been made.

Head Office: Exeter Airport, Exeter, Devon. T: 0392-66584.

Executives: directors, W. F. Andrews (managing), Robert MacDonald, Peter Faire.

Fleet: one Short Skyvan, one DC-3, one Piper Aztec C, one Beechcraft Travelair.

Strathallan Air Services Ltd (Strathair) was formed in 1963 as an executive-charter and air-taxi operator. Current operations include contract charter, company-aircraft operation and maintenance. A scheduled-service licence is held for the route Prestwick-Edinburgh-Dundee-Inverness.

Head Office: Auchterarder, Perthshire, Scotland. T: 07646-2545.

Executives: chairman and managing director, D. G. D. Roberts; chief pilot, A. R. Whitfield; technical manager, C. G. Luck.

Employees: 12.

Fleet: one Dove, two Piper Aztecs.

Transglobe Airways Ltd operate group charter, including transatlantic flights, and inclusive-tour services. The company was formed in 1959 as Air Links Ltd. Maintenance is in the hands of an associated company, Air Couriers Ltd, Gatwick. In 1966 Bolton Steamship acquired a 42 per cent holding.

Head Office: Gatwick (London) Airport, Horley, Surrey. T: Crawley 26411.

Executives: managing director, S. Wilson; commercial director, E. Richardson; operations director, E. J. Parker; company secretary, G. Townsend.

Employees: 104.

Fleet: two Britannias, four CL-44s; on lease/order, two CL-44s.

Trans Meridian (London) Ltd is the only British all-cargo airline, and has an operating base at Stansted Airport, Essex. The company is a wholly-owned subsidiary of Trans World Leasing Ltd, which specialises in aircraft lease and which is owned jointly by Mr T. D. Keegan and Mr George Batchelor.

The airline's main activity is the operation of aircraft on long-term wet lease; one DC-7C/F is leased to a national airline and a second is leased to a Middle East food importer. The third DC-7C/F is mainly engaged on the transport of livestock.

Head Office: 11 Park Place, London SW1. T: 01-629 1344.

Executives: directors, T. D. Keegan (chairman), G. Batchelor, R. Stokes (managing), P. Hardy (technical), H. G. Dawson.

Employees: 55.

Fleet: three DC7-C/F, two DC-7Cs.

Ulster Air Transport Ltd (Air Ulster) was formed on December 1, 1967, with the aim of providing local services to and from Northern Ireland and expanding into the inclusive tour field. It also provides the opportunity for the charter of freight and passenger aircraft in Northern Ireland and the Glasgow area.

Head Office: Aldergrove Airport, Co. Antrim, Northern Ireland. T: 0232-29271.

Executives: managing director, J. W. Rigby; director of operations, Capt R. S. Meldrum; commercial manager, D. G. Smyth; chief pilot, Capt A. J. Holland; chief engineer, T. Combrinck.

Employees: 30.

Fleet: two DC-3s; on order, two Viscounts.

An Aztec of the Exeter-based operator South West Aviation

BRITAIN'S AIRLINE INDUSTRY...

BRITISH AIR TAXI OPERATORS

Air Hanson Ltd 3 Pont Street Mews, London SW1.

Aircruise (Operating) Ltd Leavesden Aerodrome, Watford, Herts. T: Garston 2070 and 3115.

Air Intermovements Civil Airport Control Block, Biggin Hill Airport, Kent. T: Biggin Hill 2163 and Farnborough 52147.

Air London Gatwick Airport, Horley, Surrey. T: Crawley 28822.

Airviews (Manchester) Ltd Manchester Airport. T: Mercury 2502, 5262 (Ext 246).

Bees Flight Ltd Sandown Airport, Isle of Wight. T: Sandown 2646/7.

British Executive Air Services Ltd Oxford Airport, Kidlington, Oxford. T: Kidlington 4151.

Business Air Travel Ltd Lympne Airport, Kent. T: 0303-68241.

Chrisair Aviation Services Northampton Airport, Sywell. T: Moulton 3706 and Northampton 38597.

Cumberland Aviation Services Ltd 10 Victoria Place, Carlisle. T: Carlisle 26288.

Duke Aviation Ltd Portland Cottage, High Street, Hamble, Hants.

Executive Flying Services Ltd Municipal Airport, Southend-on-Sea, Essex. T: Southend-on-sea 49678/9 and 40201, ext 311.

Glos Air Staverton Airport, Cheltenham, Gloucestershire. T: 045271-3385.

***Gregory Air Services Ltd** Denham Airfield, Nr Uxbridge, Middlesex. T: Denham 2417.

Herts and Essex Aero Club Stapleford Aerodrome, Nr Romford, Essex. T: 6658 341.

Humber Airways Ltd Grimsby, Lincs.

Inter-City Airways Ltd Kent House, 87 Regent Street, London W1. T: 01-734 3524.

King Aviation Ltd East Midlands Airport, Castle Donington, Nr Derby. T: 0331 25-630 and 621.

Luton Flying Club Luton Airport, Luton, Beds. T: 0582 24426.

McAlpine Aviation Luton Airport, Luton, Beds. T: 0582 24182.

Management Aviation Ltd Bourn, Cambridge. T: Madingley 314 and 449.

***Mid-Fly Ltd** Birmingham Airport, Birmingham 26. T: Sheldon 6681.

Norfolk Airways Ltd Norwich Airport, Norwich. T: Norwich 48280.

Northern Air Taxis Ltd Leeds/Bradford Airport, Yeadon, Yorks. T: 09737-2251.

***Northern Executive Aviation Ltd** Hangar 522, Manchester Airport, Wilmslow, Cheshire. T: 061437-2870.

***Polyfoto Air Taxi Services Ltd** The Aerodrome, Elstree, Herts. T: Elstree 4411.

Rent-a-Copter Ltd 2 Lowndes Street, London SW1. T: 01-235 6477/8.

Rogers Aviation Ltd Great Barford, Beds. T: Bedford 62441.

Skywork Ltd Stansted Airport, Bishops Stortford, Essex. T: Bishops Stortford 3361.

Shoreham Aviation Ltd Shoreham Airport, Shoreham-by-Sea, Sussex.

Tacair Ltd Halfpenny Green Aerodrome, Bobbington, Stourbridge, Worcs. T: Bobbington 366 and 391.

***Truman Aviation** Huntingdon Street, Nottingham. T: 0602-52881.

Twyford Moors Helicopters Ltd Twyford House, Chestnut Avenue, Eastleigh, Southampton. T: Chandlers Ford 2935.

Westair Flying Services Ltd Blackpool Airport, Blackpool, Lancs. T: 0253 42660.

World Wide Helicopters (UK) Ltd Alma House, Alma Road, Reigate, Surrey. T: Reigate 48444.

Yorkshire Flying Services Ltd The Air Centre, Leeds/Bradford Airport, Yeadon, Yorks. T: 0973 7 3840.

Air Taxi Organisations

Air Taxi Operators' Association Tollerton Airport, Nottingham. T: 0602-82510. (Members of ATOA include those marked with an asterisk in the above list, and Loganair—see the list of airlines.)

Moore Airtaxi Center 151 Kensington High Street, London W8. T: 01-937 8277. Air taxi brokers.

A Look at the Books

A selection of airline accounts filed with the Registrar of Companies since our British Airline Survey last year (Sept. 28, 1967)

AUTAIR INTERNATIONAL AIRWAYS

At May 18, 1967:

Nominal share capital: 20,000 6% non-cumulative £1 preference shares
600,000 ordinary 1s shares
200,000 ordinary £1 shares
held (except for one £1 ordinary share held by J. R. Young) by Court Line.

Balance sheet for year ended September 30, 1966:

		£
Fixed assets (incl. aircraft, cost: £844,518; deprec'n: £64,451; net: £780,067)		982,298
less liability secured on fixed assets		757,893
		224,405
Investments in subsidiaries		5,020
		229,425
Current assets	£544,819	
less liabilities	£710,819	
Excess of liabilities over current assets		166,000
		63,425
less deposits against future contracts		13,792
Total net assets		49,633

Extract from profit and loss account for year ended September 30, 1966: trading loss, £15,795; loss before tax, £82,537.

BKS AIR TRANSPORT

As at June 25, 1968:

Nominal share capital: 75,000 unclassified £1 shares

Shareholders:

British Air Services	35,000	
A. G. W. Scott	1,250	in process of transfer to British Air Services
C. J. Stevens	32,500	
J. B. Sweeney	1,250	
Shares taken up	70,000	

Consolidated balance sheet for year ended September 30, 1967:

	£		£
Share capital	70,000	Fixed assets	896,820
Share premium account	30,000	(incl aircraft: cost £1,362,691; deprec'n £725,230; net £637,461)	
Profit and loss account (deficit)	(219,924)	Misc equipment	15,000
	(119,924)	Current assets	1,770,928
Deferred liabilities	1,238,615		
Current liabilities	1,564,057		
	2,682,748		2,682,748

Extract from profit and loss account, year ended September 30, 1966:
Operating surplus: £247,178
Trading loss: £103,306
Net surplus on sale of aircraft: £17,600
Deficit: £219,924.

BRITISH EAGLE INTERNATIONAL AIRLINES

At January 11, 1968:

Nominal share capital: 1,000,000 ordinary £1 shares

Shareholders:		
H. R. Bamberg		490,000
Mrs J. W. Bamberg		420,000
N. A. Hill		20,000
C. W. Bingham		5,000
J. H. Sauvage		10,000
G. D. Peacock		10,000
R. R. A. Duggin		10,000
W. H. Hodgson		10,000
N. A. Hill and C. W. Bingham		25,000
Total shares taken up		1,000,000

Balance sheet for year ended December 31, 1966 (BEIA and subsidiaries):

	£		£
Issued share capital	1,000,000	Fixed assets:	7,421,675
Capital reserves (incl surplus arising from revaluation of aircraft, £1,126,791)	1,430,234	(incl airframes: cost, £7,599,298 deprec'n, £2,264,378 net, £5,334,920; engines, £1,031,250 *less* unexpired life, £550,418)	
General reserve	102,033	Misc	525,982
Profit and loss account balance carried forward to next year	83,614		7,947,657
	2,615,881	Current assets	1,415,851
Associated companies (advances to and from)	214,365	Debtors, depositors and advance payments	1,616,054
	2,830,246	Goodwill and licences, BE (Liverpool)	60,000
Long-term liabilities	5,016,914	Misc	792,374
Provision for aircraft maintenance	212,272		
Current liabilities	3,772,504		
	11,831,936		11,831,936

Extract from profit and loss account for year ended December 31, 1966:
Operating profit, and opening provisions no longer required: £1,317,573
Capital profits on aircraft disposal: £201,005
Surplus for year: £386,073
Allocation to employee profit sharing: £25,000
Net profit: £361,073.

BRITISH MIDLAND AIRWAYS

At February 15, 1968:

Nominal share capital, 175,000 ordinary £1 shares

Shareholders:	
R. R. Paine	36,900
D.W. T. Sullivan	28,753
M. M. Ager	19,388
E.W. Phillips	21,187
J. R.Wilcock	8,165
Buckingham Gate (Life Insurance)	8,199
Control Nominees	44,820
F. Beswick	1,524
F. Marshall	1,396
and others to total of 175,000	

Balance sheet for the year ended September 30, 1966:

	£			£
Issued share capital	100,000	Fixed assets: (incl. aircraft:		255,491
Balance per profit and loss account	48,591	cost,	£490,838	
Current liabilities (includes: hire purchase engagements, £181,048; sundry creditors and accrued expenses, £556,927)	747,058	deprec'n	£264,034	
		net	£226,804)	
		Interest in subsidiaries		18,768
		Current assets		621,390
	895,649			895,649

Extract from profit and loss account for year ended September 30, 1966: operational income, £1,303,635; *other income,* £20,077 *(includes* £9,288 *profit on* sale of aircraft); operational costs, £1,084,742; net profit, £45,216.

BRITISH UNITED AIRWAYS

Balance sheet for year ended December 31, 1966:

	£			£
Issued share capital	509,432	Fixed assets		15,771,131
Capital reserves	4,657,604	(incl. aircraft:		
Revenue reserves	4,009,101	cost	£20,557,634	
Unsecured loans	4,387,500	deprec'n	£6,190,889	
Amount due to holding co	4,366,416	net	£14,366,745)	
Deferred liability (instalments due in 1967 for aircraft purchase	1,776,067	Interest in fellow subsidiaries		1,898,411
Current liability	3,892,567	Current assets		6,295,433
Misc	366,288			
	23,964,975			23,964,975

Extract from profit and loss account for year ended December 31, 1966: trading loss, £681,671 (owing to a new accounting basis for overhaul of aircraft and components, the result was improved by about £150,000); surplus on disposal of fixed assets and subsidiaries, £713,832; profit before tax, £991,720; profit after tax, £1,312,675.

CALEDONIAN AIRWAYS (PRESTWICK) LTD

Shareholders (ord. voting shares):	£
Airways Interests (Thomson) Ltd.	227,739
N.C. George Street Nominees (on behalf of Great Universal Stores)	101,330
Lyle Shipping Ltd	100,000
Scottish Air International	45,512
I. N. Reynard	20,000
D. J. Macleod	4,211
R. M. Gibson	3,167
	504,959

(*cumulative preference shares*):	£
N C George Street Nominees Ltd (on behalf of GUS)	50,000
National Commercial & Schroders Development Ltd	50,000
Industrial and Commercial Finance Corporation	100,000
	200,000

Consolidated balance sheet for year ended September 30, 1967:

	£		£
Issued share capital	604,959	Fixed assets:	4,611,421
Capital reserve	200,372	(*incl aircraft,* £4,281,872 obsolescence, £526,532 airframe expired hours, £113,611 net £3,641,729)	
Revenue reserve	121,203		
Total share capital and reserves	926,534	Trade investments	211
Loans: secured £2,746,457		Pre-operational and development costs; interest on Boeing fleet equalisation account; less amounts written off	171,975
hire purchase liabilities £808,747		*Current assets*	909,679
	3,555,204		
Current liabilities	1,211,548		
	5,693,286		5,693,286

Extract from profit and loss account for year ended September 30, 1967:
Consolidated profit, £124,658.

DAN-AIR SERVICES LTD

Balance sheet for year ended December 31, 1967:

	£		£
Issued share capital	50,000	Fixed assets	955,613
Capital reserve	19,500	(incl aircraft and engines: cost £1,465,811	
Revenue reserves	114,509	deprec'n £514,851	
Total capital and reserves	184,009	net £950,960)	
Taxation deferred by capital allowances	188,500	Amounts owing by group companies	277,247
Amount owing to group company	257,604	Current assets	265,868
Deferred liability	365,832	Training costs re new aircraft types	124,744
Current liabilities and provisions	627,527		
	1,623,472		1,623,472

Extract from profit and loss account for year ended December 31, 1967:
Operating profit, £7,914; profit before taxation, £117,914.

SKYWAYS COACH AIR LTD

As at January 12, 1968

Nominal share capital: £300,000
composed of: 50,000 ordinary £1 shares
125,000 A shares of £1
125,000 B shares of £1.

Shareholders:		
Eric Rylands Ltd	125,000	A shares
Transport Holding Co	125,000	B shares
Total shares taken up	250,000	

Balance sheet as at December 31, 1966:

	£		£
Fixed assets	975,929	Represented by: share capital, issued and fully paid	250,000
(incl. aircraft and engines: cost £742,768 depreciation £136,380 net £606,388)		Profit and loss account, debit	82,450
Goodwill	1		167,550
Subsidiary companies (shares at cost less amounts due by Skyways)	4,214	Parent company and directors' loans	85,861
Trade investment	100	Martins Bank (secured)	161,240
Associated companies (amounts due to company—Lancashire Aircraft, and amounts due by company—Skyways Engineering)	6,136	Amount outstanding on hire-purchase agreements	509,950
	986,380		
Current assets £230,309 less current liabilities £292,088	(61,779)		
	924,601		924,601

Extract from profit and loss account for year ended December 31, 1966:
Surplus on operating account: £122,027
Net profit: £20,329
Balance from previous year (debit): £102,779
Balance (debit): £82,450.

