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Routes for the second force

The commonest law is that you don't take another man's property or territory. The Government decision to force BOAC, and probably also BEA, to give up profitable routes to private airlines without compensation appears on the face of it to break this law.

If the corporations were purely commercial organisations, built up with their own risk capital, then taking away their routes would be preposterous. Much heat has been generated in the last 30 years over the doctrinal question of whether a State-owned airline should operate as a purely commercial concern. George Woods Humphrey of Imperial Airways was sacked in 1938 for taking a "too narrow commercial view of his responsibilities." Yet 25 years later Sir Matthew Slattery and Sir Basil Smallpeice of BOAC were sacked for putting the national interest—specifically the aircraft industry—first. BOAC's next chairman took the precaution of extracting the following promise from the then Conservative Government. Dated January 1, 1964, it read: "If the national interest should appear . . . to require some departure from the strict commercial interests of the corporation, this should be done only . . . at the express request of the Minister. How losses, if any, resulting from such a political decision should be presented in the accounts will depend on circumstances in each case."

Now the Government appears to be backsliding, saying in so many words "BOAC and BEA will do what we tell them to do." The point of principle so bitterly won seems suddenly invalidated. Once again—we hope for the last time—the two corporations are treated as instruments of state who must do as they

are bid and bear the financial consequences.

The Government may make the debating point that there is nothing immoral in giving away their own property, and that they are playing Robin Hood, not Dick Turpin. But does the decision make practical sense?

We know that the Edwards Committee came very reluctantly to the conclusion that "some limited concession" of corporation routes would be necessary to make the proposed second-force airline viable. This was the considered judgment of an independent body set up to study the central civil aviation problem—the role of Britain's private airlines. We have always felt this was not practical politics. It would, among other things, provoke the unions. We have believed that the proper course is to put responsibility for route-licensing where it belongs—not behind the closed doors of a Government department, but in the professional route-licensing authority, out in the open. The Air Transport Licensing Board, strengthened in certain small but key ways, is the proper authority.

But we recognise the urgency of the problem. The Government felt that the necessary legislation would take too long. It was now or never: BUA would simply go into liquidation, and hopes of a Second Force would be dashed perhaps for ever unless corporation routes were transferred. In other words, Governing Man has deferred action for so long that "diseases desperate grown by desperate appliance are healed or not at all." It will be ever thus until an independent professional civil aviation authority is set up.

The priority now, the route-

transfer decision having been made, is to give effect to it quickly, with good grace on the part of the corporations and unions and without greed on the part of independents. BOAC and BEA quite rightly, as the Government says, "must remain our principal flag carriers, bearing as in the past the main weight of this country's civil aviation effort." But in fairness the indulgence of the Government and the taxpayer has been considerable. The main point is that, at last, after years of promises and wasted opportunities, Britain has made the historic national decision positively to promote the independent sector of her air transport industry. There is now to be a major alternative standard of airline quality, employment, technical and commercial innovation, and service to the public. This can only strengthen the national air-transport effort as a whole.

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Front cover: Andover of the Queen's Flight, subject of a special feature beginning on page 244 of this issue



WORLD NEWS

Lockheed's new fighter offer

Saying that "we have created an advanced fighter design which capitalises on years of effort in aerodynamic research; the CL-1200 is a real step forward in 'dogfight performance'—a truly modern aerodynamic design for a manoeuvring fighter," Mr Clarence L. "Kelly" Johnson, senior vice-president of Lockheed Aircraft, last week gave details of the corporation's new air-superiority fighter which has been named the Lockheed Lancer. This aircraft is being offered to West Germany, the Netherlands and other countries currently operating the F-104G Starfighter.

Mr Johnson said that the new fighter had been designed primarily for air-to-air combat but also possessed the capability of close air support and interdiction missions. Although in outward performance and appearance the CL-1200 was a wholly new aircraft, he said that it had been designed from the outset to make maximum use of components and systems of the F-104G. Savings in

manufacturing the Lancer and in operational support for countries which had already bought and were flying the F-104G was measured in "hundreds of millions of dollars."

The Lancer, a photograph of a model of which is reproduced on this page, is of high-wing, low-tail design. It will be powered by the General Electric 179-19 engine now used in the Italian F-104S Starfighter. With its larger wing and full-span leading- and trailing-edge flaps, the Lancer will have take-off and landing speeds, Mr Johnson said, much lower than those of the F-104G. The aircraft will be almost 57ft long, with a wing span of 29ft and a height of 15ft; according to equipment carried, design take-off weight would range from under 25,000lb to more than 34,000lb. Mr Johnson said it had been offered as a low-cost, simply equipped, highly efficient (with M61 rapid-firing cannon, rockets and missiles) all-weather "visual" fighter.

Corporations Stand Firm

The Government's plans to set up a second-force airline meant that BOAC would be helping to pay for the setting up of a competitor, Mr Keith Granville, managing director of the corporation, said this week. Referring to the projected transfer of some of BOAC's routes to the new airline, Mr Granville said: "To see the results of years of hard work and dedication swept away and given to others on a plate so that they may enjoy the benefit is bitterly disappointing."

Writing in this week's edition of *BEA News*, Mr Henry Marking, BEA

chief executive, confirms that the corporation has no intention of handing over any routes unless and until the Government forces it to do so. "If BEA were required to give up routes," he writes, "I fear there might well be some redundancy."

Second force under way: Air Transport, page 227.

Nigeria Report Soon?

With the publication of the report of the inquiry into the crash of a Nigeria Airways VC10 near Lagos last November expected shortly, British Sunday papers

splashed on their front pages last week-end the story that firearms had been found in the wreckage.

The finding of the three revolvers (reported in *Flight* for July 9) has now been confirmed but it is not thought that the report, when published, will blame the accident on any disturbance or attempted hijacking on board. It is more likely to state that no positive cause of the accident can be established. Investigators have been hampered by the fact that the flight recorder system was not functioning. All 87 people on board were killed in the crash.

Conservatives' MRCA Briefing

A briefing on the MRCA multi-role combat aircraft was given recently by Panavia in Munich to newly elected members of the Conservative Parliamentary Aviation Committee. They also visited Messerschmitt-Bölkow-Blohm at Ottobrun.

The committee's chairman is Mr Cranley Onslow; the vice-chairman is Mr Michael McNair Wilson and the secretary Mr Robert Maxwell-Hyslop.

Cease-fire Space Watch

Both American and Russian reconnaissance satellites are being used at present to aid supervision of the Middle East cease-fire. These satellites are launched at frequent intervals and have a mission life of 12 days, although until fairly recently the Russians kept their satellites in orbit for only eight days. The orbits average from 125 miles apogee to 170 miles perigee. The cameras aboard the US spacecraft are understood to be capable of discerning 12in objects from heights of up to 300 miles and there is no reason to doubt that the Russian satellites are at least equally efficient.

After twelve days the spacecraft are brought back from orbit and film cap-

Starfighter Successor? A scale model (left), of Lockheed's CL-1200 Lancer, the Mach 2-plus fighter design being offered to European users of the F-104 Starfighter. It is characterised by a high wing set well back on the fuselage, large fin and low-set tailplane. The general design appears to embody many F-104 features including the fuselage and wings

Maritime Line-up Seven of the 38 Nimrods ordered for Strike Command (right) at RAF St Mawgan. Another four are based at Kinloss. In the foreground, one of the last Shackleton 2s still in service with No 18 (Maritime) Group. See story on page 256



sules are ejected and parachuted back to Earth. The photographs are scrutinised to detect, in this case, any troop and tank movements, changes in gun positions or increase in missile sites. This system has been used to locate Russian ICBM sites and the Chinese nuclear test area at Lop Nor in north-east China.

Lockheed Prospects

Lockheed's January to July profit figures of \$8.3 million, released recently, were less than half those for the same period in 1969. However, this was considerably better than was widely anticipated, and the company still appears to be confident of survival.

Lockheed's primary problem has been that of obtaining government aid to cover overpending on the C-5A Galaxy, and subsistence until TriStar deliveries begin in late 1971 (*Flight*, July 30, page 148). One hundred and fifteen Galaxies have been ordered, and if another \$200 million is not forthcoming production will have to stop with 31 aircraft completed and a further 50 partially constructed. This would result in a \$1,000 million loss to the US Government.

Lockheed claims that these problems have no bearing on TriStar production, continuation of which is funded for the immediate future. Twenty-four banks are prepared to complete the fundings as soon as the US Government clarifies the C-5A's future.

"FLIGHT" NEXT WEEK...

... will include a special air traffic control survey and a "Flightcolour" print of the Vickers-Armstrong Wellington, fifth in the series of World War Two colour photographs by Charles E. Brown.

BUA Increases

British United's scheduled passenger traffic in the first half of the year was 30 per cent up on the similar period last year, the airline says. The total number of passengers carried was 274,120. The domestic trunk routes showed particularly strong increases—43 per cent on London-Glasgow, 47 per cent on London-Edinburgh and 40 per cent on London-Belfast. BUA has applied to the ATLB for a progressive increase in frequencies on these routes. As an alternative, the airline has also asked the board to consider permitting any number of flights in accordance with traffic demand.

Sikorski Accident Damages

Substantial damages, with agreed costs, are being awarded to Mr E. M. Prchal, who was pilot of the Liberator in which the Polish leader Gen Sikorski lost his life after a take-off from Gibraltar on July 4, 1943, as a result of a libel action settled in London last week. Defendants were Wyndham Theatres Ltd, lessees of the New Theatre, where the play *Soldiers* was presented from December 1968 to April 1969.

In this play it is suggested that the

SENSOR

The Board of Trade expects Caledonian to say what part of the BOAC and BEA route networks it requires and then, after study of the possible damage to BOAC and BEA, it will ask the corporations for a formal assessment of the commercial effects. Tripartite discussions are likely before a directive is formally issued and licences sorted out by the Air Transport Licensing Board.

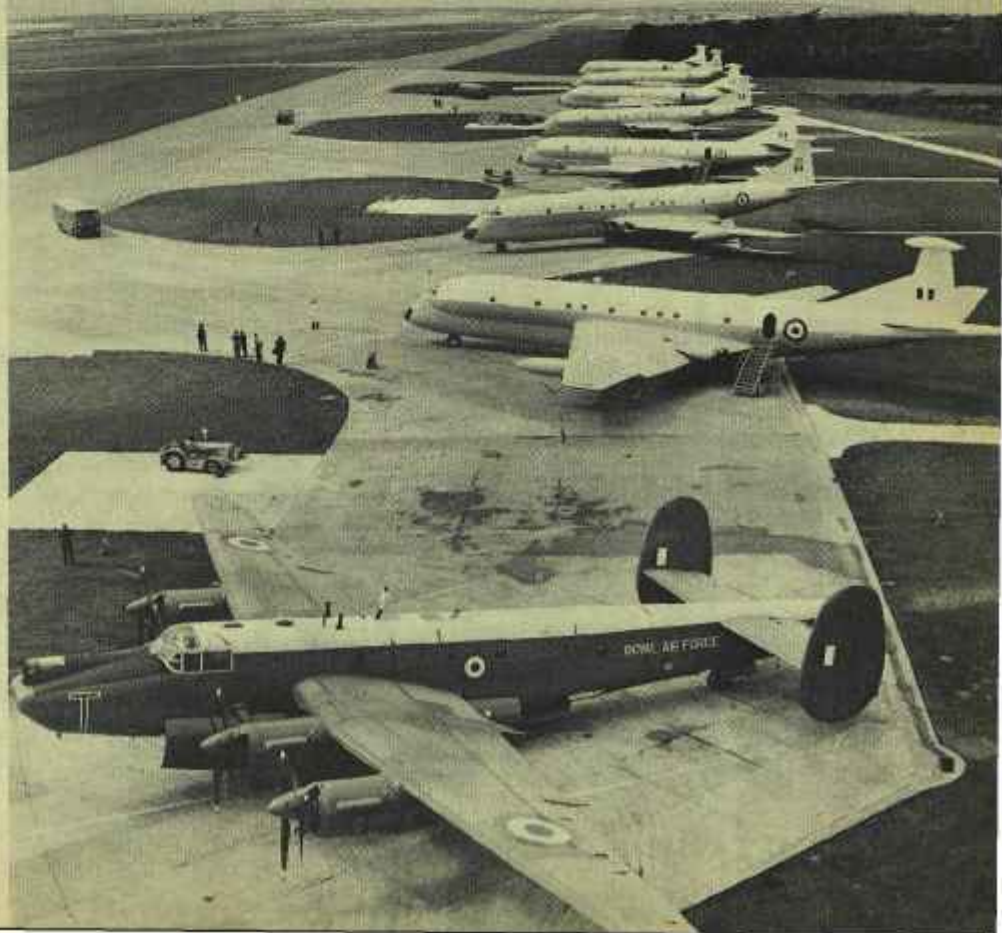
The Government will not compensate BOAC and BEA financially for the routes to be transferred to the second force. It is likely, however, that there will be a small adjustment in the return-on-capital rates agreed with the Treasury or in the dividend on equity capital. VC10 or Trident type cash compensation is completely out of the question. The BoT does not accept that route licences have any financial value.