BOOKS

New contributions to aviation literature

A GREAT MANY NEW BOOKS on aviation subjects have been received by *Flight* during the past few months and it is not possible, with the pressure that exists on editorial space, to do justice to them at short notice with adequate reviews. But it is hoped that many of them will be dealt with in course of time. So that readers of this journal may know what books have been published, and where they are available, a list of many recent titles is given here, with brief comments on their contents.

Rickenbacker, *by E. V. Rickenbacker (Hutchinson & Co, 178-202 Great Portland Street, London W1; illustrated, 30s).* Think of something in aviation and Rickenbacker has probably done it. First World War ace, pioneer transport pilot, accident survivor, airline founder and president. All these experiences have been included in his autobiography, which makes absorbing reading on aviation from an American point of view.

Racing Planes, *Vol IV, by Reed Kinert, published by Aero Publishers Inc, Fallbrook, Calif, and available in the UK from W. E. Hersant Ltd, 228 Archway Road, Highgate, London N6; illustrated, 24s 6d.* The photographs, text and data tables relate to the history of racing aircraft and air races from 1946 to the present day.

Der Aufbau der Erdatmosphare, *by Heinrich Faust (Friedr, Vieweg & Sohn, Braunschweig; illustrated, no price quoted).* For the German-speaking reader, a detailed textbook on the world's atmosphere and its implications.

It's Made Like This: Aircraft, *by Ernest J. T. Day (John Baker, 5 Royal Opera Arcade, Pall Mall, London SW1; illustrated, 12s 6d).* A simple but clear explanation of the aerodynamics, power and construction of aircraft; rather heavily British-oriented, as if there were no other aircraft in the world, and with no reference to rotating-wing or V/STOL types, but performing a useful function within a limited context.

Sopwith Scout 7309, *by Sir Gordon Taylor (Cassell & Co Ltd, 35 Red Lion Sq, London WC1; illustrated, 36s).* In 1965 the distinguished Australian pilot and aviation writer Sir Gordon Taylor sat down to remember his First World War experiences as a Sopwith Scout pilot with 67 Sqn on the Western Front. This book is the result, and it is remarkable how Sir Gordon recalled his experiences and recreated them in this realistic fashion. Completed shortly before he died in December 1966, the book is a worthy addition to his other fine writings about his civil aviation experiences—particularly his masterly descriptions of flying-boat operations.

US Civil Aircraft, *Vol 4, by Joseph P. Juptner (Aero Publishers Inc, Fallbrook, Calif; illustrated, $8.50).* Another in the series describing all aircraft which held US Government ATCs (approved type certificates). This volume includes aircraft of the 1930-31 era, among them the sleek Boeing Monomail—an all-metal monoplane—and an "airbus"—a name chosen for the Bellanca P.100 "to convey the impression of a big, every-day air transport."

Messerschmitt 163, *by Edward T. Maloney and Uwe Feist (Aero Publishers Inc, Fallbrook, Calif; illustrated, $3. Available in the UK from W. E. Hersant Ltd, 226 Archway Road, Highgate, London N6).* An interesting though inadequate book on this extraordinary aircraft. Much of the photographic material, apart from that of the Japanese conversions, is unnecessarily duplicated; and there is no reference to one of the best authorities on the subject, Mano Ziegler, whose *Rocket Fighter* provided one of the most exciting accounts, from a test pilot's point of view, of the Me163. This new book is a useful contribution to the subject, but could have been better documented and more comprehensive.

Lightplane Construction and Repair, *by Snyder and Welch, (Crown Publishers, 419 Park Avenue South, New York, NY 10016; illustrated, 14s 6d. Available in the UK from Graham K. Scott, 2 The Broadway, Friern Barnet Road, London N11).* A compact American textbook on how to build or rebuild your own or some neglected aircraft you have a wish to restore. A practical illustrated guide to the mechanics of the job.

Aeroplane Dierctory of British Aviation *(Temple Press Books, Hamlyn Group, Hamlyn House, 42 The Centre, Feltham, Middx; 50s).* Everybody's British aviation industry reference book. This 1968-69 edition performs its regular and valuable annual service.

Handbook For Agricultural Pilots, *International Agricultural Aviation Centre, The Hague, illustrated, 29s).* A handbook from an authoritative source and one small enough to be carried in the pilot's pocket; though no doubt he would familiarise himself with its advice before going on crop-spraying operations.

The Book of Aircraft, *by John W. R. Taylor (MacDonald & Co (Publishers) Ltd, 49-50 Poland Street, London W1; illustrated, 15s).* A highly selective but attractively illustrated little volume, depicting transport by air from the days of Icarus to the wingless Northrop HL-10 "Flying Stone"—which is about as up to date as one could get.

Sir George Cayley, *by C. H. Gibbs-Smith (HM Stationery Office, Atlantic House, Holborn Viaduct, London EC1; illustrated, 3s).* A concise monograph (only 32 pages long) on the great English pioneer, by a distinguished historian: Cayley in an authoritative nutshell.

United States Navy Aircraft Since 1911, *by Gordon Swanborough and Peter M. Bowers (Putnam & Co Ltd, 9 Bow Street, Covent Graden, London WC2; illustrated, 84s).* Companion volume to the same authors' *United States Military Aircraft Since 1909,* this work maintains the same high Putnam standards of authorship and production. Over 250 types of aircraft are described in text, photographs, three-view drawings and data tables, and there are appendices dealing with gliders, balloons and airships.

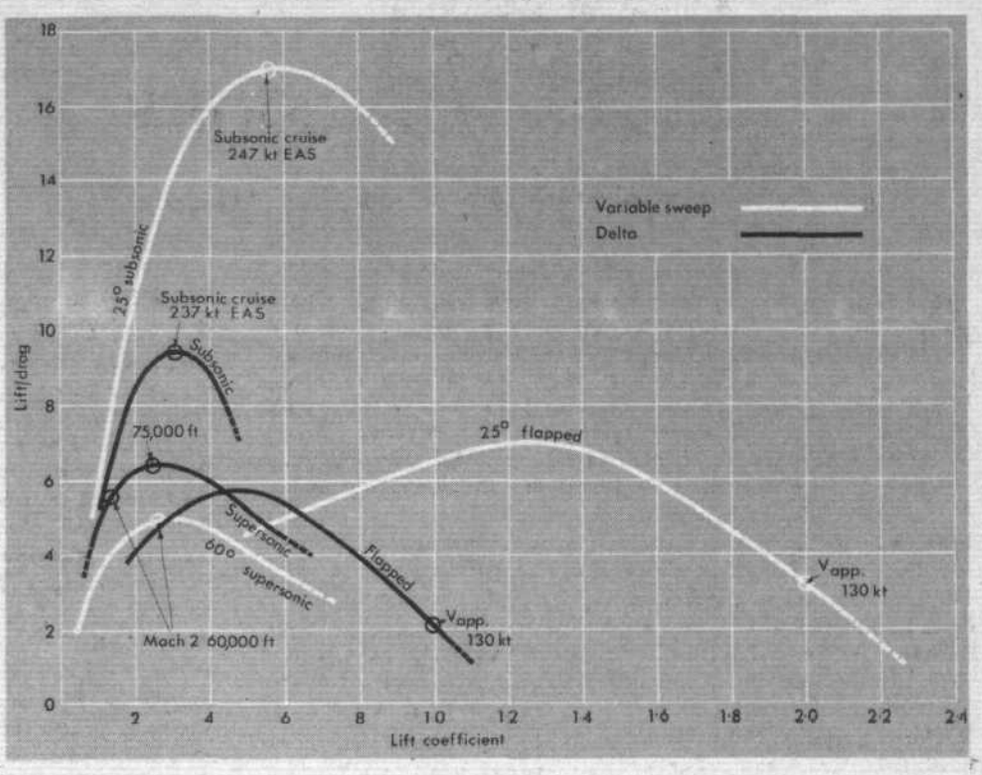
Airplane Aerodynamics, *by D. O. Dommasch, S. S. Sherby and T. F. Connolly (Pitman Publishing Corp, New York, Toronto, London; illustrated, 70s).* This is the fourth edition, published 17 years after the first, of the exemplary textbook designed to make the theory of flight understandable to pilots, especially those engaged in test flying.

The Fighting Triplanes, *by Evan Hadingham (Hamish Hamilton, 9 Great Russell Street, London WC1; illustrated, 63s).* "A transient phenomenon which briefly came to prominence in the later years of the First World War" is how AVM Raymond Collishaw refers to the triplane in his foreword to this informative and handsome book, which describes and illustrates the operational deployment of triplanes on the Western Front, and their short-lived development elsewhere.

The Great Air Race, *by Arthur Swinson (Cassell & Co Ltd, 35 Red Lion Sq, London WC1; illustrated, 36s).* Won by C. W. A. Scott and T. Campbell Black in the de Havilland Comet *Grosvenor House,* the London-Melbourne race in 1934 was one of the great air events of the inter-war years, and the excitement of it, and subsequent fates of the competitors, are extremely well conveyed in Mr Swinson's pages.

DESIGN PROBE

By LASER



The Case for Variable Sweep

I DON'T KNOW who coined the foul phrase "variable geometry" and used it as an adjective to describe aircraft which have a variable shape due to adjustable wing sweep, but most people seem to have accepted it in this context. Resistance to this sort of misuse of the English language seems to be weakening, which is a pity. I suppose this particular phrase arose from the habit of calling the shape of a thing its geometry, which is just about as sensible as calling a woman's figure her physiology.

However, in the light of recent events, such as the strange smell surrounding the F-111 and the alleged change of heart in Seattle regarding the right shape for a supersonic transport, it is perhaps relevant to study some of the basic thinking behind the variable-sweep wing.

It is well known that, if one wants to cruise economically at a high-subsonic speed, one wants a wing of fairly high aspect ratio and moderate sweep flying at a wing loading of about 100lb/sq ft. This sort of wing, fitted with the best high-lift flaps and leading-edge devices, can be flown at low altitude down to speeds of about 130kt.

If, on the other hand, one wants to cruise as economically as possible at supersonic speeds—say Mach 2—then one wants a wing of low aspect ratio with a large sweep angle and a low thickness/chord ratio flying at about the same wing loading, i.e., about 100lb/sq ft. This sort of wing, again fitted with the best flaps and other devices which can at present be envisaged, can be flown at low altitude down to speeds of about 200kt.

Since the first of these wings cannot possibly be flown supersonically and the latter has an unacceptable approach speed, the designer of the supersonic aircraft has two courses open to him. He can either reduce the wing loading of the supersonic wing to a level which gives him an acceptable approach speed but reduces the supersonic cruising efficiency, or he can make the subsonic wing capable of being swept back in flight and carry the structure weight penalty involved.

Research has shown that the delta wing is more efficient in supersonic flight than is the swept tapered wing, so the judgment which has to be made is between a delta of sufficient area to give an acceptable approach speed and a variable-sweep tapered wing.

Putting to one side the fact that a wing with variable sweep is obviously going to be far more costly to design and make than a delta wing, let us examine the other two main factors which affect economy—namely, fuel weight and structure weight.

In Fig 1 I have plotted lift/drag ratio against lift coefficient for a 60° delta having a thickness/chord ratio of 3.25 per cent and a variable-sweep wing which also has a thickness/chord ratio of 3.25 per cent when swept to 60°. Included in this chart is the effect of an arbitrary fuselage. The salient features are that the variable-sweep wing has an advantage of almost 2:1 over the delta in subsonic cruise L/D and in usable flapped lift coefficient, whilst the delta has an advantage of about 1.3:1 in supersonic cruise L/D.

Imagine now that we want to design a transatlantic transport with a maximum cruising speed of Mach 2 at 60,000ft and an approach speed of 130kt. Fig 1 shows us that the VS design can use an approach C_L of about 2 whilst the delta can use a C_L equal to about only 1. This means that the VS design will have a wing loading of 114lb/sq ft whilst the delta will have 57lb/sq ft—twice the gross area.

These wing loadings allow both designs to cruise subsonically at or near the speeds associated with $(L/D)_{max}$, the delta at 237kt EAS and the VS design at 247kt EAS. At Mach 2 and 60,000ft the low wing area of the delta forces it to cruise below the optimum C_L whereas the VS machine cruises very near to the best C_L. If height were allowed to rise, the delta wants to cruise at 75,000ft, where it would fly at or very near to its optimum C_L. These various points are marked on the curves of Fig 1.

The actual stage length will probably be split up into about 300 n.m. at each end flown subsonically and 2,400 n.m. flown supersonically, and these stages can be converted to equivalent still-air ranges as follows:—

			ESAR
1st	300 n.m.	subsonic	450 n.m.
2nd	2,400 n.m.	supersonic	2,750 n.m.
3rd	300 n.m.	subsonic	450 n.m.
Reserves		subsonic	900 n.m.
			4,550 n.m.

Continued overleaf

DESIGN PROBE . . .

Assuming specific fuel consumptions of 1.3lb fuel/lb thrust/hr for supersonic flight at 60,000ft and 0.8 for subsonic flight at 20,000-30,000ft, we have:—

$$\log_e \frac{W_1}{W_2} = \text{ESAR} \times \frac{D}{L} \times \frac{C}{V}$$

tabulating:—

Stage	$\frac{W_1}{W_2}$ Delta	$\frac{W_1}{W_2}$ (VS)
1	1.1	1.05
2	1.74	1.89
3	1.1	1.05
Reserves	1.29	1.14

If both aircraft take off at 500,000lb gross weight, the weight programme becomes:—

Stage	Delta	V. Sweep
Take-off weight (lb) at end of :—	500,000	500,000
Stage 1	455,000	475,000
Stage 2	262,000	251,000
Stage 3	238,000	239,000
Reserves	185,000	210,000
Total fuel needed :—	315,000	290,000
Percentage fuel weight	63	58

From this we can say that, to a first approximation, the weight advantage in favour of variable sweep in terms of fuel is equal to 5 per cent of the gross weight, and it now remains to establish the order of the direct structure weight penalty which has to be paid with variable sweep.

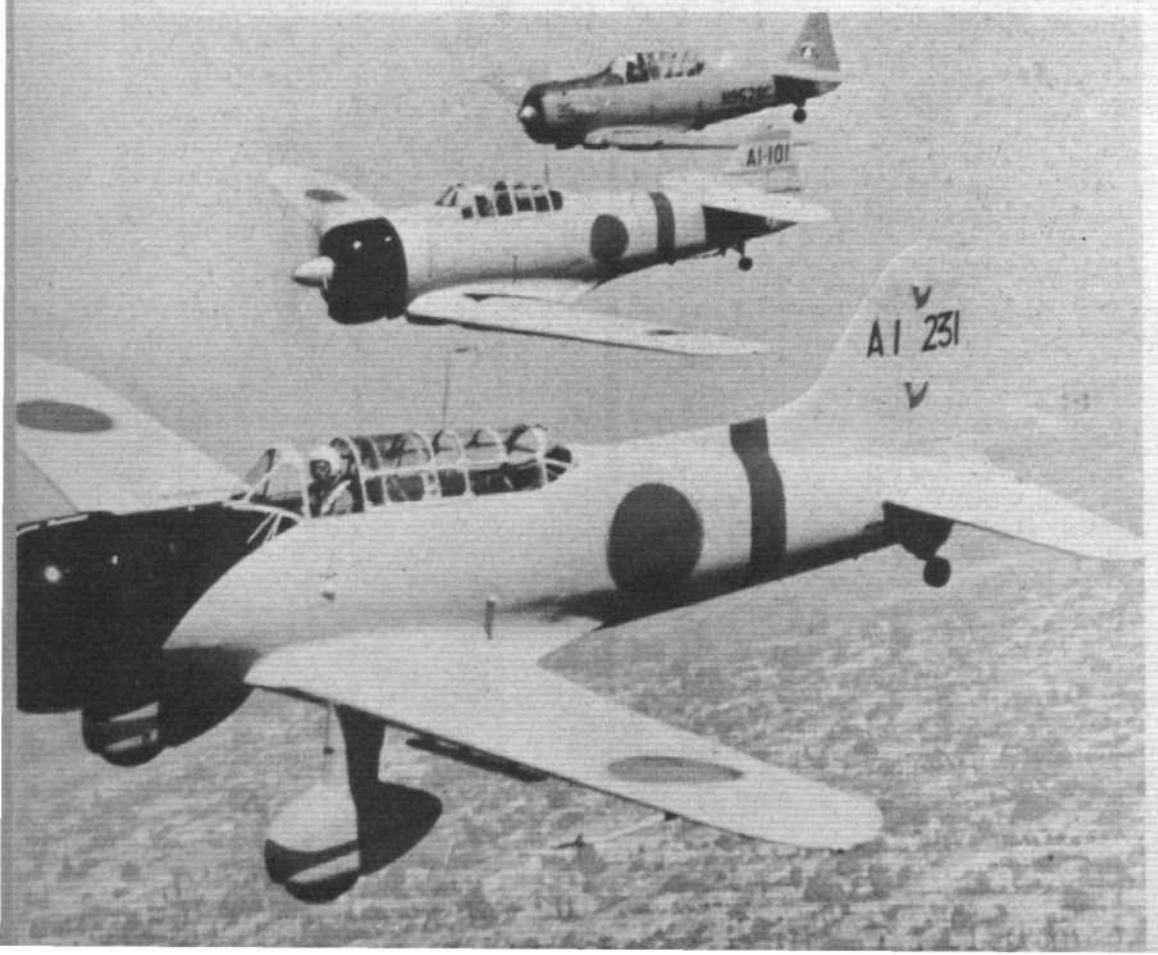
A study done by this designer some years ago on a variable-sweep strike aircraft of 40,000lb gross weight produced a weight penalty for variable sweep of 1,500lb, which is 3.75 per cent of the gross weight. Recent statements attributed to Boeing quote the penalty for variable sweep on the big SST as being 42,000lb, which represents over 6 per cent of the gross weight.