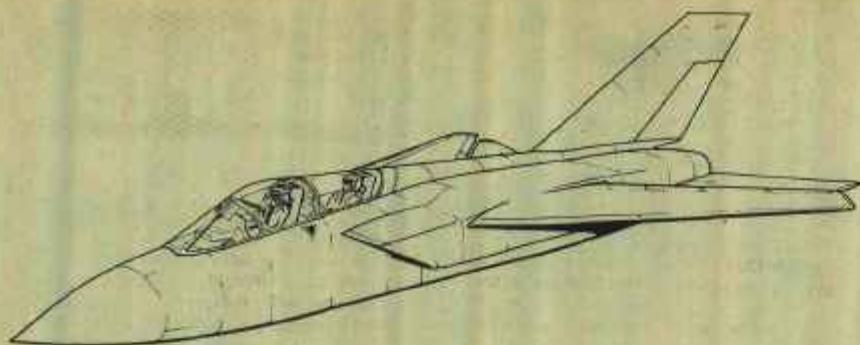
Initial coolness in the Ministry of Technology to the American invitation to participate in the Nasa post-Apollo space shuttle programme has completely changed. Both technically and financially the US offer appears to be a generous one, with acceptance of British engineers in key positions in US companies "across the board" rather than playing junior roles in particular sectors of the programme. The cost has not been defined, but the

"ball-park" figure being talked about is 1 per cent of the £2,500 million total programme cost. The deal appears to offer a key part in US space technology for £3 million a year over eight years.

A merger between BAC and Messerschmitt-Bölkow-Blohm becomes possible, though it would be some way off in time, following the launching of MRCA. This would close the only remaining "confidence gap" in the programme, the possibility that one side or the other would pull out unilaterally, especially at an advanced technical or financial stage. The British Government is opposed to a Concorde-type inter-governmental treaty which does not have a break clause. The industrial precedent which impresses the British side is the remarkable merger between Fokker and VFW.

Although the terms on which the Germans gained a national advantage in the Panavia MRCA consortium have changed fundamentally, Germany no longer buying the most aircraft and paying the most R&D, it is unlikely that the industrial arrangements will be unscrambled now. BAC technical people are finding collaboration with the Germans refreshingly easier than it is with the French, and on the all-important point of design leadership there is no doubt within Panavia that, on this first Panavia project at least, this will be in the British team.





WORLD NEWS ...

then Mr Churchill, as Prime Minister, had been involved in a plot to kill the general because he would not agree to certain Russian demands; and it is implied that Mr Prchal had implemented this plot by deliberately crashing the Liberator into the sea. A court of inquiry held in Gibraltar shortly after the accident decided that it was caused by a fault in the controls and stated that the pilot was in no way to blame.

As a result of the libel action, heard in the High Court before Mr Justice Bridge, it was stated that suggestions that Mr Prchal had flown his aircraft into the sea were fictitious and without foundation.

Model Championships

Cranfield Institute of Technology is to be the site of the first world championships for scale model aircraft, from August 29-31. Thirty-three entrants from nine countries will be taking part and, by including several scale model demonstrations, the organisers hope to offer continuous flying from 9 a.m. to 6 p.m. each day.

Admission will be 6s which includes a programme and entry to two marquee exhibitions. The championships are being organised by the Society of Model Aeronautical Engineers and sponsored by Castrol Ltd.

Helicopter Deal

An arrangement signed in Paris on July 28 by the French and UK governments has confirmed plans for the development and production of the SA.341 Gazelle, of which over 400 are to be purchased by the two countries. It also arranges for continued development of the WG.13 Lynx, from which France attempted to withdraw last year because of rising costs. The original agreement, signed in 1967, provided for the development of these and the SA.330 Puma already in production.

Hamburger Flugzeugbau

We regret that one reference to the Hamburger Flugzeugbau company in last week's German Aircraft Industry feature inadvertently used the word Hansa in the company title.

Air and Space Law

The Faculty of Laws at University College London is again to run a sessional course in air and space law for non-degree students. Part One deals with the elements of the subject; Part Two covers selected problems on a more advanced level. The two parts may be taken in successive years or concurrently, with one lecture per part per week during the session.

Satisfactory completion of the course will qualify the student for entry to the examination in air and space law held by the London Institute of World Affairs.

MRCA Official The first definitive impression of the European multi-role combat aircraft, according to the joint industrial management organisation Panavia. The layout of such universal-purpose aircraft is rigorously constrained by operational and aerodynamic characteristics: multi-mode radar nose, low-drag, fore-and-aft seating, two-dimensional variable-geometry intake to match engine demand over a very wide range of speeds, attitudes and entry angles, variable-geometry wing with no "glove", large vertical surfaces for stability at high speeds and altitudes, and tailplane set low to escape interference with the airflow from the wing.

which awards a diploma on the basis of these examinations.

Further details and application forms, which must be returned not later than September 1, may be obtained from the Faculty Office (Air and Space Law) of the Faculty of Laws, 4-8 Endsleigh Gardens, London WC1H 0EG.

Hawker Victors

All the Victors to be modified by Hawker Siddeley at Woodford have now left Radlett and only a small element of structural testing is still continuing at the Handley Page factory. Domestic financial difficulties are understood to have led to existing American options to buy the Jetstream as a complete project being allowed to lapse.

Herald Support

Product support for the 45 Handley Page Heralds remaining in service is to be undertaken with the joint backing of Scottish Aviation and C. F. Taylor (Metalworkers) Ltd. A new company, Dart Herald (Support) Ltd, has been formed to acquire existing tools and spares and it is intended that full parts and airworthiness support will be maintained. The company will be located at Wokingham, Berks. and will be managed by Mr Keith Wilkins, late of Handley Page Ltd.

Japan's 1971 Air Show

The third Tokyo Aerospace Show, now called the Japan International Aerospace show, will be held at Nagoya Airport, midway between Tokyo and Osaka, from October 29 to November 3, 1971.

Bell Sales Manager

Mr Robert Kenworthy has been appointed international sales manager for Textron's Bell Helicopter Company. Mr Kenworthy, 45, will be responsible for the development, functional direction and performance of the international regional staffs as well as field sales organizations in international markets.

Sustaining the Troops With the Vietnam de-escalation policy laid down by President Nixon, news from that war front begins to wane. However, combat troops remaining have to have food and this US Marine Corps CH-46 Sea Knight is about to airlift supplies to one of the many jungle outposts.





AIR TRANSPORT

ATLAS UNITING ON DC-10

EMERGENCE of the European ATLAS consortium of Alitalia, Lufthansa, Air France and Sabena as a McDonnell Douglas DC-10-30 operating group is now clearly a distinct probability. Lufthansa and Sabena have placed letters of intent for five and two aircraft, respectively, and Air France will decide whether to place an order in about two month's time. These latest decisions follow the Alitalia order for four DC-10s with options on six, announced in the middle of June.

The second European airline grouping (the other being KSSU) thus appears to be becoming a more cohesive entity than seemed likely at the time of the Alitalia order, when fragmentation on future equipment policy began to look possible. Alitalia was expected to order the DC-10, having been a Douglas customer of long standing, but Air France and Lufthansa have had no such ties and the latter was earlier thought to favour the long-range version of the Lockheed TriStar. That this aircraft is not a firm project has obviously left the airlines with little choice other than to settle for the McDonnell Douglas trijet. But the fact that the price of the DC-10 went up by 4 per cent on August 1 probably accounted for the latest rush to sign up before that date. Alitalia paid £7.1 million per aircraft without spares for their DC-10s before the price increased.

While the earlier Alitalia order and the recent Air New Zealand and UTA (KSSU) orders, reported in *Flight* last week, page 190, were firm it must be stressed that the Sabena and Lufthansa letters of intent do not imply that orders will definitely follow. No money has changed hands. However orders appear to be almost inevitable, even though Lufthansa says that it is still evaluating the TriStar or could eventually settle for an all-747 fleet. If bought, the DC-10s would be delivered to Lufthansa in 1974 and would be used on the long-range 707 routes where the added capacity of the 747 is

not needed—in other words, on routes other than the North Atlantic.

December will see Sabena make a definite decision on converting its letter of intent for two aircraft into firm orders. If the order materialises, delivery will take place during 1975. Air France, which has yet to make any form of commitment to the DC-10, will decide within two months whether it wants the aircraft together with more 747s, or whether it will standardise on the latter and thus buy an even larger number. If the DC-10 is bought, three will be needed in 1974 with single additional aircraft at yearly intervals thereafter. Contrary to some reports, Finnair has not ordered DC-10-30s, but it does want two or three long-range wide-bodied aircraft for the mid-1970s if finance can be arranged. Another DC-10-30 has been ordered by Air Afrique to supplement its order for two, placed in February. The airline has also taken a second aircraft on option.

With the KSSU order sown up in June 1969 and now, it appears, with ATLAS coming to the Long Beach camp *en bloc*, McDonnell Douglas seems to be moving towards a European long-range trijet monopoly.

200 ONE-ELEVEN SALES

WITH the announcement, last week, of ten more sales, BAC has passed the 200 mark in One-Eleven orders. The latest sales—four Series 500s for Philippine Airlines, two for Court Line, one for Paninternational (the airline's fourth) and three

A bevy of One-Elevens at Manchester; of 26 airlines using the airport, 11 are operators of the type. Next to the BEA -500 in the foreground is a BUA aircraft on lease to Swissair; behind that is a Laker aircraft and another of BUA. In the background a Dan-Air Comet. One-Eleven orders announced last week bring sales to 200, worth £300 million



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for an unnamed European independent—are worth £20 million, and bring the total value of One-Eleven sales to £300 million. Of the 200 total orders, about two-thirds have been for export, half of these to the United States, while 64 of the total have been for the stretched Series 500 aircraft.

The two Court One-Elevens will join the seven Series 500s and one Series 400 already in service during February, in time for the summer holiday traffic. Paninternational will take their One-Eleven on strength next March, while the first of the Philippine Airlines aircraft will be delivered in October this year. They will replace the airline's three Series 400s. The order for Series 500s was announced immediately after the airline heard that it had been granted Government approval to increase domestic fares by 30 per cent—a move designed partially to alleviate the effective devaluation of the Peso after it was placed on a free-floating rate earlier this year. A 35 per cent fare increase had been requested, the airline says, because of increased costs of up to 54 per cent on imported materials including fuel. The fares are expected to be reviewed again at the end of the year, but Philippine Airlines thinks it may have come too late to prevent a loss this year by the Philippine domestic carriers.

Mr John Young, managing director of the Court Line group, said in London last week that the Court purchase of two more One-Elevens indicated that a further growth of around 30 per cent was expected next year. In 1970 Court had sold some half-million holidays—a 50 per cent increase over last year's figure. The airline has an all-One-Eleven fleet.

THREE-ELEVEN VITAL, SAYS MILWARD

"OUR most vital task is to get the go-ahead for the BAC Three-Eleven," said Sir Anthony Milward, chairman of BEA, writing in this month's edition of *BEA Magazine*. "This certainly is the major and the most urgent decision for our new Government to make because it affects our competitive capability from 1975 onwards and will also virtually decide whether Britain is still to remain a producer of civil aircraft, engines and components, or whether we buy abroad in the future."

This was the first time that Sir Anthony had gone into print actually to name the Three-Eleven as the aircraft BEA wanted for its future operations. But he has of course made quite clear, on a number of previous occasions, the lines along which BEA is thinking. A fairly obvious plea for a decision on the aircraft, without actually mentioning it by name, was made by the chairman in the June issue of the airline's magazine.