A well-known method for predicting wing weight, when applied to a 60° swept tapered wing with T/C equal to 3.75 per cent and aspect ratio equal to 3.5, produces the answer that such a wing will be about 35 per cent heavier than a 60° delta of twice the area. This means that the penalty for wing structure on the VS design is likely to be between 3 and 6 per cent of the gross weight.

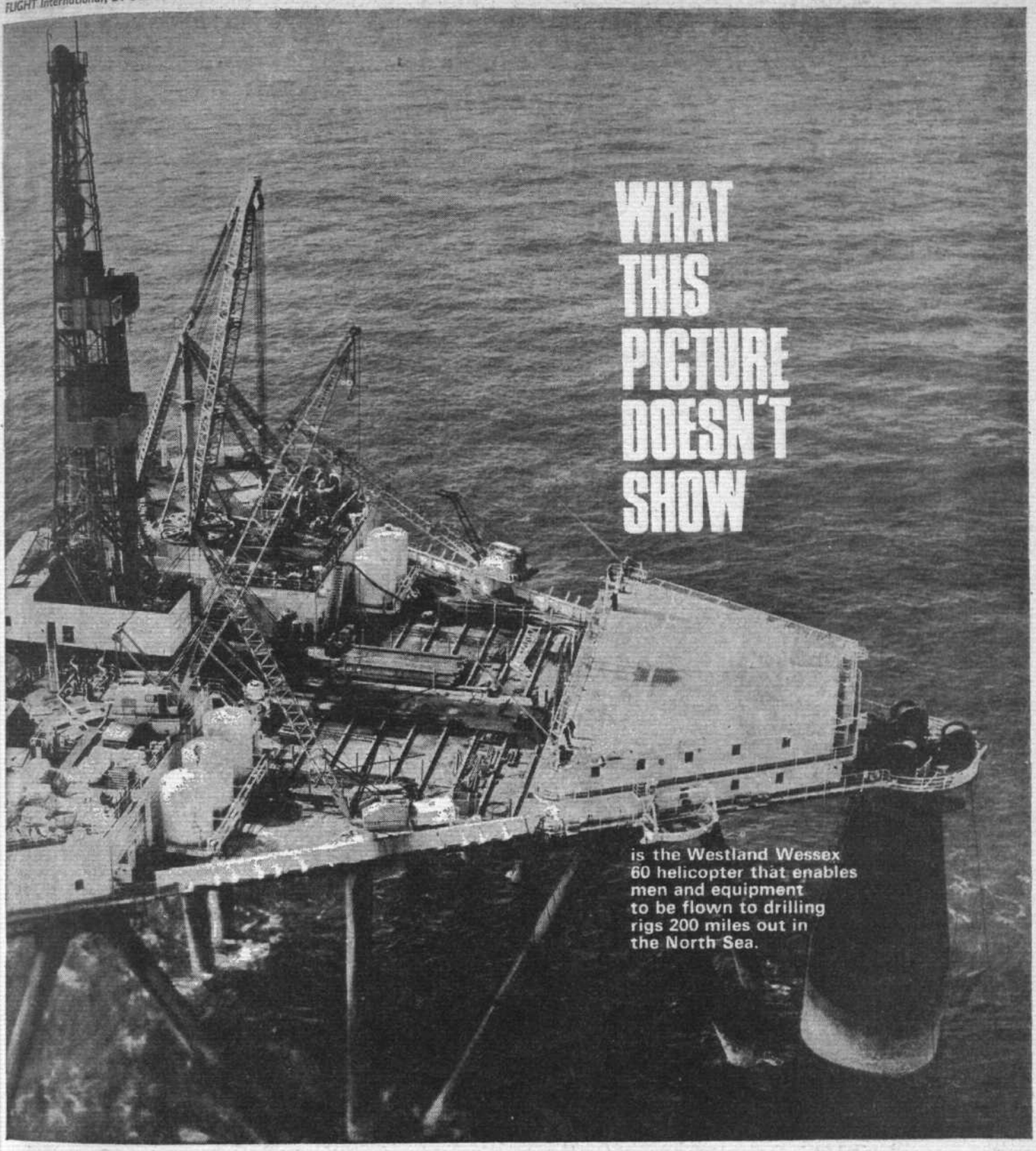
Summing up, if we take an optimistic view of the variable-sweep design, the disadvantages outweigh the advantages by nearly 2 per cent of the gross weight, whereas if we take a pessimistic view, then the disadvantages outweigh the advantages by some 7 per cent of the gross weight: and this, incidentally, ignores cost due to complication.

One wonders what sort of predictions ever produced a potential advantage, for the variable-sweep wing, of a magnitude sufficient to warrant the immense expenditure which has obviously been made to prove the point. The one case where variable sweep can clearly be shown to pay off is that where a long range or a long duration are required at subsonic speed, coupled with a comparatively short-duration flight at supersonic speed. This situation only arises in a military requirement for a patrol and strike machine or a long-range bomber.

"Tora, tora, tora!": Pearl Harbour Recreated



An Aichi "Val" dive-bomber and Mitsubishi Zero fighter with a North American AT-6 as escort—two of the fleet of more than 70 Second World War Japanese and American aircraft prepared for "Tora, tora, tora!" (code signal used by the Japanese during the Pearl Harbour bombing), a new 20th Century Fox film depicting the Japanese attack on Hawaii in December 1941. Production is due to begin at the end of this year and filming will take place on location in Japan, Hawaii and Washington, with interior scenes in the Fox studios at Beverley Hills, Calif. The forty Japanese aircraft in the production have been modified from AT-6s, BT-13s and SNJs by Steward-Davis Inc and Cal-Volair in the US and by Kawasaki in Japan. The film's first showing is expected late next year



THE WESTLAND WESSEX 60:

* **The civil twin-engine helicopter with full engine-out performance**
* **Visual monitoring by the pilot of final touch-down on small platforms**
* **Reliability proven by year-round operation under North Sea conditions**

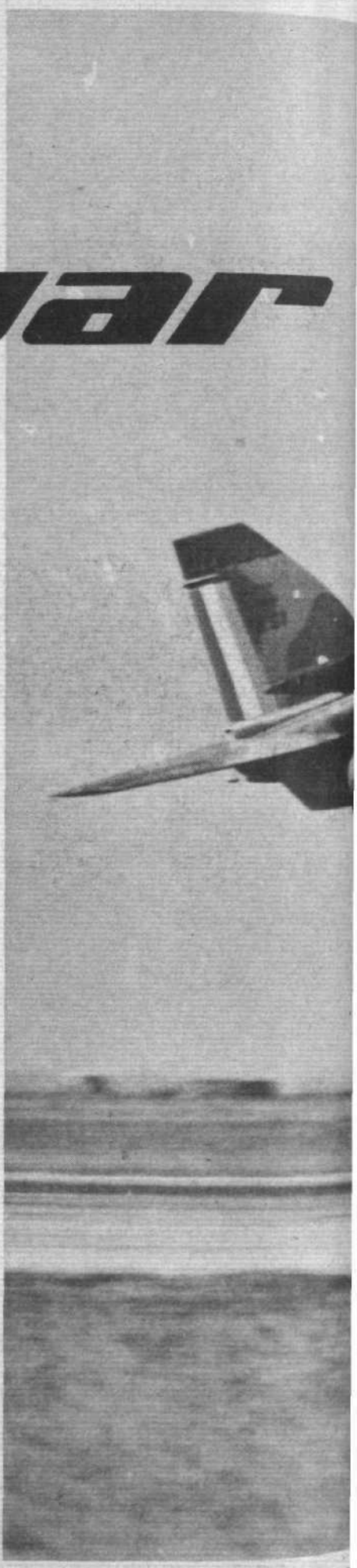
Bristow Helicopters Limited, with their recently acquired long range version of the Westland Wessex 60, have shown how this twin turbine helicopter can carry a full load to drilling rigs 200 miles out in the North Sea.

WESTLAND HELICOPTERS LIMITED

YEOVIL SOMERSET ENGLAND

SUBSIDIARY OF WESTLAND AIRCRAFT LIMITED

jaguar



SCHEDULE

1968 First flight—2-seat trainer version.
(Successfully accomplished September 8.)

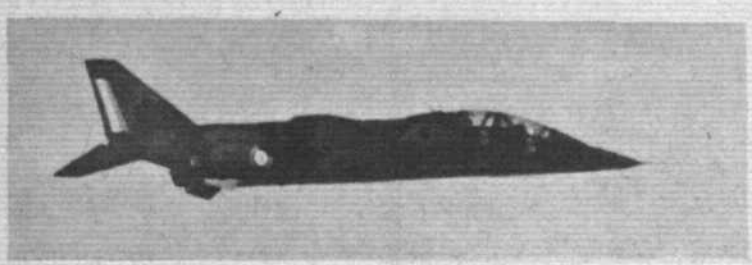
No. 2 aircraft to be completed.

Other versions—including single-seat tactical aircraft—to be at advanced stage of build.

1969 Seven aircraft representative of four of the five Jaguar variants to be on the intensive flight development programme.

1970/71 Jaguar to be fully proven in all versions. First deliveries of the 400 aircraft ordered by the British and French Governments

JAGUAR the most cost-effective tactical support aircraft and advanced supersonic trainer of the next decade.



Jaguar first flight—Istres, September 8th, 1968 Pilot—Bernard Witt.

S.E.P.E.C.A.T

Société Européenne de Production de l'Avion E.C.A.T.

British Aircraft Corporation
100 PALL MALL, LONDON, S.W.1.

Breguet Aviation
78-VELIZY-VILLACOUBLAY, FRANCE

airborne

JAG

THE NEW STEEL

Carbon-fibre-reinforced plastics: the materials that may revolutionise aircraft design

An article in the September 1968 issue of "Design Engineering" by its assistant editor, Mr D. M. Peters, provides a most valuable up-to-date review of progress with carbon-fibre-reinforced plastics, the new structural materials which have evolved during the past five years as an extension of the technology of glass-reinforced plastics. The following summary, based on Mr Peters' article, outlines this development and its implications for the future.

CARBON-FIBRE-REINFORCED PLASTICS offer every prospect of bringing about as great a revolution in many branches of engineering as did aluminium alloys when they first appeared in practical form 60 to 70 years ago. As was the case with aluminium and its alloys, the aerospace industry is the most important initial field of application and the rate at which these new materials are introduced in this industry and later elsewhere will largely depend on their cost, which is itself more a function of the method of manufacture and of the volume of production than of the availability of the basic new materials.

The tremendous growth in the use of glass-reinforced plastics led to the search for a reinforcing fibre of greater rigidity than glass. To achieve mechanical properties superior to metal alloys, materials formed from light atoms with strong bonding forces between them were required. Ceramics are suitable but brittle unless used as a fibre reinforcement in a plastic or metal matrix in exactly the same way as glass fibre in glass-reinforced plastics. The light-atom materials with the necessary chemical bonding characteristics are the oxides, nitrides, borides, carbides and boron and carbon.

A great deal of research into new structural materials has been in progress in all the technologically advanced countries during the past decade and, in 1963, the RAE began to concentrate on carbon filaments. In the autumn of that year, work started at Farnborough on methods of producing carbon fibres with machanical properties suitable for use in reinforced plastics. In about six months carbon fibres made from polyacrylonitrile fibres of a specific modulus of about 20×10^6lb/sq in had been achieved. At this time, information on similar work undertaken in Japan in 1961 by Akio Shindo became available and the RAE workers realised, from their own experience, that the Japanese results could be improved upon. Efforts at RAE were therefore redoubled and, in about another six months, a process was evolved which, using the same starting material, gave strength and moduli at least double those obtained by Shindo. These indicated an ultimate tensile strength of 300×10^3lb/sq in, a Young's modulus of 60×10^6lb/sq in and a specific gravity of 2.

The essential part of the RAE process was controlling the orientation of the carbon fibres during manufacture. Based on previous work on graphite for the nuclear power programme, W. Watt and W. Johnson produced carbon fibres from man-made polyacrylonitrile using a three-stage batch system. In the first stage, oxidisation takes place in air at 200/300°C, in the second at about 1,000°C and in the third there is final conversion to graphite at 2,000/3,000°C. This is a costly and time-consuming method of manufacture, but it produced sufficient carbon fibres for testing and development.

These first carbon fibres had twice the strength of glass fibres. The next step was to impregnate them with a suitable matrix. L. U. Phillips was responsible for development of the composite. The result was a material with several times the strength of steel but only a quarter of its weight.

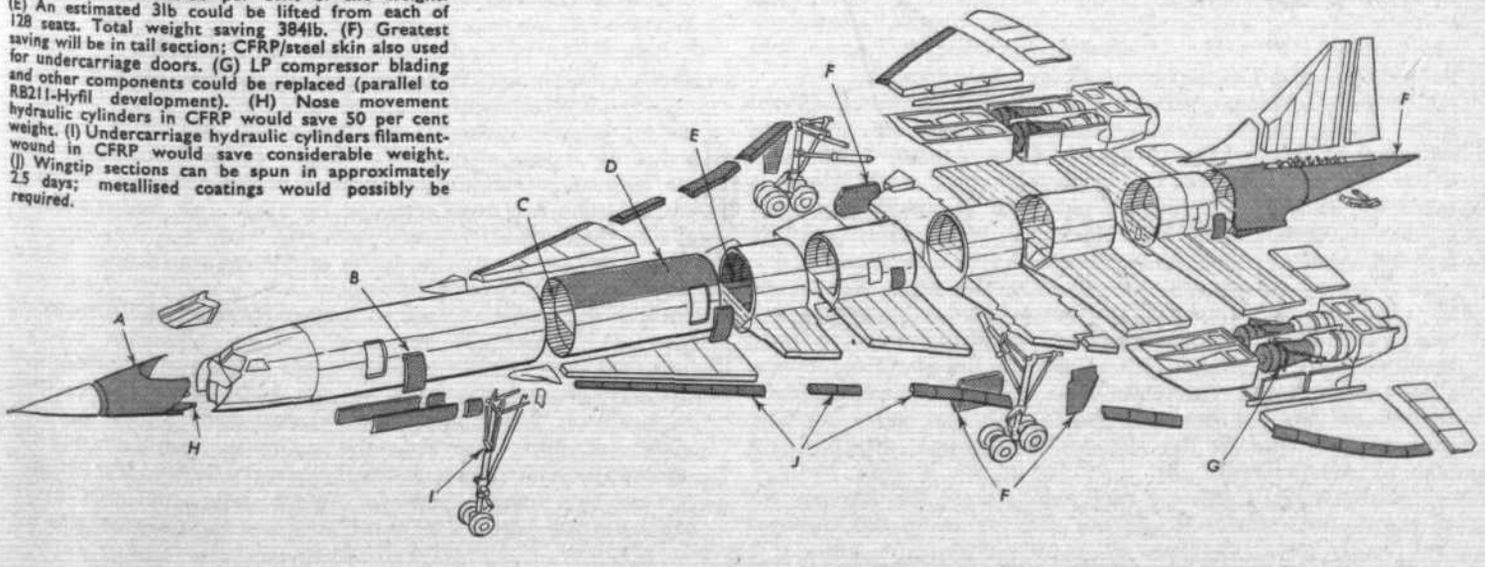
British Patent No 1,110,791 for this composite material was applied for in April 1964 in the joint names of Johnson, Phillips and Watt.