The latest call for a new aircraft was accompanied by one for the airline to "pull ourselves up by our boot-strings." Remembering his warning of last month that industrial problems would have an adverse effect on traffic during May, June and July, Sir Anthony produced figures to justify his pessimism. "The figures show a drop in overall load factor of 9 per cent on May last year and of 3 per cent in passenger load factor. International passenger traffic rose by 3 per cent compared with an average rise for other intra-European scheduled airlines of 12 per cent, so it is clear to see that we did not achieve the share of the market we could have expected if our operations had been running smoothly."

"In addition to the poor passenger traffic, cargo is still well down on last year's level," he said. "The consequence is that our shortfall on budget for May was about £400,000. June, in which more serious stoppages and disruptions took place, showed a worse result in which we were 14 points down on budget with a corresponding shortfall on budget of £1.3 million. I am not saying that our unhappy industrial problems are entirely responsible for these miserable results because the travel trade in this country is not having a happy time in any case. Trade, in spite of the removal of currency restrictions, is in a surprisingly depressed condition and nobody is very satisfied about it."

But Sir Anthony concluded "that a lot of our poor showing, compared with our international competitors, is the result of our irregularities and unpunctuality of the last few months and that if this goes on for long enough we will no longer be 'Number One in Europe' with all that that implies."

NAMC-FOKKER YS-33?

JAPANESE reports indicate that NAMC and Fokker have come to a tentative agreement to share in the development and production of the proposed YS-33 transport. The aircraft, which is now reportedly envisaged as a 150-seat twin with possible stretch to 180 seats, would it is hoped be ready for production, with four prototypes completed, in 1974. Fokker was unable to confirm the reports that agreement had been reached, but is very interested in the project, has been holding lengthy talks with NAMC and would probably take upon itself 10-20 per cent of the development cost of the aircraft in an inter-Governmental and inter-industry programme. Any agreement should be finalised by the end of the year.

The Japanese reports suggest that the aircraft is likely to be powered by a Pratt & Whitney turbofan, in the 20,000lb, 89kN thrust class, known as the STF 363. But Rolls-Royce is still submitting the smaller Trent which would be used if the aircraft were to emerge as a trijet.

Largest aircraft ever to visit Newcastle is this ONA DC-8-63CF, seen there recently on arrival with a group charter from Los Angeles



Second force under way

Last week's long-awaited Government statement was the starting signal for preparations to form a third, private-enterprise, flag airline along lines suggested by the Edwards Committee. But it did not come without controversy as to the rights and wrongs of removing routes from the State corporations to get the new airline going. DAVID WOOLLEY reports.

THE BRITISH GOVERNMENT'S GO-AHEAD for the second-force airline, the private-enterprise national carrier envisaged by the Edwards Committee, was given on August 3 (as briefly reported in *Flight* last week). The plan, which envisages the transfer from BOAC to the new airline of routes producing revenue of £5.6 million, immediately ran into criticism, not only from BOAC but also from BEA (which could also be affected) and in particular from the trade unions. Union leaders condemned the proposal to remove any routes from the public sector, and said that they were not satisfied that the airline would be controlled by British interests.

The two airlines expressly envisaged by the Government as the foundation of the second force are of course Caledonian Airways and British United Airways. The formation of the airline, which is as yet un-named, is a commercial matter between the two of them now that the Government has made its position clear; but it was not until the official statement had been made that Caledonian was prepared to proceed with its bid to take over BUA. The airline felt that a concrete assurance had to be obtained before its backers could be formally approached with a view to putting up the finance; but it gave an undertaking to the Board of Trade that, once the statement had been made, a bid for BUA would be made.

No sooner had the Board of Trade delivered Monday's statement than Caledonian acted to set negotiations in train. On Tuesday the airline's chairman, Mr Adam Thomson, met shareholders and obtained a mandate to proceed with a bid. On Wednesday he approached Sir Nicholas Cayzer, chairman of British & Commonwealth Shipping, which owns a 90.8 per cent share of BUA, and they agreed to begin meetings on Thursday. Mr Thomson also met representatives of the trade union side of the National Joint Council for Civil Aviation to discuss their attitude towards the second force. On Thursday meetings between Caledonian and B&C, with financial advisers present, began.

Both sides evidently want a speedy conclusion to the talks. B&C remains anxious to sell BUA, and must now recognise that, in view of the Government statement, it cannot rely on its original plan of selling the airline to BOAC (the sale was blocked by the Labour Government to allow negotiations over the second force to proceed, and is now not likely to be unfrozen by the present Government). Moreover, B&C is not anxious to be a participant in the ownership of the new airline, the scale of which is likely to be far smaller than that originally envisaged by B&C as a minimum to warrant continued and increased investment.

B&C's willingness to bargain with Caledonian will therefore have increased considerably in recent weeks. In particular BUA is suffering from the prolonged state of uncertainty as to its future, and its managing director, Mr Alan Bristow, was saying two weeks ago that it would have to go into liquidation rather than face the then threatened strike. In the circumstances it is reasonable to assume that the price of BUA will have fallen from the £7 million minimum (excluding goodwill) at which it stood when B&C first opened the bidding in April. It is understood that the price previously agreed with BOAC had been £9 million including goodwill. The figures mentioned refer to the cash payment involved; there are in addition liabilities connected with the BUA aircraft fleet, much of which is leased; these could involve a further £25 million or more.

The Government's object in transferring routes to the new

airline is to provide it with a sufficient base at the outset on which to build in the future. The President of the BoT, Mr Michael Noble, made it clear last week that it would be a "once-only" transfer, and that the new airline could not expect to come back for further assistance. The move was first suggested by the Edwards Committee, which is understood to have envisaged quite a small transfer—of BOAC's South American routes to Caracas, Bogota and Lima—but which did not spell this out in its report. The Labour Government in its White Paper rejected "any significant transfer" of the corporations' routes. Mr Noble said that the figure of 2½ per cent of BOAC's revenue was that put forward by Caledonian as the minimum needed to ensure a firm base for the second-force airline's development. The Government feels that the figure is small enough to avoid any lasting damage to BOAC, and stresses that the actual choice of routes must be made with regard to the least possible harm to BOAC and the maximum benefit to the second force.

BEA has not so far been mentioned by the BoT in this connection, but some participation in the route transfer is not ruled out. In addition the corporation is affected by mention in the Government statement that frequency restrictions on domestic routes, now applied to BEA's competitors, will be progressively relaxed.

Both corporations have shown a hostile reaction to the notion of transfer of any of their routes. BOAC said in a statement that it was adopting a "strictly commercial" approach to the matter, and was "unwilling" to give up any routes voluntarily; if compelled, however, the corporation said that it would have to observe the law of the land. BEA issued a similar statement, saying that it would not willingly countenance the handover of any of its routes.

Mr Noble said last week that the question of reallocation of routes would be discussed in talks between Caledonian, BOAC and the Board of Trade. He pointed out that the powers to compel the transaction had been in existence, unused, for many years. He indicated that he did not think things would come to a show-down with the corporations; the chairmen, after all, he said, were "adult, sensible people." Regulations will be needed to implement the transfer, and these will be laid before Parliament when it resumes after the summer recess.

A show-down with the Government is unlikely. In a radio interview last week Mr Keith Granville, BOAC managing director, seemed to be taking a moderate line. Asked if BOAC would be seriously hurt by the arrangement, he said that "hurt" might be an overstatement. Only "a very small percentage of BOAC's operations" would be affected. "If the Government wishes to make this kind of change in the civil aviation scene," he added, "it's entirely up to them."

Corporation spokesmen are at present unwilling to comment on whether or not compensation for the loss of the routes will be sought. BOAC said last week that the question would arise at a later stage in negotiations. The Government does not however intend to offer any direct compensation, on the grounds that the right to operate a route is not an asset capable of being bought or sold, and to compensate directly for depriving an airline of a route might create a dangerous precedent. But, as Mr Noble pointed out last week, the Government would consider amending a corporation's target for rate of return on capital in the light of experience. Such a revision would in fact be tantamount to compensation.

The powers which the Government proposes to use are

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in Section 3(5) of the Air Corporations Act, 1967, which could be invoked to enable the Board of Trade to direct the corporations not to operate any particular route; and Section 1(3) of the Civil Aviation (Licensing) Act, 1960, which would enable the Board of Trade to issue exemptions to the second-force airline from the requirement to hold an air-service licence issued by the ATLB.

The relative sections of the legislation are reproduced below. Section 3(5) of the Air Corporations Act, 1967, states:—

The [Board of Trade] may, by an order relating to either of the corporations, limit the powers of the corporation to such an extent as they think desirable in the public interest, by providing that any power of the corporation specified in the order shall not be exercisable except in accordance with a general or special authority given by the [Board of Trade].

Section 1(3) of the Civil Aviation (Licensing) Act, 1960, states:—

The Minister may by regulations provide that paragraph (b) of the last foregoing subsection [which contains the requirement to hold a licence granted by the ATLB] shall not apply to flights of such descriptions as may be specified in the regulations, and may by instrument in writing exempt from the requirements of the said paragraph (b) any other particular flight or series of flights.

One of the aspects of Mr Noble's press conference last week which gave rise to some comment was his statement that he did not know who Caledonian's financial backers were, and that he had not taken any steps to ascertain whether they were British or not. The airline has declined to reveal the identities of any backers other than the existing shareholders of the airline, but it issued an immediate statement that foreign money was not involved. Trade union representatives who visited Caledonian last Wednesday were assured that the new investors came into the same category as the existing shareholders, that is to say, British institutions. The airline points out that the only foreign shareholding—3½ per cent of the total, held by Scottish Air International, New York—is representative of a group of private individuals (expatriate Scots) who assisted the airline in its formative years.

The second-force statement

The text of the BoT statement included the following:—

"The Government wish the private sector of the civil aviation industry to be given the opportunity to form by amalgamation a 'second force' airline that would fill the role of second flag carrier on major international routes as well as sustaining extensive charter services. Such an airline, combining the resources and skills of British United and Caledonian, could provide a powerful additional source of airline management and innovation; its existence would permit the licensing of a second British carrier on those international routes such as the North Atlantic where this should increase the traffic carried by British airlines; and it could serve those domestic routes where it was desirable to offer the public a choice of airlines.

"The Government accept that such a new airline, if it can measure up to its task, should be given preference over other operators in the licensing of new scheduled routes that would contribute to a viable route network, in the licensing of a second carrier on existing scheduled routes or in any sector of the market (such as long-haul inclusive-tour charters) where there may for a time be room for only a limited number of operators. Where the new airline is licensed to serve a domestic route jointly with another operator, they accept the need progressively to relax any restrictions on the frequency of services.

"Clearly, if any useful purpose is to be served by a 'second force' airline, it must be strong enough to compete effectively in the world market. The Government therefore consider that some exceptional transfer of routes from the public sector—and possibly some rationalisation including an exchange of routes—will be necessary in the first instance, though not as a continuing process, in order to provide the new airline with a sufficient basis at the outset. In reaching this conclusion they have had to consider whether it would

be in the national interest if the only opportunity of forming a 'second force' airline in the foreseeable future were to be lost without such a transfer of routes.

"BOAC's total revenue is about £200 million. Forecasts of intercontinental traffic point to an expansion of about 14 per cent a year up to 1975. Against the background of such growth a modest transfer of routes from BOAC to the new airline, representing something of the order of 2½ or 3 per cent of their current annual revenue, would have small impact on BOAC's continuing expansion. Both revenue and employment will continue to increase. The return on the public investment need not be unduly impaired so long as the routes transferred from either Corporation did not significantly affect the overall efficiency of their operations.

"The air corporations must remain our principal flag carriers bearing as in the past the main weight of this country's civil aviation effort. The routes to be transferred must therefore be so chosen as to combine with the overall national interest the maximum benefit to the viability of the new airline with the least impact on the air corporations.

"The civil aviation industry has been subject to much uncertainty since 1967 and it is desirable that matters should be brought to a conclusion without further delay. The Government are considering legislation based on the recommendations of the Edwards Committee for changes in the regulatory machinery; they accept, in principle, the establishment of a licensing authority whose decisions will be governed by a formal statement of policy which will reflect, among other things, the considerations set out in this statement. However, the Government consider it important that the new airline should be formed as quickly as possible and should have new routes to serve by the summer of 1971. They would prefer the arrangements for the transfer of routes to be made through normal licensing procedures after discussion with the airlines concerned. They accept, however, that the Air Corporations will not willingly give up even a small sector of their routes. If necessary, therefore, pending the new legislation, they will be prepared to use their powers under Section 3(5) of the Air Corporations Act 1967 and under Section 1(3) of the Civil Aviation (Licensing) Act 1960, to ensure that the intended outcome is not unduly delayed.