The National Research and Development Council now came into the picture to negotiate commercial exploration of the new material. Licences were granted to Courtaulds and to Morganite Research and Development to expand the work started at Farnborough. AERE at Harwell developed a continuous process system of manufacture and was soon supplying Rolls-Royce—who had also been working independently of, and in parallel with, RAE on the same problem—

Ten areas of weight saving

(A) Nose section (not radome section) in CFRP would reduce weight by 20 per cent. (B) Door stiffeners and internal facings would save approximately 20 per cent in weight. (C) Stringers: RAE Farnborough have constructed CFRP stringers with 25 per cent weight saving. (D) Internal low-stressed panels in CFRP would save 20-30 per cent of the weight. (E) An estimated 3lb could be lifted from each of 128 seats. Total weight saving 384lb. (F) Greatest saving will be in tail section; CFRP/steel skin also used for undercarriage doors. (G) LP compressor blading and other components could be replaced (parallel to RB211-Hyfil development). (H) Nose movement hydraulic cylinders in CFRP would save 50 per cent weight. (I) Undercarriage hydraulic cylinders filament-wound in CFRP would save considerable weight. (J) Wingtip sections can be spun in approximately 2.5 days; metallised coatings would possibly be required.

The shaded components represented in this drawing illustrate applications of CFRP to Concorde. For the sake of clarity, only ten items are shown, but there are many other components where weight saving is made possible by the use of such materials. A weight reduction of between 20 and 25 per cent is claimed, and this could be an influential factor in any consideration of a "stretched" Concorde



with 14in lengths of carbon fibre for use in experimental compressor blades.

While this had been going on in the United Kingdom, the Americans were working on both boron and carbon fibre composites. Their main effort was on boron, but this suffers from a high manufacturing cost and from the fact that only one type of boron fibre is possible, compared with the wide variety possible with carbon. The cost of carbon fibre in the United States, at £200 per lb, is also considerably higher than in the United Kingdom, where it is £35 per lb.

Morganite manufacture two types of carbon fibre based on polyacrylonitrile. Type 1 has a high Young's Modulus (60×10^6lb/sq in) and a moderate strength, while Type 2 has a high strength (40×10^3lb/sq in) and a medium modulus. The different moduli in the two types derive from the degree of orientation of their graphite-based planes; the more nearly these are parallel to the fibre axis, the greater the modulus. A high consistency of manufacture of the fibres is achieved and this makes possible composites of uniform and predictable characteristics when used to reinforce a resin, metal or ceramic matrix. The matrix allows the fibres to be ordered in the desired pattern and directions and transmits loads both to and between the fibres.

Resins are the normal matrices at ordinary temperatures and epoxy or polyester resins are commonly used, although other types are selected for particular applications.

In terms of specific flexural modulus, carbon fibre resin composites are over four times better than most other structural materials, including wood, the majority of metals and alloys and glass-reinforced plastics. A second important design feature of composite materials is the ratio of their strength to modulus, that is their strain at failure. To make full use of the potential of a material, its maximum strength should be reached before its extension becomes unacceptable for the particular component. Thus, glass fibres may be stronger than carbon fibres but they reach a given extension under a much smaller load. Their usable strength may therefore be lower than that of the weaker but stiffer carbon fibres.

Theoretically, the tensile strength and modulus of unidirectional fibre composites are proportional to the volume of the reinforcing fibres. In practice, the degree of orientation of the fibres, their length-to-diameter ratio, and particularly the degree of adhesion between them and the matrix, can all cause differences from the theory.

With the early carbon fibres, adhesion was poor and a special surface treatment was developed whereby the interlaminar shear strength was increased to the level where it was no longer critical in a correctly designed composite structure. However, the impact strength of such structures appears to fall as the interlaminar shear strength increases, so that an infinite increase in adhesion is to be avoided.

Commercial production of fibres

Morganite started producing carbon fibres in metre lengths in tonnage quantities during 1967 and plan to produce soon even greater quantities in continuous lengths. Immediate applications are in the aerospace industries in Europe and the United States but many others await development.

Courtaulds produce carbon fibres processed into unidirectional warp sheets, random mats, preferred orientation tape and moulding powders. The warp sheet is claimed to be the thinnest pre-impregnated carbon material in the world and is currently being evaluated by the aerospace industries. Sheets 0.001in, 0.005in and 0.010in thick are being developed, the first for specific satellite applications. The thinnest material will be worked by vacuum bag or autoclave processes, the thicker by matched metal moulding. The aerospace industries are mainly interested in pre-impregnated materials, which are being developed in continuous form as well as unidirectional sheets. Courtaulds should soon be able to supply off-the-shelf continuous filament pre-impregnated with an epoxy novolac resin and, a little further ahead, pre-impregnated with other high-temperature resins.

Rolls-Royce have taken a prominent part in the development of carbon-fibre-reinforced plastics and are using this material in the fan and fan stator of the RB.211 engine for the Lockheed L-1011. The 1968 *New Scientist* Award (second prize) had gone to these Rolls-Royce engineers, J. Whitney, M. R. Rowland and S. G. Jones, for their work on the development of the continuous process system of manufacture which has been so important to mass production of the fibre and to reductions in its cost of manufacture.

This system involves bundles of 10,000 fibres being pressed into sheets and passed between graphite rollers through which an electric current is passing. The fibres act as the conductor and as the whole furnace does not have to be raised to the required temperature of 2/3,000°C, the energy required is low.

Fibre composite components are made in three ways:

(1) *Moulding* The fibres form a random mat in the resin matrix. This is the method used for most glass-fibre components, such as motor car bodies, boat hulls and some structural components used in the building industry. It is cheap and requires only unskilled labour but is not a very efficient use of the fibre reinforcement.

(2) *Wound continuous filaments* Filaments are wound on with resin as a binder and matrix. This method, which gives high strength and stiffness in the required directions, is particularly suited to circular or conical sections or pressure vessels but is more difficult and requires specialised machinery for complicated shapes.

(3) *Lamination*. Thin laminations are cut from undirectional sheet. Each sheet of parallel fibres is pre-impregnated with resin and is sufficiently sturdy for the sheets to remain together once arranged in correct order and position. Then, as a complete component shape, the laminates are placed in a matched die. The die is closed and subjected to a carefully controlled cycle of pressure and temperature to form the required shape and finally to cure the resin by a chemically irreversible process. This means that the component can later be taken back to the curing temperature yet will retain most of its strength and stiffness. The component is finished when removed from the die, except for the removal of a slight "flash" at the closing surfaces. Establishment of the correct pre-form shapes and the moulding cycle is a highly skilled procedure but, once fixed, manufacture is semi-automatic.

Compressor-blade applications

This latter method is used by Rolls-Royce for all its high-duty composite (Hyfil) components. A feature of the design of these components is the use of the concept of cross-bracing whereby components are stiffened in a torsional sense by arranging the filaments of successive laminates at carefully determined angles to each other. Varying the cross-bracing alters the moduli of the material. By selecting the correct relationship of the two principal moduli, the frequencies of vibration of compressor blades can be controlled and much higher bending frequencies achieved than with conventional materials. Similar techniques are used to control torsional vibration. As a result, Hyfil blades give considerably greater freedom from flutter than blades in titanium or more conventional materials. In addition, by altering the lay-up of the sheets, without altering the external shape of the blade, its resonance frequencies can be changed.

Attachment of blades to the disc was originally done with a "bulb" root in which continuous fibres went from the blade, round an attachment pin and back to the blade. However, there were difficulties in manufacturing this design and subsequently it was altered to a simple wedge shape which slots into the disc. Initially a single wedge was used, but more recently this has been replaced by a multiple wedge which is two or three times stronger.

It is impossible at this point to foresee the almost limitless future application of this "new steel." As with glass-reinforced plastics and earlier advanced materials, carbon-fibre-reinforced plastics will initially be used by the aerospace industry. However, it is already possible to see important applications in chemical engineering, as a bearing material, in thermoplastic applications, for competition yachts and racing craft, in racing cars, for radar scanners and masts, in submarines and underwater research craft, in the glass industry, for overhead power lines and even—for those who can afford the sophistication—for model aeroplanes and man-powered aircraft!

(continued from page 653)

A taxi through the Las Vegas streets—for aircraft bound for the AOPA Convention. In the throng, a Beagle Pup

AOPA IN LAS VEGAS

Dickie Turley-George reports on the thirteenth annual convention

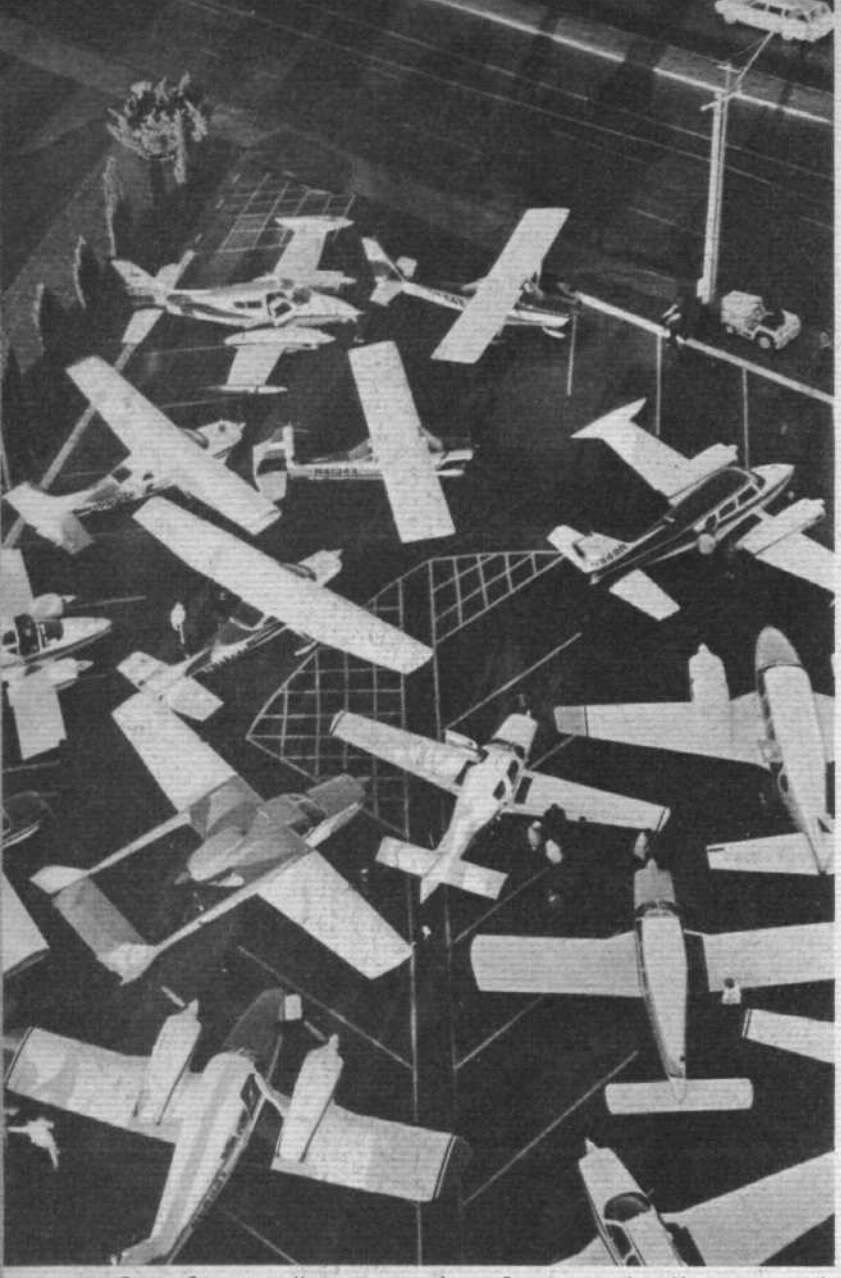
FABULOUS LAS VEGAS, the city which never sleeps, where the slot machines and gaming tables are operating 24 hours a day, the city where Howard Hughes, that well-known aviator who has a slight edge on the rest of us, bought the hotel in which he was staying when he was asked to vacate his suite in favour of a big-time gambler—what better setting could there be for this, the biggest and best Aircraft Owners and Pilots Association Annual Convention to date?

The convention opened on Tuesday, September 24, and as in previous years those AOPA members flying in to attend, plus the aircraft for display, landed at a nearby aerodrome; and this year being Las Vegas year once again—the convention was held here three years ago—the aerodrome used was McCarron Field at the Hughes Executive Terminal.

Each year the customary opening to the proceedings is a procession of aeroplanes taxying nose to tail from the airport down the highways and streets to their positions at the static aircraft display, which is usually on a parking lot or area of one of the hotels taken over for those AOPA members attending the convention. This year it was the Riviera, one of four huge and elaborate hotels which were required to house the 6,500 delegates. The number attending bears witness to the rapid growth of AOPA membership—three years ago at the same locale the number of AOPA members attending was less than half this year's turn-out.

To return to the aeroplane procession: 34 aircraft were scheduled for display at the static park and at just after 0700hr the line started to move. So efficient was the co-operation between AOPA staff members, Las Vegas officials, the Sheriff's office, the Convention Bureau and hotel personnel that the whole operation was completed in under 15min, and all the aircraft but one were in position on the static park before 0720hr. The tardy thirty-fourth aeroplane made the trip to the Riviera Hotel alone—but with the necessary escort of course—about an hour later, and who knows but that this was a bit of one-upmanship on the part of the pilot?

These taxying aeroplanes each year are most impressive, especially when moving down the main street of a town or rolling along with automobiles on a main highway—as last year on the Florida main A1A Highway. But this year it seemed just a little more unreal than ever, with the famous Las Vegas "Strip" as a backdrop and the all-night gamblers coming



Room for a small one—somewhere. Scene at a Las Vegas car park

SPORT AND BUSINESS

out into the sunlight with drink glasses in their hands to see the spectacle.

The increased interest that is aroused each year in this annual get-together of general aviation pilots is remarkable, not only because this year the attendance is more than double that of three years ago, but also because the total was up on last year by about 1,500—and the convention last year was a record. This year another record was the number of AOPA members flying in to the convention—just over 1,500, and this is impressive by any standard. In addition, delegates come from so much further afield; representatives present included some from every state on the United States mainland, Canada, Mexico, the South Americas including Puerto Rico, and AOPA members from Sweden, Holland, France, Germany and the United Kingdom.

All this of course says more than any words for the sheer hard work, capability and tremendous energy and application which is provided year-in and year-out by such stalwarts of the AOPA heirarchy as "Doc" Hartramph (president), Max Karant (senior vice-president), Charlie Miller (managing editor of the AOPA magazine *Pilot*), Art Frisch (sales and promotion) and so many others in this efficient and powerful organisation. In this connection of course it is well to record that general aviation is well and truly served in our own area by such men as Sven Hugosson and Torgil Rosenberg of Sweden, Simon Ames in the United Kingdom, Hans Mars of the Netherlands, Walter Lill and Wolfgang Trinkaus of Germany, and, of course, Hubert Koemans of the IAOPA Secretariat European Branch Office. There are others too numerous to mention throughout Europe.