"It is in the best interests of the industry and of the country that a stable and viable solution should be found quickly. In particular it is in the interests of those who work in British United and in Caledonian that the new flag carrier should have the strength and opportunities that will enable it to move quickly towards terms and conditions of employment comparable with those offered by the air corporations for comparable work."

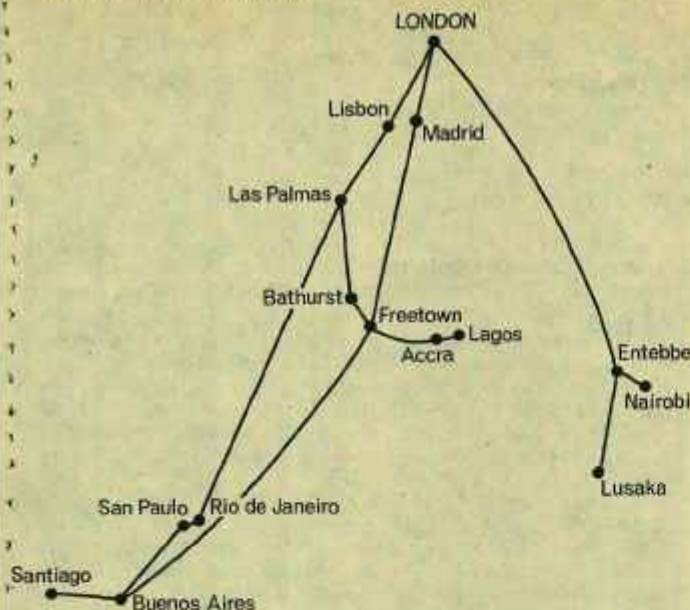
Routes and equipment

Thoughts on the possible route structure for the second-force airline are still very fluid. Mr Adam Thomson, Caledonian chairman, told *Flight* last week that the basic requirement was that routes should be already profitable, and should be capable of subsequent expansion and development.

The second point to bear in mind is that the Edwards Committee stressed that any routes transferred to the second force should form a coherent pattern. This is echoed in the present Government statement. A look at the present BUA route structure, shown in the map on this page (which does not include the short- or medium-haul routes such as London-Rotterdam or London-Tunis), suggests that a route pattern related in some way either to South America or to Africa might be contemplated.

The third point is that, as stressed by the Government statement, rationalisation of routes as between the corporations and the second force is an important possibility. Caledonian in particular feels that some swapping of routes could prove beneficial on both sides from the point of view of improving profits in the long term.

It has been widely assumed that Africa is a natural sphere of influence for the second force. This arose from earlier suggestions by BUA when it propounded its ideas as to the minimum size of the future airline. But Caledonian, which if present negotiations go through will be the driving force in planning matters, has devoted much of its thought to expansion



BUA's present long-haul route network, operated by its VC10 fleet, except for the Lagos route, which is operated with One-Elevens. Frequencies are three times weekly to East Africa, once to Lagos and three times to South America

across the Atlantic (having applied for transatlantic scheduled services in 1967). The airline is still looking mainly westwards, although it is no longer eager for North Atlantic schedules in the present depressed and over-supplied state of that market. Mr Thomson says that he would be unlikely to contemplate North Atlantic services until 1973 or later.

In line with its requirements for future development, Caledonian is anxious to avoid "cul de sac" routes. The BUA route around the west coast of Africa as far as Lagos might be expected to fall into this category, for in the present political situation it could not be extended to South Africa. Lagos is already served direct from London by BOAC. East Africa is likewise served by both BOAC and BUA.

There is at present a good deal of opposition in Africa

to service by two British airlines, and pressure is building up, especially in East Africa, for national airlines to take a half share of the traffic. It would not be surprising if the second force left Africa entirely to BOAC in exchange for routes elsewhere.

In South America BUA has the old BOAC route down the west coast, while BOAC still operates to Caracas, Bogota and Lima, an operation which ties in closely with the corporation's important Caribbean and West Indian services and with New York—BA505 to Lima, for example, operates through New York and Nassau.

Nevertheless there might be scope for the second force in taking a mid-Atlantic route which could develop in the Caribbean, north-eastern South America, and later into central America and on to the Pacific. The central and western States of the USA are another important area for the second force, for they are still relatively sparsely served by BOAC.

BOAC's average revenue yield per capacity ton-mile in 1968-69 was 25.5d. At this rate, routes worth £6 million would amount to about 56 million CTMs a year, corresponding to perhaps 2.25 million aircraft miles. (BUA's existing VC10 scheduled routes consume rather more than 4.5 million aircraft-miles a year.) These figures suggest that one route of some 6,000 miles end-to-end, operated about four times a week, would fill the bill. The figures are necessarily broad approximations, but they do suggest that the route transfer, although representing an increase of perhaps 50 per cent to BUA's present VC10 long-haul operations, may be a good deal less than is widely supposed.

Combined capacity of BUA and Caledonian last year amounted to 394 million CTMs, against 1,826 million for BOAC. Total British production was 3,375 million. Mr Thomson said last week that he expected the second-force airline to reach the present size of BOAC (reckoned in CTMs) within five years, and that by the same yardstick it would be then be rather bigger than BEA.

As for equipment, Caledonian expects that in the early years of the second force more One-Eleven 500s would be bought, and possibly more Boeing 707s. The BAC Three-Eleven is described as "a certainty if it is built—we definitely want it." The order might be for three in the first year of production, three more soon afterwards, and more later. The 747 is also considered a strong possibility for the second-force fleet, but not at the outset. The present jet fleets of the two airlines combined would comprise four VC10s, seven 707s, 12 One-Eleven 500s and eight One-Eleven 200s.

ALIA, PIA JOIN FORCES

AN airline-operating consortium has been formed by Pakistan International Airlines and Alia Royal Jordanian Airlines. It is believed that it will operate the two Boeing 707-320Cs which Alia has ordered for delivery next year. *Flight* understands that the intention is to make the consortium in effect an airline in its own right, with its own name (yet to be chosen) and livery.

The permanent secretariat is to be established in Amman next month; the chairman of the consortium is Mr Bahjat Talhouni who is chairman of Alia, and the chief executives of the two constituent airlines will be joint managing directors. The executive director of the consortium will be nominated by PIA.

Operations are expected to include flights to Europe and South-east Asia, beginning next year.

MERGER RECOMMENDED

THE proposed merger between Northwest and Northeast airlines has been found to be "consistent with the public interest" by CAB examiner Mr Robert L. Park. He has therefore recommended that the board approve the deal, subject to accounting, rate-making and redundancy considerations. Mr Park noted that "despite the board's efforts to preserve Northeast as an independent entity and those of successive carrier managements to carry out that mandate, Northeast had been unable to make its own way as a viable airline." He concluded that, "by substituting a consistently healthy carrier (Northwest) for a habitually weak one," the proposed merger offered a

sound economic solution that did not upset the balance of the air-transport system. Mr Park said that Northwest would "unquestionably" be able to recover to profitability the Northeast operation and that the public would benefit from having a competitive airline rather than "a relatively ineffective carrier."

He refuted claims by competing airlines that some routes given to Northeast last year in an attempt to make it profitable should be denied to the new group. It would be, he said, "a strange construction of the public interest which would demand that Northeast bear all the burdens of the merger but be deprived of the potential it offers for economic growth."

TMA Buys 707s Three Boeing 707-320Cs have been bought by Trans Mediterranean Airways from Braniff. The aircraft will be delivered next April. A similar aircraft is to be leased from Aer Lingus-Irish from October 1.

South African 748s From August 1, South African Airways increased its domestic services by 25 per cent by introducing 70 extra flights a week. Boeing 737 and Hawker Siddeley 748 services have been extended so that all domestic and most regional routes are now served by turbine-powered equipment. The 748 demonstrator has been on lease to SAA since last May. Sales of the aircraft to SAA are expected before the end of the year.

Pilots' safety forum—2

A special report on the US Air Line Pilots' Association safety forum, held in San Francisco recently, continues below. The first part of the report, by a special "Flight" correspondent, appeared last week (pages 192-193).

SURVIVAL WAS A MAIN TOPIC at the conference. Mr Robert Fraebel of the Garrett Corporation said that, with the advent of jet aircraft 12 years ago, the dependability and reliability of air travel had increased tremendously. Until some recent incidents, there had been no planned ditching of jet aircraft. Millions of miles of uneventful overwater flights had been made and a number of people were beginning to wonder if it was worthwhile carrying some 1,000lb of rafts and survival equipment.

There had been, he said, in the same period, some 100 emergency evacuations of aircraft necessitating the use of inflatable slides. The natural conclusion was that a combination slide and raft would be a most desirable item. A new tube-on-tube design which provided a one-tube buoyancy that did not reduce floor area was now available. The importance of this principle was that if a chamber was accidentally punctured, survivors would not need to move to the unpunctured section. The new concept was simple in that no secondary operation was necessary to release or inflate outriggers for the raft mode. This combination slide/raft was easily detachable from the aircraft in event of a ditching.

Captain Norman Hiley of the US Coast Guard described his service's role in rescue operations, illustrating the comprehensive nature of the operation by describing the recent rescue operation in the Caribbean of a ditched DC-9. However, he said, more aircraft incidents and accidents happened near airports and ended up in swallow water or on mud-flats. The US Coast Guard would begin operations with two air-cushion vehicles in October 1970. These would be based near the Golden Gate Bridge in San Francisco, and would be used for operational testing and evaluation. The feasibility of this vehicle would be tested for rescue and other related missions.

"Without question," said Captain Hiley, "the search phase of a search-and-rescue incident over water is the most time-consuming and difficult. Anything that a distressed aircraft can do to assist in making its position known significantly increases the chances of rescue and recovery." He thought that the emergency locator beacon was one of the best means of ensuring speedy rescue.

Adding emphasis to Captain Hiley's points was Captain Don Heine, of Alpa's rescue and fire committee. He noted that in 1967 Icao's 5th Air Navigation Conference had established a rescue and fire-fighting panel composed of representatives and advisers of member States plus certain international organisations. They had been directed to gather whatever technical data was available on the subject and try to determine the amount of fire protection needed at an airport. Captain Vic Hewes of Delta Airlines, Ifalpa's representative, had been chosen as the panel's chairman. After a great deal of deliberation a report had now been presented to the Air Navigation Commission which satisfied all interested organisations.

"For several years," said Captain Heine, "we have been making a plea for crash locator beacons and ejectable, floatable flight recorders. Meanwhile we lose lives and spend millions searching for downed aircraft, or, as has happened on several foggy nights, we go merrily about our business unaware that a tragedy has occurred and unable to locate it once it has been reported."

ASDE, he said, was a great help but not sufficient to direct a rescue crew to an accident site. The United Kingdom had been doing the bulk of the research in vehicle deployment under zero-zero conditions.

Dr M. I. Radnoffsky of Nasa's Manned Spacecraft Centre explained the differences between the fire-resistance requirements for manned spacecraft and those for commercial aircraft,

the chief difference being the 100 per cent oxygen atmosphere in the manned spacecraft. Non-metallic spacecraft materials that could be used for aircraft curtains, upholstery, carpets and straps included fabrics woven of yarn made from asbestos and glass fibre. A tenfold increase in time-to-flame breakthrough on some materials, he said, could be attained by coating them with a compound elastomer which could be foamed, cast, moulded or extruded.

The final paper of the session came from the irrepressible General "Smokey" Caldara, formerly president of the Flight Safety Foundation. Gen Caldara pointed out that during the last ten years only one out of four available cabin exits had been used in survivable commercial-aircraft accidents, in which 794 out of 1,584 passengers did not survive. His figures were based on a study of passenger survival by the Flight Safety Foundation covering United States air-carrier accidents for 1957-67.