The convention programme was similar in format to that of previous years, with flight courses running daily at McCarron Field and the complementary ground-school courses continuing each day in one of the hotels. The courses included:—

(1) the 360° rating course for the pilot wishing to increase his VFR proficiency and/or begin training for an instrument rating;

(2) the instrument nav/com course designed to give increased knowledge of radio-navigation aids and the second step for the pilot working towards his IR;

(3) the instrument en-route procedures course, the third step towards an instrument rating, with emphasis on the airways system, ATC system, and IFR cross-country procedures;

(4) the instrument-approach procedures course, the fourth step leading to an instrument rating, and covering all types of instrument approaches possible with the equipment in the individual aircraft being used;

(5) the instrument pilot refresher course, designed for the instrument-rated pilot wanting to up-date his instrument proficiency;

(6) the "pinch-hitter" course, designed for non-pilots or those with minimum flying experience, such as wives of aircraft owners, in order to teach them how to take over the controls en route, navigate to an aerodrome and land the aeroplane unassisted. (As all followers of American baseball will know, a "pinch-hitter" is the chap the coach keeps in reserve and sends out to bat when his team's fortunes are failing or the rest of his players have dropped dead, in the hope that with his mighty strikes he will retrieve the situation.)

Intensive study

In addition to the above, AOPA members were given the opportunity to take one of two intensive study courses lasting for three days prior to the formal opening of the convention to prepare them for taking the FAA written examinations for private pilot's licence or instrument rating. Both courses were comprehensive; the instrument written examination course covered meteorology (including the translation of teletyped weather information), cross-country planning (including computer work), Federal Aviation Regulations, flight instruments, radio-facility chart reading, and radio navigation, while the private-pilot written examination course included characteristics of aircraft performance, aircraft engine operation, Federal Aviation Regulations, basic navigation and radio navigation, use and operation of the computer, radio communcations procedures, weather, and aircraft instruments and their operation.

There were three symposium subjects: engines and equipment, general aviation's role in the national airspace system, and "hangar flying with the FAA." The first was a question-and-answer symposium which created considerable interest, with about a thousand people attending to fire questions at the panel. This consisted of Joe Diblin (Lycoming Division, Avco), Ray Fencl (Continental Motors), L. C. Gartin (Cessna), Henry Gregory (Beech Aircraft), and Al Hundere (Alcore Aviation). AOPA senior vice-president Max Karant directed the meeting and entered into the spirited discussions.

The main interest centred around increasing engine life, proper techniques for using lean mixtures at altitude, and correct fuel management. The engine experts pointed to the fact that over-rich mixtures can occur even at sea level, and can be corrected safely by proper leaning procedures; they further emphasised that engine roughness from over-rich mixtures can be caused by high altitudes, hot weather, application of carburettor heating, or a fuel system that is out of adjustment.

The second symposium was presented by James W. "Pete" Campbell, chief of the FAA's Flight Instructors' Refresher Unit at their Academy in Oklahoma City. He said: "The

answer to improved aviation safety is the flying instructor; if student pilots are taught to fly properly, safety will be greatly increased." Members of the FIRU travel throughout the United States teaching flying instructors the latest regulations, manœuvres, instruments and performances, as well as passing on the recognised additional procedures for teaching. The FIRU believes that thee answer to aviation safety is the flying instructor, and that if he teachers his pupils to fly aeroplanes instead of *an* aeroplane—in other words, if whilst instructing on one type he teaches the student the performance of others that he may move or up-grade to—then safety will be greatly increased.

In addition to this, Mr Campbell said, instructors should go further and instruct on the problems of hypoxia, hyperventilation, rapid decompression and other factors in modern aviation. He described the flying instructor as "a pilot, a teacher, a communicator, and a public-relations man all in one; he has the hardest job of any tutor in the world, for he has to teach in an environment that the human being was not created for. In doing so, he has first of all to overcome a basic human fear that everyone has from birth: the fear of falling. . . . Today's instructors should also stress the national aviation system; the airlines, the military and general aviation all use the system, and every pilot should known how to use it properly."

The third symposium subject was of importance to all Americans in general aviation; a meeting was starting at about the same time in Washington to discuss propesd rules which would establish both limitations of operations for general aviation and priority usage for airlinese at five major airports in the USA (the FAA has already named five other cities where similar restrictions would be imposed, and has declared that they may eventually be expanded to cover all 22 major hub areas).

An FAA group formed a panel to visit the convention to answer AOPA delegates' questions. This group consisted of Dr Peter Siegel, federal air surgeon, Robert R. Reynolds, assistant administrator for general aviation, Chester Bower, director (airport services), William Flener, director (air traffic service) and James Rudolf, director (flight standards). The group was headed by Dave Thomas, acting federal aviation administrator.

For two hours questions were fired at the panel. They ranged from the system of user charges to the enforcement of the 250kt speed limit, and touched on such other questions as the limitations of the transponder system, FAA safety rules, and the two-pilot per aircraft rule.

In addition to the flight course and symposia, there was an outstanding programme of aviation films supplied by the FAA, the Moody Institute of Science and United Air Lines.

This year, in conjunction with the convention, AOPA instituted its first aviation law seminar. Three sessons were held and some 70 lawyers attended each session. So successful was this adjunct to the convention that the originator of the idea, John Yodice, who acted as chairman of all three sessions, told me that "there is every indication that we should continue these seminars and hold them annually with the convention."

The vast array of general aviation products which are assembled each year has firmly established the AOPA show as one of the leading general-aviation exhibitions. This year there were well over a hundred exhibitors, many with two or three stands in different areas of the Exhibit Hall.

Many of the aircraft exhibited had new features and modifications, and some manufacturers are at last turning their thoughts to producing fully aerobatic light aeroplanes—far too many pilots for far too many years have been taught to fly, and even trained up to commercial-licence standard, on non-aerobatic aeroplanes. One shudders to think how they would go about returning their aeroplane to normal flight from an "unusual attitude," and this is what aerobatics teaches a pilot.

An AOPA convention, with its aim of serious business, hard work and lively discussions, would not be complete without its social side. Each year excellent entertainment is laid on in the form of nightly dinners, which afford contacts with people one may not have seen since the previous year, plus entertainment by professional performers. This year was no exception.

The final item to be recorded is that one AOPA member who owns a Travel Air and who flew into the convention was 22 when he was demobbed as a pilot at the end of the war—and that was in 1918.

THE 1969 HELIO COURIER

A new interior with a redesigned instrument panel and 3in gyro flight instruments in standard "T" arrangement distinguish the 1969 model six-seat Helio Courier. There is ample space for installation of additional avionics and instrumentation. Rectangular windows replace the former circular windows at the rear of the cabin, and access to the rear baggage area has been made easier. Powerplant can be either a 250 b.h.p. direct-drive Lycoming engine or a 295 b.h.p. geared Lycoming, driving a three-bladed propeller. Deliveries of the 1969 Helio Courier have already begun

DIARY

Oct 24	RAeS Glasgow Branch: "The Buccaneer," by Lt Cdr R. N. Moore; Glasgow University, 7.15 p.m.
Oct 24	RAeS Astronautics and Guided Flight Section: All-day symposium, "Commercial Applications of Satellites for Europe," 4 Hamilton Place, London W1, 9.30 a.m.
Oct 24	RAeS Christchurch Branch: "Weather for Flying—Forecasting procedures for Today and Tomorrow," by R. J. Ogden; East Cliff Hotel, Bournemouth, 8 p.m.
Oct 25	RAeS: Joint meeting of Graduates' and Students' Section and Cranfield Society: All-day symposium, "After Concorde and the Airbus What Follows?," 4 Hamilton Place, London W1, 10 a.m. (Tickets required).
Oct 25	European Organisation for Civil Aviation Electronics: Annual general assembly, Rome.
Oct 27	Shuttleworth Collection: Open day with flying demonstration, Old Warden Airfield, Biggleswade, Beds. Gates open 11 a.m.
Oct 29	Guild of Air Pilots and Air Navigators: Symposium, "Career Structure of Professional Pilots" (open to non-members); Royal Institution of Naval Architects, 10 Upper Belgrave Street, London W1, 6 p.m.
Oct 29	RAeS: Joint meeting with IEE: Discussion, "Increasing the Reliability of Electrical and Electronic Equipment under High Ambient Temperature Conditions" (opened by A. Thomas): Savoy Place, London WC2, 6 p.m.
Oct 30	RAeS Weybridge Branch: "Aircraft Interiors," by C. Butler; Apprentice Training School, BAC Ltd, 5.15 p.m.
Oct 30–31	Institution of Electronic and Radio Engineers: Conference on electronic weighing; Middlesex Hospital Medical School, Cleveland Street, London W1.
Oct 30	RAeS Southampton Branch: "Long-range Ferry Operations," by Wg Cdre D. E. Bennett; Lanchester Lecture Theatre, Southampton University, 8 p.m.
Oct 31–Nov 1	RAeS and SBAC: Symposium, "European Aerospace Data Exchange," 4 Hamilton Place, London W1 (admission by *invitation only*).
Oct 31	RAeS Cambridge Branch: "The Battle of Britain Film," by Air Cdr J. Wallace; Cambridge University Engineering Laboratories, 8.15 p.m.
Oct 31	RAeS Hatfield Branch: Film show, HSA Senior Staff Restaurant, 5.30 p.m.

INDUSTRY International

Products

Company News

EE-GEC Merger A document circulated to shareholders of the General Electric Co and English Electric Co on October 14 describing the proposed merger between the two companies—which is now likely to take place following the Plessey decision not to make a counter bid for English Electric—describes ways in which the two concerns' capabilities would be combined. An assessment of these, as far as the aircraft industry is concerned, was made in *Flight* for September 26, page 475.

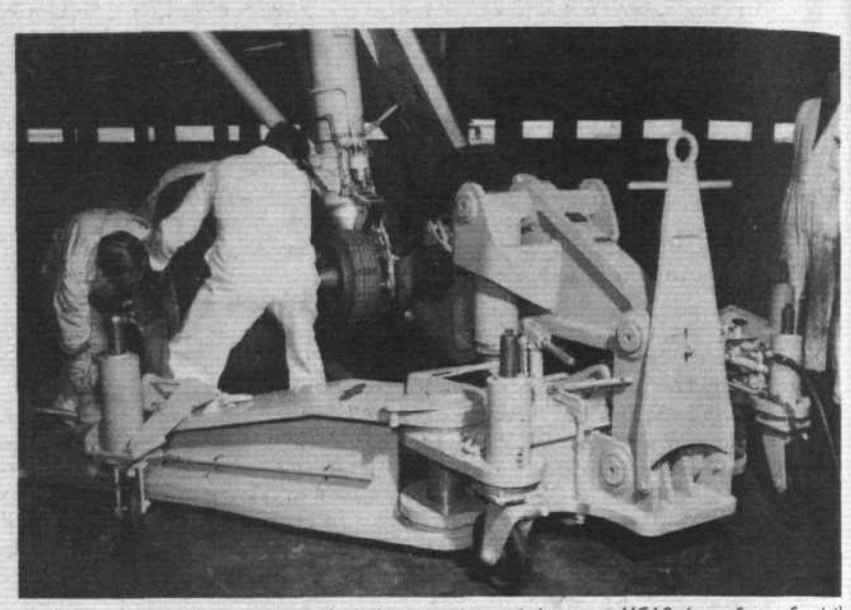
The merger brochure says that in electronics, the businesses of GEC-AEI and English Electric (including Elliott-Automation and Marconi) are largely complementary, particularly in radar, aerospace and defence equipment. It comments: "The broad range of radio communications equipment manufactured by Marconi would be strengthened by the highly specialised items manufactured by GEC-AEI." In telecommunications, Marconi products and technologies "are complementary to those of GEC. . . . Complete integration is desirable between Marconi and GEC on projects to meet the increasing overseas demand for comprehensive communication systems, including satellite communications. . . ."

Referring to exports, the document says that the present annual level of the two companies is about £175 million. It comments: "Apart from the sale of a wide range of products through agents, distributors and overseas subsidiaries, very substantial business is obtained through participation in major engineering schemes in many parts of the world. In such projects the combined marketing resources of the two companies could be deployed more effectively than has hitherto been possible or economic for either company."

Considerations which apply to a merger of GEC-EE activities in the UK also apply overseas in territories where the two companies both have subsidiaries. "In Australia, India and South Africa in particular, there is considerable scope for better utilisation of the manufacturing facilities built up separately, and joint operations will avoid duplication of future investments."

Jumbo Jack The cantilever aircraft jack, widely used in the United States, is claimed to have several advantages over the orthodox type. It is usable under any wheel-change conditions and is unaffected by tyre spread, even in the event of a double flat tyre, and in many cases renders mainplane jacking unnecessary in these circumstances.

Skyhi Ltd (772/7 Buckingham Avenue, Slough, Bucks) has designed and manufactured a 70-ton cantilever jack for use with the Boeing 747 and similar aircraft. Its low closed height of 4½in and its relatively high lift of 31in increase its versatility, and its manual mechanical safety lock, consisting of a threaded ram and lock collar, makes a double wheel change safe and reliable. The unit, which has positionable outriggers, is designed for easy dismantling and transportation; lifting eyes are provided for hoisting the unit complete or in component parts. Variable manual pumping is provided, and an air-operated power unit, eliminating the need for manual effort, may be simply incorporated. A lighter (50-ton) model is at present being developed.



Skyhi 70-ton cantilever jack undergoing proving trials on a VC10 (see foot of col 1)

Radio Simulator Powered by DEAC rechargeable batteries, a ground station simulator has been designed and developed by Cossor Electronics Ltd. Known as the CRM 555 ILS/VOR precision ramp test set, it produces radio frequency signals similar to those received by an aircraft in flight for the purpose of automatic landing guidance in the Cat 2 and Cat 3 operations. These ILS signals are provided by localiser, glide-path and marker transmitters.

For testing ILS and VOR receivers the CRM 555 simulator equipment must maintain extreme stability and reliability. This is achieved by using the latest electronic circuit techniques and a stable lightweight source of power which is provided by DEAC batteries.

Acceleration Transducer Smiths Industries Aviation Division has developed a miniature low cost seismic acceleration transducer which not only weighs less than 2oz but also contains all the electronics necessary to produce d.c. output from a d.c. source.

The unit, which is six times lighter than previous models, operates from a 9V d.c. supply and is contained in a volume of 0.7cu in. It has been produced to satisfy the growing demand for miniature transducers for control, guidance and instrumentation systems for space vehicles and missiles.

Performance is enhanced by an extremely low sensitivity to cross-coupling effects. A transverse acceleration of six times the full operating range will not cause a change in output greater than one per cent. Linearity is better than one per cent and the effect of temperature is less than 0.05 per cent per °C.

ATC Simulator for Holland The Netherlands Government Purchasing Office, acting on behalf of the Department of Civil Aviation (Rijksluchtvaartdienst), recently placed a contract worth over £100,000 with the Digital Systems Department of Ferranti Ltd, Bracknell, Berks, to supply a radar simulator system for use by the training school for approach and area radar controllers being established at Schiphol Airport, Amsterdam. The system will also be used to test and evaluate new operational procedures.

Training is currently carried out in Holland in parallel with the control of real traffic on operational ATC equipment. The limitations of this method will be overcome, and the time taken to train controllers be considerably reduced, by using the simulator which is based on a Ferranti FM1600B micro-miniature digital computer, to be equipped with 24,576 words of 1μS cycle time

core storage, word length being 24 bits. If required, the core store can be expanded to 65,536 words.

The FM1600B is one of the Ferranti FM1600 series of general-purpose, integrated circuit digital computers. This series is specifically designed for real-time on-line applications, and capable of multiple simultaneous peripheral transfers via a Ferranti standard interface. Use of this interface considerably simplifies system design and manufacture.

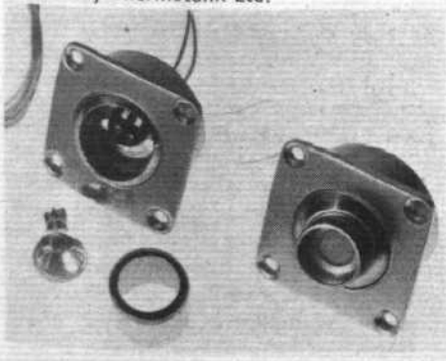
The FM1600B employs Ferranti Micronor II integrated circuits mounted on multi-layer printed circuit boards. The central processor, including one 4,096-word block of 1μsec core store, complete with drive and address circuits, fits in a single shelf module 49cm×41cm×18cm (19in×16in×7in) and weighs 18kg (40lb).