He described the Teledyne McCormack Selph system, which used linear-shaped charges for door ejection and had been developed by the military. For commercial airliners, he estimated that the system would weigh about 20lb, 9kg, and cost approximately \$15,000 (£6,250) if put into aircraft at the time of manufacture. He described the system as a linear charge which would positively open any door under any condition. It could be: (1) armed, for takeoff and landing only, from the flight deck; (2) disarmed from the flight deck and from the cabin; (3) armed and fired automatically if the crew were incapacitated by using a G-sensor for impact; (4) selective, so that the flight-deck or cabin crew could operate any or all cabin-exit doors; (5) operated by anyone at an exit (at discretion of flight deck); (6) secured by cabin attendants (as a precaution against "nutcases"); (7) provided with a visual readout in the flight deck or cabin; and (8) disarmed by cabin attendants.

Tests had proved, Gen Caldara said, that the charging explosives of the system were insensitive to impact, could not burn and would not be actuated by stray radio, lightning or lasers.

He thought the time had come to think in new terms, to apply the fall-out from the space programme, to stop paying lip-service and to start taking action in the aeronautical side of the operation.

Congested airspace

The final panel of the conference discussed the very topical subject "Man in the air traffic control environment." Opening the discussions, Mr William Flener, FAA's director of air traffic control services, outlined his administration's new "terminal control area" plan for US airports. He also explained new landing procedures going into effect at airports in Los Angeles, Miami and Atlanta. Mr Flener described the terminal control area plan as one of the most far-reaching airspace plans ever undertaken by the FAA. He said that it was designed to increase air safety in heavily congested terminal airspace and to decrease the risk of mid-air collisions. A number of aviation groups, including Alpa, had opposed the plan, preferring instead a "climb-and-descent corridor" concept; but Mr Flener said that such an arrangement would not permit the necessary vectoring, sequencing and metering of traffic flow in high-density areas.

New landing procedures for the three airports, he said, involved back-course ILS approaches at Miami and Los Angeles and a reduction of separation between aircraft making

parallel approaches at Atlanta. These new procedures were considered both safe and feasible by the FAA, a view reached in the light of past experience with other programmes.

"There is little mystery about ATC problems," declared Mr William T. Hardaker, the Air Transport Association's director of air navigation/traffic control. "No scientific breakthroughs are required and the needed technology is available. We need vigorous, unified leadership of a practical nature and a strong implementation programme to put into effect what we know how to do."

Among the research developments cited by ATA as most needed to improve the ATC environment, he said, were computers and automation to organise air-traffic flow; use of digital communications instead of voice ATC communication; new ways to reduce runway-occupancy times and provide closer parallel-runway spacing; a new data-acquisition system for traffic control and air navigation, mandatory in all aircraft, and a ground-traffic surveillance and guidance-control system.

Among other matters, Mr Hardaker called for improvement of air-navigation capability with guidance in three dimensions; development of ATC procedures for Stoll and V/Stoll aircraft; reconstruction of the airspace to separate aircraft of different performance and equipment standards, and a new and superior system of altimetry. "Finally," he said, "we obviously believe that the users should have a strong input into the establishment of systems and the development of priorities by the government, since we pay a very large share of the bill."

Mr Leroy H. Brown of the Air Traffic Control Association described today's air traffic controller as a "rapidly ageing man in a young man's job—tired of being managed and with little hope of help." The controller was a problem to the FAA and was likely to remain so until he had the tools, training and skills to accomplish his job with confidence in himself and his supervisors and his administrative support. He and his colleagues felt that mutual respect between pilots and controllers was essential to a smoothly functioning ATC system. They did not think that pilots met controllers frequently enough.

A significant number of landing accidents during the past five years might not have occurred if flight crews had been equipped with three-dimensional area-coverage navigational

equipment, according to Mr Glen A. Gilbert, an aviation consultant. Such equipment, he said, would improve landing safety in the absence of precision landing systems. A 3-D area navigation system was also capable of reducing mid-air collision hazards in terminal areas, he said, by its application to a proposed "arrival-and-departure-corridors" system for terminal area control. "Airline pilots today," he concluded, "should move to realise the safety benefits inherent in this concept at the earliest possible time."

This last remark brought a wry smile to the face of Mr Harvey Schwarz of the Decca Navigator Co, who was in the audience. Someone later reminded Mr Gilbert that pilots had been advocating this concept since 1959 when the ill-fated Icao meeting chose the USA's VOR instead of Britain's Decca as the short-range navigation aid, but added that it was not too late to switch over to area navigation using VOR/DME even at this late date.

The last speaker of the meeting was the ageless Captain Sam Saint of American Airlines, who has been propounding on ATC matters for over 30 years. He thought that air traffic controllers were by far the most serious bottleneck in the ATC system. "Controllers' workload," he said, "is the most limiting factor in air traffic control today." The ATC system was in trouble, he said, and there was urgent need for a technological breakthrough to prevent the controller from going down for the third time. The only way this could be accomplished was by bringing computer technology to bear on the decision-making functions of control. The controller and the computer must be put together in a working relationship—the computer initiating routine orders and the controller monitoring.

"In order to prevent daily rush hours from becoming total chaos," Captain Saint said, "an unacceptably high level of restriction has become a way of life, costing operators untold millions." Pilots should beware of losing the flexible use of airspace, which was so important to safe operation, as a result of such restrictions.

Optimism for the ATC system might now be justified because of new programmes to incorporate on-line computer operations and automation into the ATC environment using Nasa experience and increased finance.

CRASH BLAMED ON PROPELLER

MOVEMENT of a propeller into ground fine pitch is given as the probable cause of the accident to a BEA Argosy at Stansted on December 4, 1967, according to a Board of Trade report published last week.* The crew consisted of a training captain, a pilot under training and a supernumerary pilot, two of whom were slightly injured.

The pilot under training was briefed for an instrument take-off using standard BEA screens for simulation; he was warned to expect a simulated engine failure while the speed was between V_R and V_2 (102kt and 111kt respectively). At 107kt the captain throttled back the starboard outer engine to a zero-thrust condition and the pilot under training corrected the subsequent yaw to starboard. However, approximately one second after the correction had been applied, the aircraft yawed sharply to starboard at a rate of 11° per second and struck the ground 6sec later in a 45° banked attitude.

During the time the aircraft was yawing and rolling the captain confirmed that full port rudder and aileron were applied and attempted to restore power on the throttled back engine. On impact the aircraft cartwheeled, caught fire and disintegrated, and the crew escaped through a hole in the fuselage.

Recovery of information from the flight recorder was delayed by a number of defects which resulted in a need for manual analysis instead of automatic print-out. Distortion of the trace precluded analysis of the final seconds of the flight; however, it was possible to draw some valid inferences regarding the rate of roll and degree of slip. It was concluded that a sufficiently large moment to induce the high degree of roll and slip could not have been produced even had both star-

board engines been at zero thrust, and disruption of the airflow by a malfunction of the propeller was considered.

The report concludes that the most likely cause of the accident was that No 4 propeller moved into ground fine pitch when the engine was throttled back but no evidence could be found to explain the failure of the flight fine-pitch protection systems of the propeller.

MIDAS CORRECTION

AN incorrect statement was made in *Flight* for July 16 (page 72) to the effect that the Midas crash recorder in the Viscount which crashed at Castle Donington in February 1969, was inoperative. The recorder was in fact functioning correctly; our report should have stated that the flight-recorder system was inoperative. It must be added, however, that the direct quotation from the Board of Trade report on the accident, which also stated that the recorder did not function correctly, was accurately rendered in our news item.

BOAC Link 707 simulator BOAC has bought a 707-336C flight simulator, at a cost of more than £1 million, from Link-Miles of Lancing, Sussex. The simulator, which will be completed by November, 1971, will have a four-degree-of-freedom motion system and a Link-built visual display.

CAB Post Mr Gerald F. Hadlock has been appointed deputy director of the CAB Bureau of Enforcement. Mr Hadlock, at present counsel for the US Atomic Energy Commission, succeeds Mr William H. Lundin, who has retired.

*CAP. 339, HM Stationery Office; price, 4s.

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LIGHT COMMERCIAL & BUSINESS

Safe Circulars Three recent Aeronautical Information Circulars have been designated as having a specific flight safety slant. No 61/1970 discusses the practice of reporting altimeter pressure settings to the nearest half millibar. The Board of Trade recommend that for the purpose of in-flight altimeter setting, pilots should round down half-millibar settings to the nearest whole millibar. The risk of R/T misunderstandings is also highlighted and the Board of Trade say that it is their intention to have the half millibar procedure reviewed at Icao as soon as opportunity arises.

Circular No 64/1970 amplifies earlier warnings about turbulence behind the Boeing 747. Tests have shown that the 10-mile separation standard is not warranted and normal separation (i.e., 5 miles) will be applied in future by air traffic control. Pilots are warned to apply the same separation in the event of passing behind a Boeing 747 outside controlled airspace and at the same height or within 1,000ft below.

Circular No 62/1970 provides guidance on the operation of helicopters with external loads. The circular is comprehensive and discusses problems of loading and lifting, route planning, electrical static charges, oscillation and the use of hand signals with particular reference to their use by persons (e.g., crane crews) familiar with a different convention of signals. The signals to be used when marshalling helicopters are reprinted in the circular.

Temporary London "Helistop" A temporary "helistop" for a limited number of helicopter movements in St Katharine Docks, Tower Hamlets, has been agreed by the Central Area Board of the Greater London Council's Environmental Planning Committee.

The site is on the East Quay of the docks. Conditions of the

The Swearingen Merlin III for which FAA type certification was granted on July 27



The first flight of the Rolls-Royce Viper 600 was made in a BH-125 flying test bed from Filton on August 3. The engine is being developed jointly with Fiat and it will be offered for civil business-jet or military trainer applications

temporary tenancy require that not more than 30 movements—that is 15 aircraft taking off and landing—are made each day during the week September 7-13 (Farnborough week) and only 20 movements—or 10 aircraft—a day during the remaining period. The use can take place for 28 days without planning permission.

Mr Neil G. Thorne, chairman of the board, said recently: "The site will be restricted to use by only the quieter type of helicopters available—the Bell JetRanger and the Hiller U-12. This experiment will give us practical experience of the effects of helicopter operation and enable us to carry out a noise and social survey in the locality, thereby gaining information which will be extremely valuable when we consider future heliports or Vtol terminals. At no time will the helicopters fly over any houses in the area. They will go directly out to and from their flight path over the river."

Swearingen Certification FAA type certification was awarded to the Swearingen Merlin III on July 27. The eight-seat series III is powered by two Garrett AiResearch TPE 331 turboprops. A disposable load of 4,975lb allows a high degree of flexibility in payload/range planning and with a 7lb/sq in cabin differential the cruise can be planned at any level up to 28,000ft. At this height the cruising speed is 296 m.p.h. and the maximum range with reserves is 2,710 miles.

Geophysical Twin Otter International Nickel has purchased a second de Havilland Canada Twin Otter for use by its Canadian-based exploration division at Sudbury, Ontario. International Nickel was the first company to acquire a Twin Otter for geophysical survey work in 1967, and the combination of the aircraft's low-speed handling characteristics and the Inco-developed survey system has proved highly effective.

Inco experts worked closely with de Havilland engineers to design an installation which would reduce interference with the electromagnetic equipment caused by the metal airframe. In the final design, which has proved highly successful and will be used on the second aircraft, the transmitter coils are contained in a wooden tripod structure mounted on top of the aircraft. The back portion of the longitudinal coil is embedded in the leading edge of the fin which was reconstructed of glass fibre. A glass-fibre bomb-shaped vehicle, also containing survey equipment, can be lowered from the Twin Otter by winch on a 500ft rubber-covered steel cable to be towed at 120 m.p.h.



By Tony Smith

EUROPEAN LINK

NEW MARKETING SCHEME ASSESSED: DIPLOMATE AND MONSUN IN FLIGHT

INITIAL STEPS IN THE MARKETING LINK-UP between Socata and Messerschmitt-Bölkow-Blohm (see *Flight* for July 16, page 78) were taken recently when the Diplomat and the Monsun visited the UK for the first time. Some of the details on the extent of the agreement do not appear to have been finalised but basically the idea is that, in the UK, Air Touring Services of Biggin Hill should market the Bo209 Monsun as well as the full Socata range, as at present. The name Bölkow is to be dropped and Messerschmitt used instead. In France, Socata dealers, already agents there for the Islander, will also market the German aircraft. In both cases, the Monsun virtually becomes part of the Socata range since all payments for this aircraft will go through Socata.