Simulating the movements of up to 30 aircraft within the Amsterdam FIR, the system will generate video signals—representing one approach radar and one long-range radar—for display on the trainee controllers' equipment. In addition, flight progress strips will be printed for each exercise. Different exercises can be run simultaneously at the four trainee positions provided, movements of the simulated aircraft being either pre-programmed, manually controlled, or both methods combined. Each of the control positions has a Ferranti CRT tabular display unit for automatic presentation of aircraft data, and a Ferranti keyboard for control and requests for additional data.

The system will be supplied complete with all necessary programmes, real-time simulation programmes being written so as to make exercise preparation a relatively simple procedure. An on-line Teletype 33 will also be provided; this will permit parameter changes and other supervisory actions during exercises. Input tapes for three complete exercises will be delivered with the system, together with general-purpose programmes which will facilitate maintenance and development of further software.

Light and Air A reading light for cabin or flight-deck fitting and a new, twin development to the existing range of punkah louvres for all types of aircraft have been designed and manufactured by the Products Division of Thermotank Ltd (150 Helen Street, Glasgow SW1). The units are the lightest of their type available and weigh 2.5oz. The twin units, supplied in self-coloured

The reading light (left) and punkah louvres produced by Thermotank Ltd.

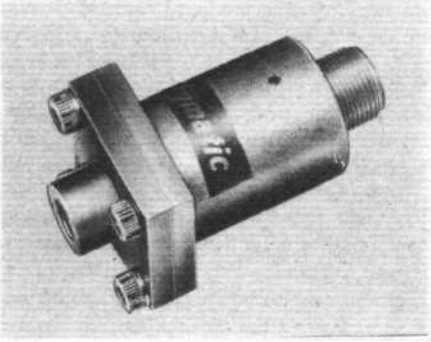


or gold anodised aluminium, are 2.14in square across the flanges and have a ball diameter of 1.5in.

The HPSA 1½ aircraft louvre has a capacity of up to 13 cu ft/min and embodies a nylon cone and nylon sealing rings in a spring-loaded flange. Directional control over the air louvre is 24° from the centre line.

The reading light (Type ARL 1½) gives a 12in-15in pool of light at 3ft with minimal dispersal of light concentration. The standard fitting uses a 6.75W 28V wedge-based conical aluminised bulb. Bulbs are also available for use on 12V and 24V systems. The light is also available with a bulb guard attachment. Directional adjustment of the fitting can be made 14° from the centre line.

Pressure Switches A range of pressure-operated electrical switches, with high resistance to vibration and acceleration for aerospace applications has just been introduced by the Aerospace and Advanced Products Division of the Hymatic Engineering Co (Glover Street, Redditch, Worcs). The range includes both gauge and differential switches suitable for use with a wide range of gases and liquids, including fuel and hydraulic oils. Operating pressures up to 3,000lb/

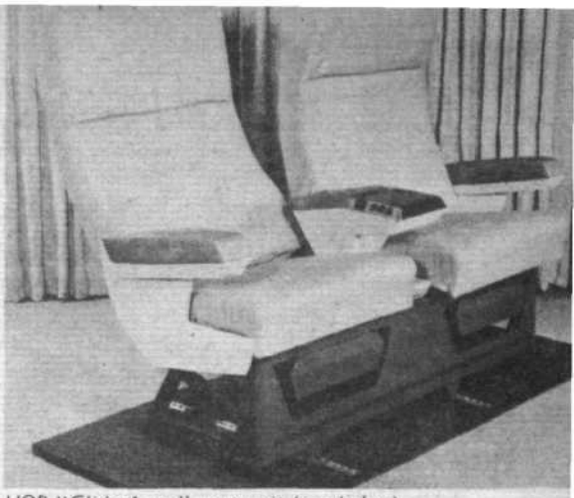


Hymatic's new pressure-operated valve

sq in are covered by the switches, which are designed to operate at temperatures between −50°C and 180°C; service life is stated to exceed 100,000 cycles.

A coned disc spring is employed, the low mass of which contributes to efficient operation under extreme vibration and acceleration conditions. The shape of the spring makes it possible for a wide range of strengths to be accommodated in a standard body; and the spring also supports the sealing diaphragm, reducing the possibility of diaphragm failure.

Comsat Contract British Telecommunications Research, a Plessey subsidiary, has received a contract from Communication Satellite Corp, manager of Intelsat, to study demand assignment techniques. These enable a variable number of circuits to be allocated in accordance with the immediate needs of Earth stations, rather than a fixed allocation as currently employed. The benefits which, it is hoped, could accrue from the adoption of such techniques include better utilisation of satellite capacity and economic use of satellite systems by



UOP "Glide-Away" seat unit (see below)

countries offering only small amounts of traffic.

To achieve this, BTR engineers will call upon knowledge available at Plessey Telecommunications Group and Plessey Radar, which have long been associated with international and space projects. In addition the company will retain the services of Cable and Wireless and Stanford Research Institute to advise upon the various operational, economic and technical aspects. The GPO will also advise.

Seating Concepts Two new aircraft passenger seat units have been introduced by the Aerotherm Division of Universal Oil Products Co (Bantam, Conn 06750, USA). The first is a new concept in seat structure, called the Olympian, which prevents under-seat baggage from sliding forward, aft or sideways, and provides a built-in stowage area for lifejackets. The lateral structural member is on the floor, permitting support legs to be placed in a position providing maximum space under the seat. Seat interchangeability is also increased.

The other newcomer, the "Glide-Away Recline," employs new geometry to increase levels of comfort. The seat squab itself moves in an aft direction, with the rear of the seat squab lowering at the same time.

Testing Throbbing Tyres A vibration system designed to test wear, flexibility and cord stresses in tyres has been designed, built and installed by Fairey Surveys of Maidenhead, Berks, for the Bridgestone Tyre and Rubber Co of Tokyo, Japan.

The system comprises three low-thrust hydraulic vibrators mounted on a rigid base frame and connected to a platform which can then be vibrated in the vertical, horizonal and transverse planes simultaneously. Each vibrator is independently controlled by its own electronic unit and the entire system is controlled by a punch tape or punch card programmed on a computer or by a simple pre-recorded control signal.

A Thousand Mach/ASIs Orders have recently been received by Smiths Industries which bring the total number of Mach/ASIs ordered by the Boeing Company in the last two years to more than 1,000 units. These alone are worth nearly £500,000.

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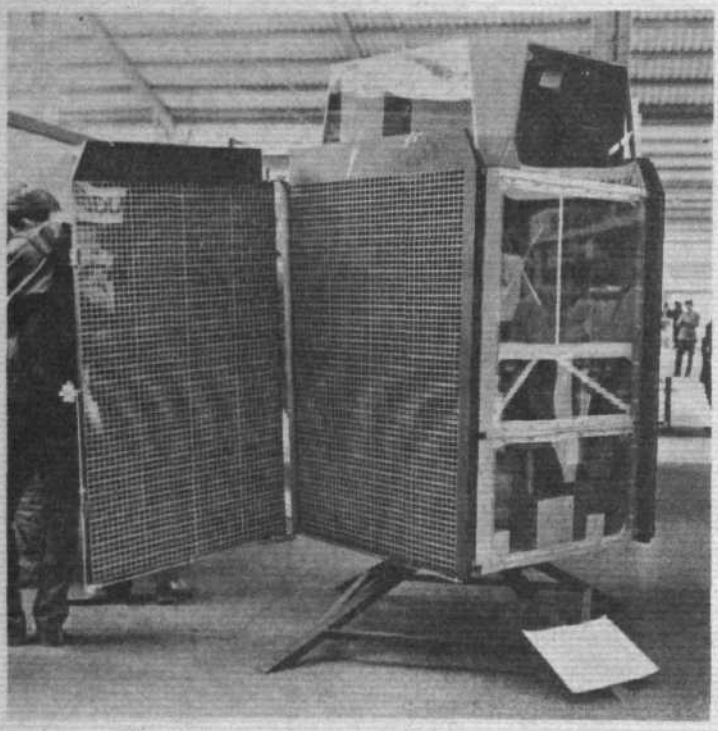

As recorded on this page, ESRO's TD1 satellite is to be revived, although in slightly different form from that originally proposed by the MESH consortium. The mock-up illustrated here was photographed at the Hanover Air Show last May, at just about the time that cancellation of the project was announced by ESRO. The demise of LAS (ESRO's large astronomical satellite) leaves TD1 as the largest ESRO project at present under development

TD1 TO GO AHEAD

As a result of the ESRO Council meeting which took place in Paris last week, it has been decided to resume full-scale work on the ESRO TD1 scientific satellite. The TD1 and TD2 satellites were cancelled by ESRO last May (see *Flight* for May 9) because of cost increases. Since then the MESH consortium (Matra, Entwicklungsring, Svenska Aeroplan Aktiebolag and HSD), which was developing the two satellites, has been carrying on work common to both satellites on the basis of a three-monthly holding contract while ESRO and MESH sought to find ways to keep at least one of the projects alive.

Agreement has now been reached on the form in which this can be done for the first project; the satellite (now designated TD1A) will proceed as an ESRO "special project" because of the refusal of one member—Italy—to finance the programme on the grounds that she will have insufficient work for her investment.

The original TD1 project has been considerably simplified, notably in respect of the attitude control system, and a Sun-synchronous orbit will be employed so that the satellite will be continuously in sunlight. These changes will reduce the cost and increase the system reliability. The cost is expected to be about NF200 million (about £17.3 million) of which Britain will pay nearly £4 million.

A simultaneous exercise to salvage TD2 has also been in progress since May. ESRO has proposed that the TD2 experiments be flown aboard an American OSO-type satellite (which would be bought from USA), while a counter-proposal from HSD is to use an existing ESRO satellite structure (ESRO 1 or 2) and thus capitalise on existing experience.

TD1 and TD2 are both astronomical satellites. While TD1 is concerned with the ultra-violet and infra-red measurements of stars, the purpose of TD2 is to accumulate data on the Sun during the years of maximum solar activity (1969-1970). Under the original schedule, TD1 was to have been launched after TD2.

HUGHES TO BUILD INTELSAT 4

The Interim Communications Satellite Committee, governing body of Intelsat, approved on October 4 the choice of Hughes Aircraft Company as the prime contractor to build the advanced Intelsat 4 communications satellite. The contract calls for the delivery by September 1970 of four flight spacecraft, one prototype and associated test and ground equipment. As with Intelsat 1 (Early Bird) and Intelsat 2 and 3, the new satellites will be owned jointly by the 63 member nations of Intelsat. The first will be launched in late 1970 or early 1971 by Titan 3B-Agena into geo-stationary orbit. The competition was won from two other submissions by TRW and Lockheed.

Intelsat 4 is a follow on from the TRW Intelsat 3, and the value of the order is about $72 million. Some $19 million of this will be subcontracted to other Intelsat members, including the United Kingdom, France, West Germany, Japan, Italy, Switzerland, Belgium, Canada, Sweden and Spain. BAC Filton will be responsible for the structure of the third and fourth flight models.

Intelsat 4 will be much larger than its predecessors: its length and diameter will be 16ft 1in and 7ft 11in compared with 3ft 5in and 4ft 8in respectively for Intelsat 3 (the first of which, launched on September 19 to provide coverage for the Olympic Games, was lost when its launcher rocket had to be destroyed just after launch as a result of a gyro unit being incorrectly installed). The new satellite will be spin stabilised, with two dish aerials and four horn antennas.

Each satellite will contain 12 transponders, of which eight may be used for "spot-beam" coverage directed at selected high communication-traffic areas, or for broad beam or "Earth coverage" when it will serve over one-third of the Earth's face. The remaining four transponders may be used for broad-beam coverage only. This ability to switch from narrow beam to broad beam as required will provide great flexibility in the selection of the best configuration for particular traffic needs. The capacity of each Intelsat 4 will be 5,000 voice-grade circuits (Intelsat 3 has 1,200). Power will be supplied by a solar array and battery system similar to the earlier satellites, and the life expectancy of each spacecraft is seven years.

HEOS AT CAPE KENNEDY

The prototype HEOS (highly eccentric orbital satellite), the third spacecraft in the ESRO programme, has been sent to Cape Kennedy for compatibility and checkout trials and these will be followed by the two flight models later this month, in preparation for a launch by a NASA rocket on December 5.

The satellite carries experiments to measure the energy spectrum of electrically charged particles outside the Earth's magnetic field. To this end it has (as defined by its designation) one of the most eccentric orbit of any Earth satellite. Specifically, the orbit will have a perigee of 248 miles and an apogee of 155,000 miles. The experiments are designed by the Max Planck Institute for Space Physics, Munich; Imperial College, London; the Laboratory for Electronics and Physics, Saclay (France); and the Institute for Physics, Bari University, Rome. Total cost of the project is about £3.25 million.

APOLLO'S SMOOTH WEEK

PERHAPS THE BEST INDICATION of the uneventfulness of the flight of Apollo 7 during last week was the—initially—friendly banter of the crew—Walter Schirra, Walter Cunningham and Donn Eisele—with the Houston control centre, and their preoccupation with minor details such as food.

Both Schirra and Eisele continued to suffer from their colds, and on October 13 Cunningham was also reported to have symptoms of a cold. Doctors at Houston have thus been given their first chance to diagnose and prescribe for illness in space. Possibly because of the continuing feeling of discomfort, Schirra complained about a number of minor design faults in the command module. For example, discussing the new hammock-type sleeping bags (Mercury and Gemini had contoured couches), Schirra said he missed the g-effect of the earlier restraining harness, with its better control of body movement.

Schirra also complained that the work load was such that he could not get enough sleep, and accordingly a new schedule was devised to give a rest period of nearer 8hr.

Another grumble concerned the drinking water system. Separated from the waste water tank by only a valve, a daily chlorination procedure was adopted as a precaution against contamination until the crew complained that the water was becoming unpalatable. After discussion with Houston it was decided to stop the process for a while until the taste improved. The provision of hot water was, according to Schirra, one of the best features of the spacecraft (all food was dehydrated, and had to have water added before consumption). Another minor criticism concerned the quality and taste of the food. The crew complained that they had too much food, and that it was too sweet; also that the command module was gradually becoming overrun with crumbs.

The only fault which caused major concern last week was the shut-down of the a.c. supply from the inverter system. This obscure snag occurred twice and an investigation at Houston indicated that the probable cause was the periodic switching of high-current equipment; specifically the fan motors in the oxygen system were suspected, and the crew was told to turn off one of the motors. There were no subsequent reports of this snag, but as a precaution against a possible recurrence that might result in a permanent shut-down of the supply, the orbit was lowered by some 40 miles at perigee to make it easier to effect a re-entry in the case of an emergency. The orbit was therefore changed on October 15 to 103 miles (perigee) and 184 miles (apogee).

Four TV transmissions were made using the RCA miniature camera, and viewers were shown close-ups of the crew, both at work and at rest. These transmissions, although intelligible, were not up to commercial standards, probably due to the large variations of light intensity with which the camera had to contend. During these transmissions Schirra drew attention to one of the windows which had become coated with debris during the flight.

While the colds from which the astronauts suffered seemed to have little more than nuisance value, the crew began to be increasingly worried as the week progressed about the effects which the rapid pressure changes on re-entry would have on their ears. Schirra had fears that this could result in burst eardrums and discussed the possibility of a "shirt sleeves" re-entry, so that the crew could pinch their nostrils and blow, thus equalising the pressure during this phase. One possibility was that the astronauts could wear the suits without helmets, so that their bodies could be suitably restrained (the suits are strapped to the astronauts' couches). Schirra pointed out, however, that this procedure would not provide a head restraint, introducing the possibility of broken necks. This problem was left unresolved.

A further snag concerned the medical harness, from which heartbeat and breathing data were telemetred to Earth, and which gave persistent trouble by continually breaking. Schirra refused to repair his damaged harness and said that the crew was very concerned at the possibility of sparks from broken wires causing a fire. The faulty harnesses caused the crew considerable irritation.