MBB has dropped production of the Bo208 Junior, claiming that this was partly due to difficulty in obtaining the 130 h.p. Rolls-Royce Continental O-240 in sufficiently small numbers. While the 100 h.p. unit was adequate for many European countries, export versions needed the extra power. This leaves the Monsun as the only light aircraft made by MBB. The consortium's motives in linking with Socata are probably two-fold. First, the agreement provides MBB with an entry into the notoriously "closed-shop" French market and, through the British Socata agent, into the UK market which it has not fully exploited to date. Secondly, the Monsun becomes part of a range—an important requirement for this class of aircraft as has been shown by the American industry, and more notably by Beagle. To ensure an adequate and efficient distribution network, it is essential for dealers to be able to stock a range of types so that they have sufficient scope within the entire market.

That the agreement centres solely on marketing is emphasised by the fact that MBB will do its own selling in Germany where its dealer network is understandably very good. In the two countries where the agreement applies at present the

merging of the two makes of aircraft appears to be complete since Socata would be content for Monsuns to be taken by its distributors instead of, say, Rallye Clubs. Also, some minor Rallye components are to be used on the Monsun.

Socata, for its part, could not previously offer a spinnable aircraft. In most European countries, where the requirement for spinning in the PPL test has been dropped, this did not matter too much. To expand in the British market, however, a spinnable aircraft was essential in the range offered. Also, emphasis on fully aerobatic capability is growing and there are still relatively few types available which fit the basic trainer/aerobatic trainer/tourer requirement. Chief rival to the Monsun in this country would seem to be the AESL Airtourer. Herr Helmut Taschinski, MBB sales manager, told me during his visit last week that low production of the Airtourer would prevent it becoming a threat but he appeared to overlook the fact that Trojan, the new UK licensee, intends to produce at a rate of 100 to 150 a year by late 1971 or early 1972.

Socata is certainly in a good marketing position now with aircraft ranging from the small Rallye Club to the advanced Diplomat and Rallye 7—which is expected to be fully certificated by the next Paris Show. The gap existing between the advanced singles and the primarily third-level Islander may be filled if Partenavia joins the consortium with the P.68.

Officials from Piper have recently been talking to Socata and MBB representatives. The American company has virtually closed down production until September and could well be seeking a wider outlet in Europe. If anything comes of this

Heading picture, the Diplomat showing its landing-gear operation; below, same situation, different angle. Worthy of note is the large fin area and also the ventral fin—two features which provide the Diplomat's outstanding directional stability





The extremely well-equipped cockpit of the Diplomat demonstrator. The autopilot is mounted beneath the throttle and propeller control

EUROPEAN LINK...

it will be interesting to see on whose terms an agreement is reached.

The introduction of the Diplomat on to the British market—probably in October together with the Monsun—will provide direct competition to the Piper Cherokee Arrow. Performances of the two types are very comparable but Mr Bob Cleary, joint managing director of Air Touring Services, feels that price differences are likely to be wide enough to prove significant. The basic price of the Diplomat will be £9,750 while that of the Arrow is £10,560. Basic price of the 150 h.p. Monsun will be £6,000, with the 160 h.p. fuel-injected version costing an extra £600. The least powerful model was to have had a 115 h.p. Lycoming, but this has been abandoned in favour of a 125 h.p. version which is now being developed.

Monsun re-acquaintance

I flew the 150 h.p. Monsun briefly at Hanover during the show earlier this year (see *Flight* for May 7, page 758) and a similar machine was used at the Biggin Hill demonstration. During a short flight I was unfortunately unable to further my knowledge of the aircraft very much owing to the demonstration pilot's reluctance to surrender the controls, but my earlier impressions were confirmed of pleasant handling in spite of rather heavy ailerons.

Recapping briefly, the Monsun needs but little run before climbing away at 1,000ft/min, 5m/sec at 75 m.p.h., 122 k.p.h. Using 2,400 r.p.m. and 24in. 61cm manifold pressure—the 75 per cent setting at 1,000ft, 300m—the Monsun indicated 130 m.p.h., 210 k.p.h. I took the opportunity to try a spin

The Monsun formates on the photographic aircraft. This particular example was not fitted with retractable nose gear



Private Flying



which turned out to be steep and reasonably rapid, but with a very quick recovery. The stall, in any configuration, is accompanied by a marked and sudden wing drop—no doubt every club's CFI has his views on the desirability or otherwise of this characteristic in a trainer. Still viewing the training side, it seems a pity, in a new aircraft with side-by-side seating, that intercom is necessary.

The Monsun is aimed at the smaller clubs where a single type has to fill all training and touring rôles. It should achieve this very well from the handling point of view, and, equally important, it appears to be robust enough to withstand the less than kid-glove treatment inevitable with flying club operation. At the same time an excellent finish has been attained. The other benefit of the aircraft is the wing-folding facility. This is a two-man job—one unhitches the wing at the root and the other walks back, twisting the wing to fold flat alongside the fuselage.

Diplomat assessment

Socata developed the Diplomat from the Horizon, basically by enlarging the cabin and lengthening the fuselage. Originally built as a private venture by Yves Gardan, Socata bought the Horizon design in 1962 and in all 272 were produced up to June 1968. Gardan's designs are now built by the Sitar company.

My first flight in a Socata ST-10 Diplomat was made with sales pilot Maurice Serec. The Diplomat demonstrator was one of the most comprehensively equipped light single-engine aircraft I have seen. Quite apart from an array of King avionics—KR-85 ADF, two KX-170 VOR, one with localiser, and KT-75R transponder—it was fitted with the new Crouzet-Radiostal three-axis autopilot which is marketed by Socata.

To the accompaniment of a French pop broadcast issuing forth from the ADF we taxied to Biggin Hill's runway 23. With four up, half fuel in one tank and a third in the other, we used up a fair amount of tarmac before lifting off—this is not a short-field aeroplane, but then nor is it intended to be. The gear came up with a sound like rusting clockwork and we were climbing respectably at 1,000ft/min, 5m/sec.

The immediate impression was of the remarkable stability. A large rudder deflection produced no oscillation as the nose swung back again and the large fin area brought the aircraft quickly back into line. Once in a bank, the aircraft would stay there, just where it was put. Yet at the same time, there was no sloppiness in the controls—any movement produced an instant and smooth reaction. The controls are, in fact, just about ideal for an aeroplane designed specifically as a transport.

At 1,500ft, 460m, the 75 per cent cruise setting is 2,450 r.p.m. and 83mb manifold pressure. This built the speed up to a useful 130kt. We then locked in the autopilot which proved very accurate although in calm evening air it seemed hardly necessary in view of the Diplomat's superb stability.

The stability and control extends throughout the entire speed range. Down at the 60kt mark, the controls felt just as responsive as at higher speeds. The stall was notably gentle in any configuration and, even with power on, there was no sign of a wing drop. In fact, with lots of power on, it was extremely difficult to make the nose drop at all and when it did go still nothing violent happened. The approach to the stall seemed progressive with no evidence of a sudden increase in drag and altogether I found the Diplomat's behaviour very docile.

Lowering the gear caused a marked loss in speed and this needed to be watched a little downwind when power had to be reduced to get the gear-lowering speed of 100kt and then



The Monsun parked outside Air Touring's base at Biggin Hill. The service division has five licensed engineers and, apart from engine and airframe work, carries out radio installations

had to be increased to stop the speed decaying below 80kt. Even so, trim changes with both gear and flap operation were small.

With full flap the Diplomat motored comfortably down the approach at 75kt. Initially, I made the mistake of rounding out a little high and then of letting the nosewheel down a bit too soon while the elevator was still fully effective.

A short trip in the rear seat of the Diplomat showed up a shortcoming which would prove tedious for rear-seat passengers on a long flight. The main spar passing beneath the front seats meant that, although knee room was sufficient, there was no foot room so that it was not possible to change position very much. This one reservation should not be allowed to detract from the Diplomat's value as a superb touring aircraft. Its extremely good stability cannot be over-emphasised especially as pleasant feel has not been sacrificed.

Canada Second Recently published figures show that Canada comes second only to the USA in number of licensed private pilots. The total last year was 21,300, compared with nearly 300,000 in the USA and 15,000 in England. There were also just over 1,000 glider pilots in Canada and 7,500 commercial pilots. Of the total Canadian civil-aviation fleet of 10,590 aircraft (compared with the USA's 135,000), 6,709 were private and 3,113 commercial. There were nearly 428 ultra-light aircraft.

Seventy per cent of the civil fleet consists of general-aviation aircraft, compared with 97 per cent in the USA and 60 per cent in the UK. Utilisation in Canada has been relatively low, averaging only 95hr p.a. per general-aviation aircraft. The major limitation on GA operation is distance.

Private flying has increased more rapidly than commercial aviation in the past few years and the trend is expected to continue. In 1969, the estimated 700,000hr flown by the private sector compared with 603,000hr in 1967.

Seeing Small Aircraft on Radar The American National Transportation Safety Board has told the Federal Aviation Administration that passive radar reflectors can be made for

Accomplished autopilot

The Crouzet-Radiostal autopilot is being viewed as something of a breakthrough for light aircraft even though it has not yet been certificated for IFR operations. Technically, the French unit is rather different from the classical gyro and pneumatic jack principle. Pneumatic servo controls are still incorporated, but a system of photo-electric cells is used which, the company claims, provides both reliability and low cost.

The unit consists of two components: the RG-10 roll and yaw stabiliser and the RG-10T pitch control. The two combined provide a full three-axis autopilot. In the RG-10 unit the single reference gyro is mounted with its rotational axis lying fore and aft along the fuselage but set at 45° to the vertical. Thus, one sensor is used to detect aircraft movements about two axes. The gyro has one degree of freedom and precessions are recorded by an indicator which is in turn noted by a photo-electric cell—all the sensors employed are measured in this way. The signals—plus any pilot inputs from the control box—are received by a pneumatic distributor which regulates the feed to two pneumatic jacks mounted in the aileron control circuit. The RG-10 can be coupled via a transformer and directional gyro to an ADF or VOR.

The RG-10T uses two sensors: one for the Badin artificial horizon to give the attitude of the aircraft and the other for the altimeter to measure the difference between the required and actual altitude. Control links to the elevator are the same as for the roll/yaw unit. The pitch element of the autopilot can be coupled to the ILS glideslope receiver so that, with the full three-axis set up, ILS approaches can be made.

In France the autopilot is authorised for use on several light aircraft but it is still a lengthy process to obtain clearance owing to the lack of established standards. Also fitting costs are very high. In this country the unit will have to be thoroughly evaluated and approved by the ARB before it can be fitted in British-registered aircraft. In anticipation of this, possible prices in the UK are £600 for the roll/yaw unit, £250 for the VOR/ILS coupling and £700 for the altitude hold unit.

small aircraft and it has suggested that the rules be amended so that all aircraft flying in areas where radar is used should have a minimum amount of radar-reflective area.

Race aircraft found The wreckage of the Australian Shrike Commander which disappeared during the London-Sydney air race on December 19 last year has been found. A statement from the rescue centre at Aix-en-Provence reported the wreckage to be on a mountainside near Courcheval, approximately 110 miles off the pilot's planned course.

A total of 41 vintage Cessna 195s recently flew to Wichita for a meeting of the International 195 Club. The Cessna 195, manufactured between 1947 and 1954, was the first commercial Cessna aeroplane which used all-metal construction and was the last Cessna model powered by a radial engine. The 300 h.p. Jacobs engine provides a cruise speed of about 165 m.p.h. for the five-seat aircraft. A total of 890 Model 195s was manufactured by Cessna.



AIR TRANSPORT

Continued from page 231

Flying the Boeing 707-320C

By Captain R. E. GILLMAN

Established work-horse of the long-haul airline, the Boeing 707-320C has been in service for seven years. For a fresh look at its handling qualities, Captain Gillman, who works for a short-haul airline, visited Boeing Field. His report follows.

THE BOEING ESTABLISHMENT in the State of Washington has the sort of stimulating vitality that one finds in much of American industry. Apart from the glossy conversion at what was Payne Field, one gets the impression of an outfit that has developed, if not haphazardly, then piecemeal as the market grew. It's strictly for business and the complex sprawls from Renton to Everett, with Boeing Field in the middle.

I had the pleasure of flying a 707-320C from there. The aircraft was one of Pan American's, and it stood on the tarmac at Boeing Field among some 20 aircraft of different types, each of which was the centre of much activity.