The manœuvre rocket engine was exercised on a number of occasions for test purposes, the longest firing (66sec) occurring on October 18. Its performance and controllability (at 21,500lb thrust, it is the largest rocket motor yet used by American astronauts in orbit) was highly praised. This rocket is critical to the success of the Moon-landing flight; it will be used to place the command and lunar modules in orbit around the Moon, and also to provide the boost to fly the command module back to Earth at the conclusion of the flight. The burn, initially controlled automatically but later operated manually by Schirra to test an emergency procedure, increased the apogee from 174 miles to 280 miles.

On October 18 flight director Eugene Kranz said that the Apollo 7 flight had so far been extremely free from faults. He had a list of 36 snags which had been encountered, all but one of which had been tracked down, while the outstanding one had disappeared. This was, he said, a result of the spacecraft settling down during the long flight, thus allowing a thorough evaluation of the systems at leisure.

As the week drew to a close, the only thing casting a shadow on re-entry—apart from ear problems—was Hurricane Gladys, centred about 170 miles south-west of Tarpa, Florida. "Tell them to get it out of the way" was Schirra's comment.

The Crisis in Europe

By KENNETH W. GATLAND

In this, the second of two reports on the recent BIS meeting, the political aspects of European space activities are again seen to be predominant.

THE tendency in Britain was to get out of the launcher field as one could always get scientific satellites launched elsewhere. This meant playing no significant role in communications satellites. As far as defence applications were concerned, we could get hardware launched if the launching country went along with our policy. The Gaullist line was different. They wished to preserve independence.

There had been suggestions from some quarters—but not from people in R&D—that if we went out of the field for ten years we could come back in and catch up within a decade. The task, Mr Cleaver emphasised, would be immense and our competitors would then include the Japanese and Chinese. The arguments against going on now, when technical teams, facilities and hardware are in being, would then be ten times stronger as we should have to build again from the beginning. In the circumstances, industry and the establishments would play only a minor role as sub-contractors to programmes dominated by the United States.

Dr Simmons thought Mr Cleaver had made a fair summary of the present difficult position. European space conferences were dominated by political considerations and as a Government servant he did not propose to touch on political issues. In his work for CETS and the Causse Committee his first concern had been communications satellites. Initially, the choice had been between Thor-Delta and the ELDO launcher but

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after the European Space Conference of 1966 studies had been concentrated on ELDO-PAS. Thor-Delta vehicles were more economical because they were in serial production.

The first-level capability of ELDO-PAS was 170kg in geo-stationary orbit. This was usable but "tight" for the communications requirement. Small modifications allowed the payload to be brought up to 190kg, sufficient to exploit a Eurovision satellite and perhaps some others. ESRO had been brought into the deliberations as "they knew all about satellites." The next step would be payloads of some 500kg, which added much more than power/weight ratio, particularly in power. This really would have flexibility and be capable of exploitation, Dr Simmons observed. Within ten years there was the prospect of 1½ to 2 tons in geo-stationary orbit. As far as could be seen this level of payload for stated applications (for example direct-broadcasting of TV) was not going to be appreciably reduced. The Causse report had indicated the scope of this programme using new boosters, lox/hydrogen and electric propulsion.

The ink was hardly dry on the Causse report before these prospects were demolished.

Meanwhile, the cost of ESRO was escalating and the ELDO situation had grown worse. In mid-summer there had been a US offer of collaboration on launchers, including those for scientific and applications satellites, but there was one important proviso. The project must not compete with Intelsat or drain revenue from a global system. Mr Creasey "was not quite fair" in saying that all activities were truly global; some could be regional. It had yet to be decided if Intelsat would be extended to cover all such circumstances.

It was impossible to predict what would become of the CETS/ESRO deliberations. CETS was still nominally linked to the ELDO launcher and it could still appeal to some Governments. If an established US launcher were used one could come closer to a cost-effective system. However, political factors would play a great role and the future was hazy.

In other fields some development could proceed on the basis of national programmes. Meteorological satellites could be launched by Black Arrow and Diamant B. The French already had such a programme in Eole but using an American Scout. Although air-traffic control satellites might be studied in Europe they were subject to the same international considerations as communications satellites.

Dr Simmons concluded by contrasting the amount of public interest in space he found in France as compared with Britain. The difference, he said, was quite marked.

Political politician

Mr Neil Marten said he was merely a politician, and he would be political. Mr Cleaver had put the Government's case though his heart wasn't in it.

In his own mind the Government's attitude had been made perfectly clear by the Minister of Technology in a Parliamentary response to Mr Woodrow Wyatt on April 23. Mr Wedgwood Benn had said: ". . . when it becomes apparent that a programme cannot be economic even if the research and development is written off it makes a lot more sense to do what we are doing and put money into an airbus engine, shipbuilding, computers, machine tools, or any technology which leads to a return on our balance of payments." This was the essence of the matter. The Government looked at this entirely politically. They were determined to get the balance of payments right for political reasons. They had not been statesmen but put Party political matters before the national long-term interest.

It seemed, Mr Marten continued, that Parliament was totally disinterested in space. He had asked for a full day's debate, or even half a day. But never in all the four years of the present Administration had even a quarter of a day been given over to it. Space did not carry the popular appeal of other issues. "If you were to push pensions aside there would be an absolute outcry."

Mr Marten thought a Conservative Administration would take a more rational view despite Treasury pressures. One had only to look at the record of the 1950s. It was a Conservative Government that started Blue Streak, admittedly for military purposes. The Conservatives started ELDO in 1961 "which apparently we are burying tonight." Black Knight was started, and in 1964 they gave the go-ahead for Black Arrow and UK-3. The record shows that they did see potential in space. Had they remained in power, Mr Marten said, he was sure these efforts would have continued.

What should we do when we got back? Could we start it all up again? It was rather sad because Britain would be regarded as perfidious in collaborative space projects.

It is odd that we should be in this position when the Prime Minister talked so much of technological revolution. We ought to have a fall back position. Any one country in five or six could have a balance of payment crisis and rupture the whole thing. How wise was it to put all eggs into international collaboration of this sort?

We have Blue Streak, we have Black Arrow. We could mount Black Arrow on Blue Streak. We could later apply RAE work on electrical propulsion and have a satellite of commercial size in geo-stationary orbit. We could get a useful return and offer a package deal to other countries. Such countries could have their own TV satellite serving their own particular areas. If we didn't go into this (continued the speaker) we should miss out on one of the most important developments of the latter half of this century. Telephone traffic will grow to the extent that cables cannot cope, and regional satellite systems will relay TV where at present we rely on large numbers of booster stations. We may even see United States and Soviet propaganda going into our homes from direct-broadcasting satellites.

There were obviously tremendous economic advantages in satellites for communications, navigation and meteorology. And how risky it was to rely on other countries for all our needs.

East of Suez

It was very likely, Mr Marten went on, that a Conservative Government would wish to retain a modest East-of-Suez capability. A fairly small defence force in the Far East which could be quickly reinforced was highly desirable. Communications with the Middle East and Far East must be reliable, and dependency on the United States for launching our defence communications satellites was taking the surrender of our defences too far. "We must retain our own launcher capability."

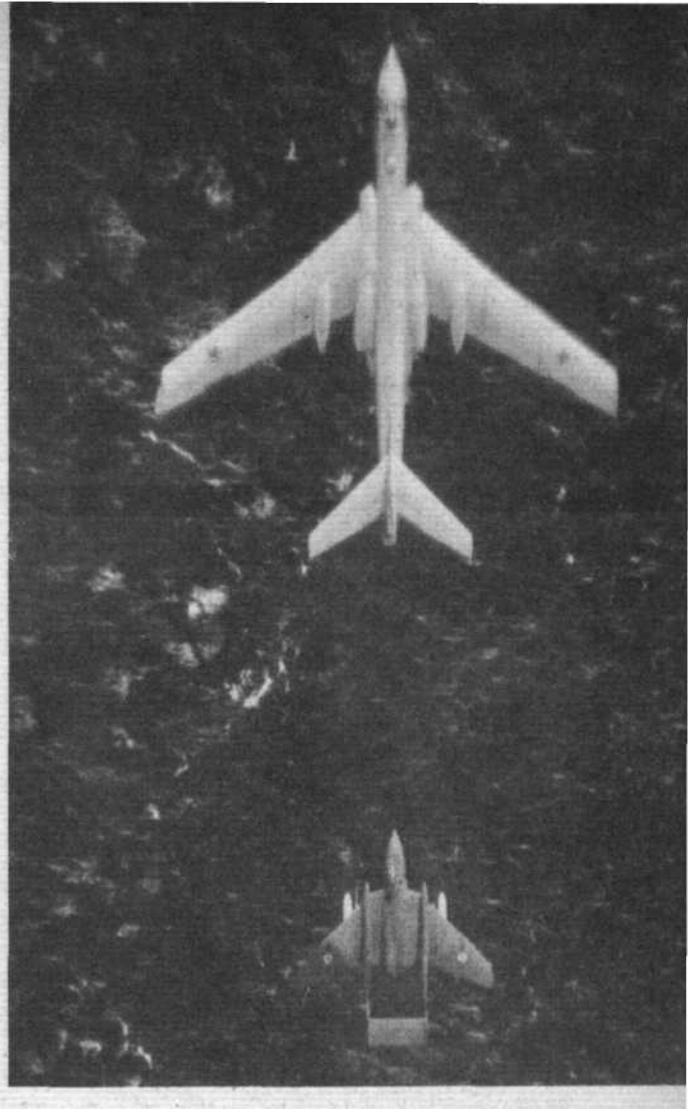
Mr Marten also agreed with Mr Cleaver that it was essential to have one Minister with responsibility for space matters. The Treasury liked to "divide and conquer"; and this was easy when so many ministries and departmental committees had minor responsibility.

Mr Marten said he hoped that if ELDO did finally collapse the Government would "not do a TSR-2 and scrap Blue Streak and all the valuable facilities for political reasons."

In the discussion that followed Mr B. Buss (Hawker Siddeley Dynamics) said he felt the Causse report did not deal sufficiently with economic aspects. This was the important area. He didn't agree that industry should continue to support studies indefinitely. They had now being doing PV work for ten years. If ELDO fell down the tendency would be to write *finis*. One could not keep a project on ice. If work was stopped on Blue Streak, one might as well bury it as TSR-2. He thought it wrong to compare Europa with Thor-Delta. The European launcher would be capable of putting up something like a ton, and he had not seen a proper economic study on this. Replying to the last point, Dr Simmons said CETS studies had looked at a much improved Thor-Delta of 1972 vintage.

Another speaker who wished to remain anonymous (he was on the point of retiring from "the Ministry") said in no uncertain terms that neither Conservative nor Labour came out with credit. Parliament had pursued a vacillating policy over the past ten years in missiles, aircraft and space. A successful programme needed continuity, regular employment and gathering expertise. Policies pursued by both Parties had caused enormous damage to the aerospace industry and wasted vast sums of money.

DEFENCE



Russian Badger and RN Sea Vixen: a photograph taken by F.95 camera from another Sea Vixen during the recent NATO maritime exercise Silver Tower ("Flight," October 10), which Soviet ships and aircraft kept under constant surveillance. The Sea Vixens were from 899 Sqn, HMS "Eagle"

Australian Aermacchi MB.326, one of the RAAF "Telstar" aerobatic team. A total of 75 of these Italian light strike/trainer aircraft has been ordered

TURKEY'S DAGGERS

RECENT RECEIPT BY Turkey of a squadron of F-102 Delta Daggers adds sharpness, if not of the most modern kind, to the armoury of her air force. She had been hoping for F-4 Phantoms, but the recent US decision to supply 50 of these aircraft to Israel (*Flight*, October 17, page 626), plus the pressures of the Vietnam conflict, makes even more remote the likelihood of Turkey's receiving them.

It may also be that the use by Turkey of US-supplied F-5s on sorties over Cyprus during the 1966 Greek-Cyprus troubles has slowed down the prospect of her getting Phantoms, though the Royal Hellenic Air Force had also received F-5s as part of American military aid.

The Turkish Air Force (Türk Hava Kuvvetlui) is the largest in the Middle East area and an important part of NATO's Central Treaty Organisation. At present, in addition to the F-106s just acquired, it has an intercepter/strike force of about 100 F-86E Sabres, some 250 F-100C Super Sabres, about 40 F-104G Starfighters and 140-150 F-5s. Additionally it has some 30 RF-84Fs and RT-33As for reconnaissance purposes.

The THK transport force numbers about 50—ten C-130Es, plus C-54s and C-47s; it has no maritime aircraft, surprisingly, in view of Turkey's long coastline. With the Bosphorous as Russia's entrance to the Mediterranean, Turkey is in an ideal position to observe Soviet naval movements, as could be seen from the *Moskva* helicopter carrier photograph reproduced in *Flight* for October 3. However, lack of appropriate equipment inhibits her from playing a part in NATO's new command, Maritime Air Forces Mediterranean, whose formation was announced last week (see page 681).

French Missile Armoury

IN ADDITION TO THE ICBM France recently announced her intention of building, she is to have a range of land- and sea-launched intermediate-range ballistic missiles. Four Naval FBMS (fleet ballistic missile submarines) are due for completion between 1970 and 1972, an experimental vessel of the type being currently used for test firings. The Air Force is to have a missile brigade with 27 IRBMs, organised into three squadrons with nine missiles each; this unit is now being formed with 1970-71 as its in-service date. The missiles are being based in Haute-Provence, where construction of silos and underground control centres has already begun.

France's ICBM, although it will take her several years to develop, will give her complete nuclear independence when added to the Force de Frappe based on Mirage 4As armed with 80-kiloton atomic bombs.

F-111 Criticism Rejected

ANOTHER CHAPTER in Australia's Parliamentary argument over the F-111 purchase was closed on October 10 with rejection by the House of Representatives of an Opposition motion condemning Government handling of the purchase. Moving it, the Opposition's deputy leader, Mr Lance Barnard, criticised the Government's failure to secure basic guarantees and safeguards on cost and delivery of the aircraft. He described the F-111 as "a vastly expensive weapon system which Australia was not equipped to sustain or use effectively."

In his reply, the Prime Minister, Mr John Gorton, said that the F-111 had been subjected to months of examination by expert advisers of the Government. He believed it was not unwise to buy an aircraft which would fly far into the future and be the most modern available.

DEFENCE

RAAF IN VIETNAM

RAAF SUPPORT of Australian operations in Vietnam, and those of her allies, has been largely overshadowed by the flying operations of the USAF; but the fact remains that, not only in South Vietnam, but in long-range transport flights between Vietnam and Australia, these operations greatly exceed in extent and significance RAAF action in any air operations since the Second World War.

In the four years during which they have been operating in Vietnam, RAAF Caribou have transported more than 48 million pounds of freight, four million pounds of mail and 250,000 passengers. Their tasks also include medical evacuation, supply and paratroop dropping, and the movement of Vietnamese families who are being relocated.

The RAAF Canberra bomber squadron which has been based at Phan Rang in South Vietnam since April 1967 provides four day and four night bombing sorties daily, each aircraft carrying six 1,000lb and two 500lb bombs. The squadron also provides pilots as forward air controllers, flying light observation aircraft at low altitudes to guide strike aircraft on to their targets.

Recently, a communiqué issued from RAAF headquarters in Canberra told how a Canberra crew had killed an estimated 35 Viet Cong in a bombing raid on an enemy camp. It dropped four 500lb bombs on the target, accounting for another 20 wounded, and destroying 15 buildings and nine sampans.

RAAF HQ said that this was the most significant bomb strike yet by No 2 Sqn. The previous highest death toll in any bombing raid was 20 enemy killed. Latest strike in the Delta region brought the total enemy killed by 2 Sqn to 432.

The Canberras have an enviable record of accuracy against enemy installations throughout South Vietnam. Canberra crews often fly more than 100 missions during their tour. In that time they drop thousands of tons of bombs on enemy targets.

The RAAF has lost no aircraft through enemy action, but two Caribou transports and an Iroquois helicopter have been lost in flying accidents.

More than 700 RAAF personnel are now serving in Vietnam. They are in Nos 35 (Caribou) Sqn, No 9 (Iroquois) Sqn at Vung Tau and No 2 (Canberra) bomber squadron at Phan Rang, 165 miles north-east of Saigon. There is also an administrative unit at Vung Tau, a command headquarters at Allied Headquarters in Saigon, and a number of small elements scattered through the Republic on a variety of tasks.