It was loaded to some 208,000lb, 94,000kg; the fuel load was 72,000lb, 32,660kg, and the trim laid at 26.1 per cent SMC. The engines were started from an external low-pressure air supply. The co-pilot held the engine-start control switch in the spring-loaded "ground start" position, and the duct valve pressure on the engineer's panel dropped, indicating that the start valve had opened. The engineer monitored the N2 (h.p. turbine speed) gauge and called "15 per cent N2", whereupon the start lever was moved from "cut-off" to "start". The rise of the exhaust temperature on the pilots' centre panel indicated a light-up, and this was watched closely to ensure that the maximum starting temperatures were not exceeded; also the fuel flow and N1 (l.p. turbine) speeds were monitored. The engineer was keeping an eye on the N2 r.p.m., engine oil low-pressure light and pressure, generator drive low-pressure light, voltage and frequency in that order, and when the duct pressure rose again, he called "starter cut-out". The co-pilot released the start control switch and as the exhaust temperature stabilised, the start lever was moved to the idle position and we were in business. The starting order was 3, 4, 2, 1.

The engine noise was surprisingly low—less, I thought, than on the flight deck of a 727. The start levers are the equivalent of the h.p. cock levers in British installations, but with the additional facility that they activate the ignition system when moved to the "start" position and deactivate it when locked into the "idle" position.

To get the aircraft rolling, only a modest power increase was required at this weight, but amid the clutter of other aircraft on the tarmac, momentum was more than sufficient, so that the engines had to be throttled back to idle before the turn out was commenced. The nosewheel steering wheel, which is on the captain's side only, was quite heavy, and it was necessary to get a firm grip and to ease it in the direction of the turn in order to get a smooth response.

With the nosewheel some 9ft, 2.7m, behind the pilots, and the main wheels a further 60ft, 18m, aft, one needs to position oneself well on the outside of any turn in order to keep the aircraft moving round a guide line. Visibility from the flight deck is good, but it is difficult to judge just how much wingtip clearance one has.

There is some lag in brake reaction. One needs to apply a little toe pressure and then to wait for the brakes to bite before increasing it to the necessary amount, but it is relatively easy to apply smooth positive braking. This is just as well,

for the turbofan engines develop more than the usual thrust even when throttled to the idle position; a lightly loaded aircraft tends to accelerate all the time and has to be kept in check with intermittent use of the brakes.

Approaching the runway threshold, the flaps were set to 14°, and the stabiliser trim to the computed 3° nose-up. The vital pre-takeoff drills are covered by a warning system which sounds a horn intermittently if No 3 thrust lever is advanced beyond the flap quadrant and the airbrake lever is out of its detent, if the stabiliser trim is not in the green sector or if the flaps are not correctly positioned for takeoff.

The figures on the vital data card stuck over the face of the radar scope showed me that the thrust for takeoff should be 1.82 EPR on the inboards and 1.84 on the outboard engines. The V_1 and V_2 were 122kt, and the V_R was 136kt.

Before rolling, the attitude warning system was tested, the operation of the test switches on the pilots' overhead panel causing the control columns to vibrate. Should an extreme nose-high attitude develop on takeoff, pressure transducers on each wing send signals via potentiometers on the flaps and a summing unit in the nose which cause the control column to vibrate in the pilots' hands.

The noise level on the flight deck was fairly high as the engines were opened up to the takeoff setting. By 70kt, the rudder was giving full steering control, and 30kt later we hit the famous 100kt bump in the runway at Boeing Field. With the control column held slightly forward to load the nose-wheel, there is no inherent tendency to swing, and then just before V_1 , the stick is allowed to come back to the neutral position; on the call "rotate," quite a long rearward movement with a load of about 40lb, 18kg, is required to achieve the 10° nose-up attitude necessary for unstuck.

Being so far forward and in this attitude, it is difficult to be sure when the wheels have left the ground, and the only safe technique is to wait until there is a positive reading on the altimeter before selecting the wheels up. It is not necessary to apply the brakes as this is done at a reduced pressure automatically as the gear lever is moved to the up position.

A natural nose-up couple develops with increasing speed, but even so a positive effort is required to limit the speed to V_2+10 kt for the initial climb. This is the best angle of climb speed with a takeoff flap setting. With the undercarriage up, the initial climb at 150kt was 2,000ft/min, 610m/min.

Passing through 1,000ft, 305m, the speed was increased to 180kt, 333 k.p.h., the flaps retracted without any noticeable trim change, and the power reduced to the climbing value of 1.76 EPR, which resulted in a consumption of around 9,000lb/hr, 2,750kg/hr, per engine.

As the speed was increased to the en-route climb figure, a continuing nose-up couple had to be trimmed out with the aid of the stabiliser trim trigger on the control column. For newcomers to Boeing aeroplanes this is rather disconcerting, for it causes the large trim wheel to rotate rapidly with a loud buzzing sound. However, due to its gearing, it is possible to trim very finely and with the minimum effort.

By 5,000ft, 1,500m, the speed had been increased to 250kt,



and the rate of climb was 2,800ft/min, 855m/min. In order to comply with the FAA regulations, this speed was held until 10,000ft, and then increased slowly.

Passing 13,000ft, the indicated airspeed was 280kt and the true airspeed read-out showed 373 with a machmeter reading of 0.522. The Mach number is shown digitally within the airspeed indicator itself. By 23,000ft, 7,000m, with an IAS of 260kt and a Mach number of 0.614, we were still climbing at over 2,000ft/min with an EPR of 1.92 and a consumption of 4,600lb, 2,086kg, per engine per hour. Noise on the flight deck was remarkably low, the engines being barely discernible above the airstream.

We ran into some light turbulence at this stage, and the aircraft proved very stable in pitch while exhibiting the peculiar sideways shake that one gets used to on the flight deck of a long-bodied aeroplane.

Levelling at 31,000ft, 9,450m, the speed was allowed to build up, and as Mach 0.81 was passed, the automatic Mach trimmer got busy to counter the nose-down couple. At 330kt IAS the machmeter was reading 0.83 and the fuel consumption was 3,500lb, 1,590kg, per engine per hour at a setting of 1.45 EPR.

Control loads

At this speed, the control loads were quite high, but it was possible to fly quite accurately in pitch by applying pressures to the control column and trimming out the loads with the powered stabiliser trim.

We had passed the snow-capped peak of Mount Adams some time previously and were now crossing the Washington-Oregon border by the Columbia River. With unlimited visibility it was a magnificent sight.

The aileron loads when going into a turn were also relatively high and the rate of roll commensurate with the size of the aircraft; the slight nose-down couple was held manually without trimming. In the "clean" configuration, the outboard ailerons are locked in the faired position, and roll control is by the inboard ailerons supplemented by the spoilers, which move out to a maximum of 40° on the down-going wing.

When the airbrakes were selected "out" a marked nose-up couple was felt initially, as the outboard spoilers tend to lead the inboard set, causing the lift to be spoiled over the aft portion of the wing first. With the airbrakes in an intermediate position, movement of the control wheel causes double action of the spoilers, moving the down-going wing spoilers further up and the rising-wing spoilers further down. This increases the roll rate markedly, and it may even make the roll control seem over-sensitive.

Differential control of the two sets of spoilers can be used to supplement pitch control should the stabiliser jam during the cruise, for, as the aircraft decelerates, the resultant nose-down couple may be too severe to hold manually.

In the event of a runaway trim, a smooth opposing movement of the control column will engage a stabiliser trim-wheel brake and disengage the automatic trim clutch in the tail. The pilot can then resort to manual trimming.

An interesting point noticed during the descent was a digital flight level read-out situated just below the altimeter. This is slaved from an air-data computer and its readings are coded out through the height channel of the transponder.

On the run into Boeing Field, the speed was reduced to 230kt and the slight nose-up couple held as the undercarriage extended. A further slight nose-up couple was trimmed out as the flaps ran to 14°. Speed was now settled at 150kt which

represented $V_{ref} + 30kt$ for the weight of 188,000lb, 85,400kg. At this speed, control loads in all axes were moderate, stability in pitch was excellent and the roll rate, supplemented by the outboard ailerons, was good.

Extension of the flaps to 25° now resulted in a nose-down couple and the extra drag helped to bleed off the speed to the desired $V_{ref} + 20kt$. On base leg, the selection of 40° flap gave a drift down of 300-400ft/min without the necessity to change the thrust. A descending turn on to finals was made at about three miles, and the flap settled at 50° and the speed adjusted to the V_{ref} of 120kt.

Once established, I throttled back both starboard engines and increased the power on the others to maintain a 3° slope. There was no roll from this asymmetric condition and the swing was held comfortably with a foot-force of around 30-40lb, 130-180kN.

Approach power was restored all round by 500ft. With one hand on the throttles, I found it relatively easy to make the small power corrections necessary to stay on the approach path, and the control column could be managed easily with one hand; admittedly it was a smooth day with a surface wind of less than 10kt.

Crossing the threshold at around 60ft, 18m, a gentle flare was begun, and the pitch control was found to be excellent—though, not unexpectedly, there was some inertia. At the completion of the flare the aircraft was flying level just above the runway, and I succumbed to the temptation to prolong the hold-off in order to achieve a soft touchdown. This is not recommended where landing distance is critical, but at this weight a 9,000ft, 2,750m, runway seemed more than adequate and this certainly proved to be the case.

The nose was lowered on gently after the main wheels had touched, and the use of the spoilers, reverse thrust and a modicum of brake resulted in a landing distance of an estimated 5,000ft, 1,500m.

From the outset I had felt very much at home in this aeroplane. Its stability gave one confidence, and control in all axes was good, in fact almost crisp for an aircraft of this size. I had the pleasure of travelling as a passenger in the -320 on Pan American's Polar Route from Los Angeles to London, and can vouch also for its passenger appeal. The excellent attention one gets militates against boredom on the 10hr flight and it went surprisingly quickly.

Radial routings

During a visit to the flight deck, I was intrigued by the course-changing facility of the Sperry autopilot. A VOR radial and distance to go can be fed in, whereupon the autopilot intercepts and locks on to the desired radial. Ten miles before the facility an alert light comes on, and in the absence of any updating on the part of the pilot, the autopilot will switch over to the next radial, already fed in, when the first facility is reached. Ignoring the ambiguous signals at this stage, it will, with the aid of a Doppler position, take up an interception on the next radial. The Doppler also gives an offset read-out so many miles to the left or right of track. While over the wide-open spaces of the North Atlantic the Doppler is checked against Loran.

I learned that our takeoff weight out of Los Angeles had been 331,000lb, 150,000kg, which included 150,000lb, 68,000kg, of fuel. At 37,000ft, 11,300m, we were cruising at Mach 0.82, a TAS of 476kt, and the power setting of 1.8 EPR resulted in a consumption of 2,500lb, 1,135kg, per engine per hour. Los Angeles to London direct in supreme comfort and no worry about fuel reserves: quite an aeroplane.

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To aid investigations into the complex stress patterns in compressor and turbine blades, a new technique is being used by Rolls-Royce in the development of the RB.211 engine. A specially prepared ceramic coating is sprayed on to the surface of the components to be tested. When glazed and dry, the coating becomes very brittle, and strains induced in the part result in the cracking of the coating at the maximum strain position and at right angles to the direction of the principal tensile strain. The patterns formed by the cracking are used to assess the stresses in the different sections of the component.



Automatic Testing Elliott Flight Automation has delivered four computer-controlled automatic test systems to three customers during a single month. Of the four installations two were exported, one was delivered to the RAF and one went to another division with Elliott Flight Automation. The four systems with their various software packages are worth about £500,000, and all belong to the current production 770 Series.

This significant rate of delivery, said to be unequalled anywhere else in Europe, indicates the scale of Elliott's share in this important market and the steadily increasing demand for computer-controlled automatic test equipment by operators and manufacturers.

In detail, the four deliveries were two transportable Special Support Equipment (SSE) systems despatched by air freight to the USA: a static installation delivered to the RAF to support the Nimrod maritime aircraft; and the first Factory Automatic Test Equipment (FATE) delivered to Elliott's own Airborne Display Division.

FATE is the first application of the 770 Series to automatic testing on the production line and demonstrates Elliott's own faith in the value of this technique as an integral part of a quantity production operation.

The Nimrod system is the first computer-controlled automatic test equipment ever adopted by the Royal Air Force and is by far the most powerful test equipment it has ever put into service. It is able to test 34 different "black boxes" under on-line computer control, incidentally using the same Marconi-Elliott 920B computer as is used in the Nimrod's airborne tactical system.