Iroquois of 9 Sqn, RAAF, with three Centurion tanks of the 1st Armoured Regt, Australian Army, during tactical manoeuvres in Phuoc Tuy Province, South Vietnam. The helicopters are based at Vung Tau (see map below)

Map showing location of RAAF units based in South Vietnam

Since they were first deployed to Vietnam on August 8, 1964, the Caribou aircraft have flown many thousands of miles in all kinds of weather on their varied transport tasks.

In a typical day the Caribou crew may land at as many as nine or ten airstrips —ranging from heavily defended air bases to temporary dirt strips. One mission could be to evacuate Vietnamese families, complete with household goods and livestock. Next on the list could be the supply drop of cows to a village. The beasts are crated up and parachuted gently to the ground, ready for the morning's milking.

The aircraft of 35 Sqn perform a wide variety of functions throughout South Vietnam. Under the direction of the US 7th Air Force they operate as a troop transport. They carry vital supplies of rations and ammunition. To the small special forces camps dottting the central highlands of South Vietnam, they are a most welcome sight with their bags of mail. Responsibility for the delivery of

all items, for their safe handling and disposal, fall on the loadmaster and his assistant.

No 9 Sqn operates exclusively in support of the Australian Task Force, while the other two RAAF squadrons (2 and 35) are under USAF operational control.

The helicopter squadron, which arrived at Vung Tau in mid-1966, recently acquired the newer and more powerful Hs. Originally equipped with eight of the Bs, the squadron has now more than doubled its strength. With the gradual phasing-out of the B model, the helicopter squadron in Vietnam today is as modern and well-equipped as any operating in the theatre.

From first light to nightfall, the supporting role of the helicopters covers combat assault troop movements, re-supply missions to forward lines and evacuation to hospital of battle casualties.

While re-supply and troop movements are an important part of their work, perhaps the most demanding, and at the same time most rewarding, of the squadron's tasks is that of medical evacuation. During the day medical evacuations, or "dustoffs", as they are termed, are part of the normal functions of the squadron. At night, in cases of emergency, an all-night crew maintains a vigil.

These "dustoffs" are often performed under heavy enemy ground fire, exposing both crews and aircraft to serious danger. Although its primary role is one of support, 9 Sqn, because of its greater proximity to actual participation in the war than the other two RAAF operational squadrons, sees more action.

The daylight bombing missions of No 2 Sqn are conducted under the control of a Forward Air Controller (FAC), who pinpoints the target with smoke and directs in the strike aircraft. A number of RAAF pilots have completed six-month tours as Forward Air Controllers in provinces around Saigon. Others are currently doing a tour.

Flying in light observation aircraft at low altitude, the FAC controls many air strikes and flies additional sorties on visual reconnaissance and associated missions.

In addition to the three squadrons engaged in tactical operations in support of the Australian effort in Vietnam, the RAAF has the task of providing air transport and medical air evacuation between Vietnam and Australia, not only for its own personnel, but also for the Australian Army forces in Vietnam, whose strength now exceeds 7,000. The increased commitment, which was made in April 1967, has proved no problem for the RAAF because it had just taken delivery of a whole new squadron of Hercules transports, more than doubling uplift capacity in this type of aircraft. The new squadron, based at Richmond, NSW, was numbered 37 to continue the tradition of a Second World War transport squadron. All of its 12 Hercules are C-13Es which have a much greater payload and capacity than the C-130A Hercules already in RAAF service.

RAAF Butterworth Mirages

A SECOND SQUADRON of RAAF Mirages is to be sent to Butterworth in Malaysia, in accordance with decisions reached at the five-power defence talks (Australia, UK, Malaysia, Singapore and New Zealand) in June, when Australia agreed to maintain an air force detachment at Butterworth. The move involves 16/18 aircraft and about 250 men.

NATO's Mediterranean Response

RESPONDING TO INCREASED Soviet naval forces in the Mediterranean, the North Atlantic Treaty Organisation has set up a new command, Maritime Air Forces Mediterranean. Based on Naples, it will come into existence on November 21 and its first commander will be an American, Rear Admiral Edward C. Outlaw. Three countries—the US, Britain and Italy—are assigning forces to the command from its outset.

Dassault/Dornier Military Trainer?

IN ADDITION to his announcement of plans to build the Mercure, a new twin-turbofan short-haul transport (see page 636, M Marcel Dassault said last week that his company's design office was looking at the possibility of developing a light trainer, somewhere between the Magister and Jaguar in specification, to be built by Dassault in co-operation with Dornier in West Germany. It was proposed to power the trainer with two of the small Larzac engines at present being tested by SNECMA and Turboméca. There is no confirmation at present, however, that the two partners would go ahead and build a prototype.

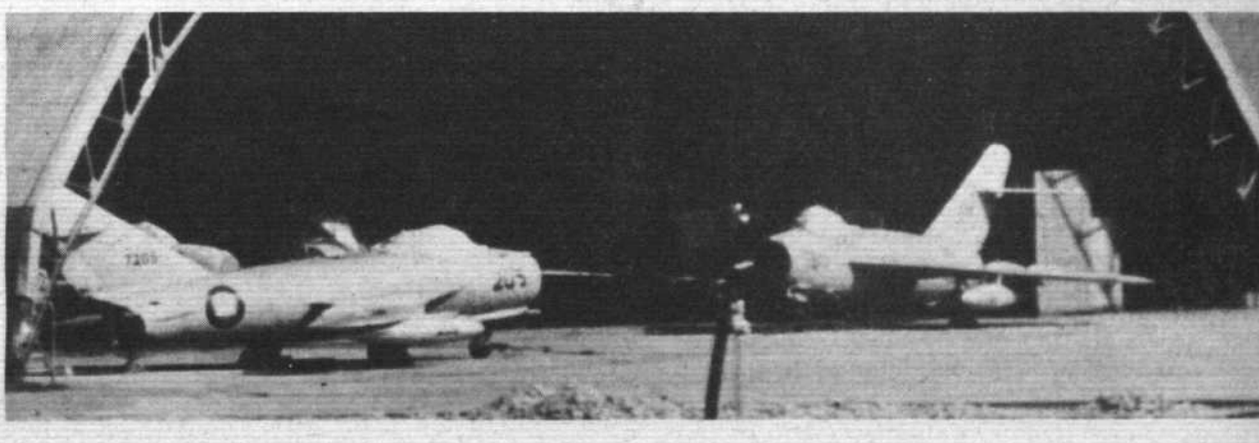
RAF Long-range Terminal

MAIN PASSENGER TERMINAL for RAF Air Support Command is now Brize Norton, Oxon, replacing Lyneham which has filled this function for the past 25 years. All VC10 services to the Middle and Far East and the USA flown by 10 Sqn are now terminating at Brize Norton, the command operating about 35 of these schedules per month. ASC's Britannias and Comets will continue to operate from Lyneham.

Brize Norton opened in 1937 as a training station; during the war it was a base for parachute and glider operations, its squadrons operating on D-day and during the Arnhem landings. From 1951 to 1965 the station was used by the USAF.

The "Maggie" Recalled

FIRST LOW-WING monoplane trainer to be adopted by the Royal Air Force, the Miles Magister is the subject of a modest monograph describing its origin and history (*The Miles Magister*, by G. H. R. Johnson. Illustrated; Newark, Nottingham and Lincolnshire Air Museum, 127 Hawton Road, Newark, Notts. No price quoted). "Any *ab initio* trainer must be expected to encounter a certain amount of rough handling and the Magister's rugged frame was well suited to this treatment," the author comments. As a u/t pilot at No 16 Elementary Flying Training School, Burnaston, Derby, in the spring of 1941, the present writer heartily agrees, recalling the type of handling to which EFTS "Maggies" were subjected. Not till long after the war did he fly a Tiger Moth, the "other" RAF basic trainer; and the Magister is remembered as a prime object of affection—rugged, yes, but also very agile, a good introduction to the operational monoplanes one went on to fly. H.W.



USSR-supplied MiG-17s seen in this photograph (taken from an airliner window) at Phnom Penh Airport, Cambodia. The insignia on the nearest aircraft is of a white temple on a blue background. The Cambodian Air Force has 20 MiG-15/17s

Straight and Level

THIS WEEK the Government is deciding whether or not to sell Shorts to America. The US company Rohr, having been beaten by Shorts to at least £50 millions'-worth of RB.211 pod business, is now trying to buy 'em.

For years Shorts have been financially sick, kept alive by public assistance. Now, having pulled off the RB.211 Lockheed 1011 deal . . . *having* at last got the Skyvan selling and in production (63 sold, 17 delivered) . . . *having* a glowingly successful missile record including £20 millions'-worth of Seacat and Tigercat exports . . . *having* the only really promising infantry missile in the world, Blowpipe . . . and *having* built up their industrial side to the point of profitability . . . HAVING DONE ALL THIS Shorts are now, it seems, to be sold to America.

Politically, I suppose, this is unobjectionable (I like Americans this week). As a business proposition is seems to me the sort of thing that only this Government could think up.

BIG GOVERNMENT CHANGES

Emphasis on Aviation

by our Planes Staff

Important new changes in Ministerial responsibilities were announced last night from No 10 Balls Pond Road. Mr Anthony Wedgwood Benn, Minister of Technology, will look after the aircraft industry. Mr Anthony Crosland, President of the Board of Trade, will look after the airlines.

From a Hawker Siddeley Harrier brochure

Harrier GR Mk. 1 Leading Particulars

TYPE	Single-seat V/STOL ground attach and reconnaissance

Lockheed's C-5A boys certainly seem to have overcome the human engineering problems

● When anybody asks me to explain the theory of the sonic boom, I—er, well it isn't that I don't *know* the theory, or anything like that. It's just simpler to explain that it's a sort of airquake.

● According to the *Financial Times*, Mr Denis Healey, Minister of Defence, is "delighted to find that his opposite number, Dr Gerhard Schroeder, saw the problem in exactly the same way."

Gad! He has managed to persuade the Germans to allow Messerschmitt-Bölkow to have design leadership of the new combat aircraft, rather than BAC.

● Concorde expenditure at risk is now up to £940 million, or £470 million per country. Assuming that the British economy continues to inflate at 3 per cent a year, that means £14 million a year in inflation alone, which over five years is enough to design, build, test, develop and deliver the HS.136 and the BAC 201, with a new type of engine for good measure.

Thinks: the inflation of the inflation is £400,000 a year.

● An American aircraft-industry chief whom I was chatting up the other day could not understand why British firms didn't introduce productivity slogans and get employees to wear buttons proclaiming PUT SCRUGGS ON TOP and all that type of stuff.

I tried to explain that this wasn't in the British nature, and that it would make us all feel rather embarrassed. He seemed convinced that we are just hopelessly, irredeemably lazy. There was nothing I could say to persuade him otherwise.

Later, alas too late, I was reading what Admiral Cunningham said on the deck of the *Royal Sovereign* at Trafalgar when Nelson ran up his famous signal England Expects Every Man To Do His Duty. "I do wish Nelson wouldn't keep on sending signals," he said, munching an apple. "We all know what we have to do."

Of the nine F-111s built for the U.S. Government, only 83 have been officially accepted. The one

From the Bournemouth "Evening Echo," September 28, 1968

● There have now been 11 F-111 crashes, report the newspapers with relish.

The F-111 is now like the SRN.4—it's only got to scratch its nose for the whole of the national Press to foam with delight.

It's also rather nice to crow about American technical failures. It makes us more of a technical success, admit it.

The F-111 is not a technical success, and because of the position of those intakes it may never be. But it has flown 16,000hr with only 11 crashes. After 10,000hr the F-100 had 13 crashes, the F-101 16, the F-102 12, the F-104 17, and the F-105 12.

● According to the Administrator of the American FAA, "the sale abroad of one American SST will offset the import of eight million bottles of Scotch whisky."

The only thing in common between Scotch whisky and the American SST is that I like them both on the rocks.

Roger Bacon

And thereby hangs a tail . . . Deperdussin seaplane after a landing accident, some time before the 1914-1918 war

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No. 1 Aircraft. Exterior navy blue and white, interior cream. New Public Transport C of A. Check IV completed. Full panel, rotating beacon, full night flying equipment. Radio King KY 90 E, with intercom. **£3,100**

No. 2 Aircraft. Exterior navy blue and white, interior cream. Current Public Transport C of A. Full panel, rotating beacon, full night flying equipment. Radio King Ky 90 E with intercom. **£2,750**

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Cessna 150 E. Built 1964. Two seats plus seating for children. Exterior white and chocolate, interior white and red. C of A until May 1969. Engine TSO 475 hours. Full dual controls, rotating beacon, etc. Radio Narco Mk 12 360 channel VHF/VOR/LOC. ADF Cessna 300. A little beauty. **£3,950**

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PIPER TWIN COMANCHE. Exterior Blue and white, interior Blue. Public Transport C of A till September 1969. Engine TSO's 787 hrs and 953 hrs. Full de-icing, dual controls, Magazin compas, rotating beacon. Auto pilot Mk. 2. Radio VHF/VOR KX130E 50 kcs. and ILS VHF 2. Narco Mk. 12A 50Kcs, also VOR. Bendix ADF T12B. King KR 20 Markers. Fully approved for instrument ratings, and in very good condition. **£11,500**

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WANTED Low-time or nil-hour Gipsy Major 1. Telephone Homersfield 250. [7105

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MODERN Single- and Twin-engine Light Aircraft wanted for dry hull lease. Long and short term. Details and rates to Box No 1873/1. [7130

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OFFICE STAFF: During the winter months our office staff are available for technical copy typing, work sheets, manuscripts, etc. CABIN STAFF: trained hostesses being repatriated from overseas available for employment in UK. Redwing Aviation Services (Staff), Ferryfield, Lydd, Kent. [7122

SITUATIONS VACANT

ROYAL AIR FORCE MUSEUM
SENIOR MUSEUM ASSISTANT AND MUSEUM ASSISTANTS

The Department of Aircraft, which is concerned with aircraft, engines, weapons, equipment, etc., has vacancies for a Senior Museum Assistant and a Museum Assistant for a wide range of duties. Previous museum experience and detailed relevant knowledge are essential in the senior post; the Museum Assistant must have some knowledge of RAF history and equipment, and should preferably have museum experience.

The Library and Archive Centre has a vacancy for a Museum Assistant with knowledge of the history of aviation and the RAF, and preferably with library or archive experience.

The Museum, now at Henlow, Bedfordshire, will move to Hendon, London, NW4 in early 1969. The posts are open to men and women.

AGE: At least 16 for Museum Assistant and normally not under 33 for Senior Museum Assistant.

QUALIFICATIONS: normally GCE passes in English Language and at least three other subjects (or equivalent or higher qualification). Interest in the RAF essential.

SALARY from January 1, 1969 (national): Senior Museum Assistant £1,200-£1,560. Starting salary may be above minimum. Museum Assistant £430 (at age 16)—£880 (at 25 or over but possibly higher if at least 26)—£1,100. When the Museum moves to Hendon an outer London weighting of £75 will be payable. Non-contributory pension. Promotion prospects.

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INSTRUMENT RATING TRAINING
Board of Trade approved instruction for instrument ratings 1179s—on Twin Comanches. Limited places available. London School of Flying, The Aerodrome, Elstree, Herts. 953 4411. [7011

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Classified Advertisements continued on page 26

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The function of the School is to train Technicians in those trades associated with supersonic military aircraft and their supporting ground services, including a comprehensive range of navigational aids, control radars, and communications.

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Ground – Radio/Radar
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Successful candidates will receive a substantial salary, free accommodation and messing, and generous leave with free air passage.

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Apply to CROWN AGENTS, M. Dept., 4 Millbank, London, S.W.1. for application form and further particulars, stating name, age, brief details of qualifications and experience and quoting reference M3B/60771/ FE

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APPLICATIONS are invited from suitably qualified candidates to fill the vacant posts of Pilots (First Officers) under the Nigeria Airways.

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(a) Candidates must have qualified as Airline Pilots and possess Commercial Airline Pilot Licence.

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Methods of application: Applications in candidate's own handwriting should be addressed to the Personnel Manager, P.O. Box 136, Lagos, Nigeria to reach him not later than 8th November, 1968.

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