The two SSE systems are part of a batch of 23 included in an order worth nearly \$10 million. Elliott's total order book for computer-controlled automatic test equipment now amounts to some £6 million.

Plessey in East Africa A major air traffic control and meteorological radar network, valued at more than £1 million, has been ordered from Plessey Radar Ltd, a member of the Plessey Electronics Group, by the Directorate of Civil Aviation for the East African Community.

The network will cover most of East Africa and is part of the modernisation programme currently being carried out to re-equip the airports and air traffic control system of Kenya, Tanzania and Uganda with the most advanced equipment available. It will provide for the rapidly growing tourist industries and the ever-increasing air traffic movements.

The hub of the new air traffic control

system will be a central area control radar station equipped with a Plessey AR-5 long-range radar, and a Plessey automatic secondary surveillance radar (SSR) system. These radars will be used for surveillance and control between the three major airports of East Africa: Entebbe (Uganda), Nairobi (Kenya) and Dar-es-Salaam (Tanzania).

Also on order for the Directorate of Civil Aviation are three Plessey AR-1 medium-range terminal area radars for Entebbe, Dar-es-Salaam and the new Kilimanjaro International Airport.

Triplex in A-300B The Triplex Safety Glass Co has secured a contract for the main pilot's windscreens for the A-300B. The Triplex order is for the two flat windscreens which are larger than those generally used in commercial aircraft: each measures 44in (1,120mm) wide and 25in (635mm) deep. Two 10mm strengthened glass plies act as load-carrying members and the outer ply, which carries the gold film, is 5mm toughened glass. The glasses are bonded together with sheets of vinyl, the edges being protected with moulded silicone rubber.

The first two sets Triplex will deliver by the end of August. Work on the test panels is going ahead to a strict manufacturing schedule. The contract has an unusual clause: Triplex has been asked to carry out the structural and environmental testing of the windscreen. This high compliment to the quality of the extensive test facilities at the Research and Development Centre at the Triplex Works in King's Norton, Birmingham, results from a visit by executives of the airframe constructors, Snias. Experimental panels have already been assessed at Snias's Toulouse factory and successfully passed a 470 m.p.h. (210m/sec) bird-strike test using a 4lb (1.8kg) chicken.

PEOPLE AND POSTS

Mr G. Howell has been appointed to the board of High Duty Alloys Ltd as finance director.

Mr John Davies, MP former head of the Confederation of British Industries, becomes Minister of Technology in succession to Mr Geoffrey Rippon who is made Minister for Europe in the changes resulting from the death of Mr Iain Macleod, Chancellor of the Exchequer.

General Electric's Military Engine Division has named new general managers in two of its operating departments: Mr L. R. Heurlin is now general manager—Military Product Support Department; and Mr L. V. Tomasetti has been made general manager—TF34 Department.

IN THE AIR

By Tony Smith: Number 244 of the series

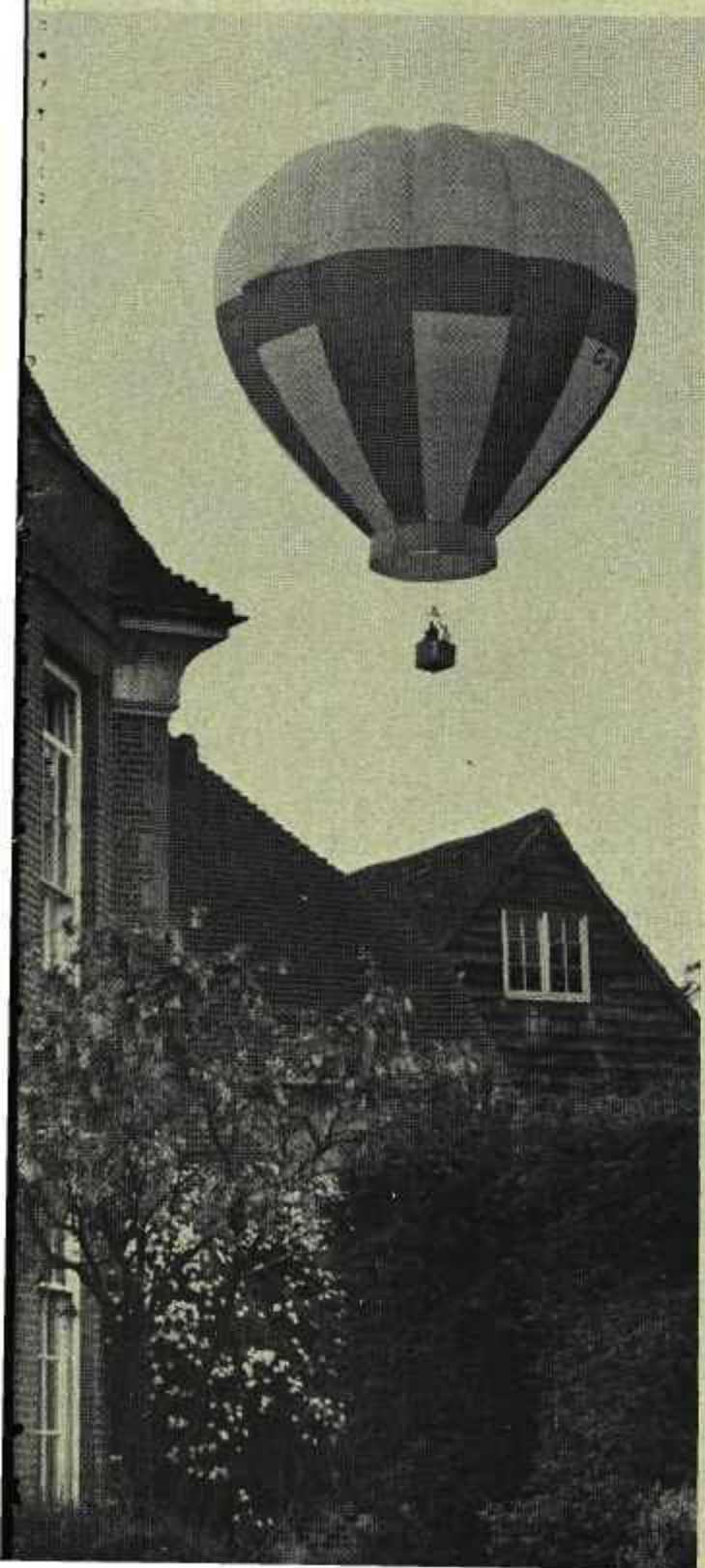
"BURN! BURN!"**Hot-air drift over Oxfordshire**

MY APOLOGIES TO SOME OXFORDSHIRE FARMER (whom I have never met) for the four-foot square patch of very flattened corn in the centre of one of his fields. He may wonder how on earth anybody got there without trampling a path or he may now be a firm believer in the existence of mini-men from Mars. In fact it was done when I made an unplanned and none-too-gentle arrival in a hot-air balloon. A little to my credit, perhaps, my first landing earlier on had been both intentional and rather more controlled.

Britain's first steps in the newly revived art of hot-air ballooning were taken in 1967 when the Hot Air Group produced the *Bristol Belle*. My own introduction to the sport began in the appropriately ancient country-seat surroundings of Rycote Chapel near Thame. In the back garden of the adjacent farmhouse, Don Cameron, previously a member of the Omega group which produced ten craft between 1968 and its disbandment last year, laid out his 84,000 cu ft magenta and yellow *Golden Eagle*, G-AYAM. He built the monster himself in the Bristol workshop where he produces similar units to special order. So far, since he began building balloons earlier this year, he has made six, two of which have been exported. A production rate equivalent to one a month for something as expensive (from £1,500 complete) and, well, peculiar as a balloon illustrates the extent to which this sport is now growing.

Don Cameron sub-contracts much of the work involved. He supplies the design drawings and has sub-contractors cut out the material and do the routine sewing—a full mile of which is involved. The important fiddly bits are done back at Cameron's workshop—with his wife's help. The canopy material is high-tensile nylon proofed with polyurethane. The normal method of construction is to join together a series of gores rather like a parachute. Each gore is of nearly semi-circular cross-section so the tension in each one is very low. Minor rips, from trees for instance, are thus prevented from running around the entire structure like a ladder in a pair of stockings. Smooth balloons can be made—Cameron recently delivered one to Belgium—but lines of lateral ribbing have to carry tension loads and act as tear stoppers. In the gore-type versions, nylon webbing between each segment takes the stress—with a safety factor of no less than 25—while horizontal tapes prevent tears from spreading but take no strain. Gores also allow the shape to change with varying loads—from flat and squat with a light load to long and narrow with a heavy one. This has the advantage of keeping the stresses equal; with a smooth balloon, there can be only one load where the stresses are the same throughout the canopy.

Laid out forlornly on the grass, *Golden Eagle* looked rather like a giant steam-rollered banana. Preparations for inflation are relatively straightforward. The vast volume of fabric fits into a surprisingly small bag—a sort of distended holdall five times the size of the hand-luggage variety. At the top of the canopy is the rip panel, which is the top half of one of the gores and is held closed by Velcro strips. On landing it is pulled open to allow the hot air to escape. Prior to inflation the line to this panel must be checked and this involves entering the monster's mouth and wading, arms flailing, through acres of nylon to the crown. From the outside the impression is of a six-foot jumping bean making staccato progress up a mammoth handkerchief. The danger in this procedure is of



HOT-AIR BALLOON in the Air...



Above, Don Cameron emerges after checking the rip; below, a trifle worrying for the novice, with 1,900°C roaring past his knees; right, Tim Godfrey sinks ever lower into the basket complete with an armful of burner



becoming lost, but I avoided this by staying close to Tim Godfrey, a member of the London Balloon Club, who was to pilot *Golden Eagle* on this trip.

Watching a balloon drift gently over the countryside one might imagine that this was one of the least active sports possible. This is not at all true as far as the preparations for flight are concerned. Ordinary, simple ambient-type air has to be introduced into the canopy before any heating can be done. In still air this is achieved by opening and closing the neck as if shaking a sheet. Ripples then flow up the body as it starts to breathe.

This is the time to light the burner, which hangs from the base of the balloon on 12 steel wires. It feeds from propane cylinders in the basket (four is a typical load although we carried only three) each of which holds 35lb of liquid at a pressure of up to 100lb/sq in, depending on ambient air temperature. The fuel is vaporised in coils surrounding the burner jet. The whole unit is quite a piece of precision engineering formed of welded-up stainless steel tubing and costing about £120.

Protective clothing is something normally associated with technical complexity and it seemed incongruous to see the crash-helmeted pilot pull out a box of matches to start things going. But a helmet is a necessary piece of equipment with the hefty burner installation just above head level. Once the pilot burner was alight, Tim Godfrey tested the main jet which is controlled by a small lever. I wasn't really ready for the 6ft of flame which shot out at about 14ft/sec like the tongue of some demon chameleon. Exceeding the output of most industrial heaters, the burner produces around five million Btu/hr with a burning temperature probably near the 1,900°C maximum for propane. This ensures almost total combustion which, in turn, prevents build-up of an explosive mixture inside the balloon.

Tim Godfrey crouched behind the burner, half in the basket which lay over on its side. He aimed the jet at the mouth of *Golden Eagle* which Don Cameron and I held open, feeling like Lilliputian dentists. When the hole was big enough he fired the burner in short bursts and gradually the great whale-

like canopy began to heave and expand as it gulped in huge breaths of air. With only three crew, we were rather short-handed since normally someone would have held down the crown of the balloon until the canopy had filled quite substantially. We lacked this team member which resulted in *Golden Eagle* making its own decision on when to rise. It soon did this, floating gracefully upwards, an awe-inspiring brightly coloured genie, towering above the house and up to the height of the trees.

All this caused a problem, for the canopy was still filling and after each burst of the burner it sucked in more air, the pressure difference closing up its mouth. Don Cameron and I heaved away at opposite wires above the burner to try to force the gap open but this also pulled the balloon down, plus the burner, plus Tim Godfrey, who sank ever lower into the now upright basket until only a white helmet and two gloved hands tussling with the fearsome flame-thrower could be seen. At this point we conceded to Tim's urgent request to release our grip on the rigging lines and to allow the canopy to ascend to the full extent of the wires. We then repeated the performance until eventually the big, colourful bubble had filled.

The next stage was to heat the air enough to make the balloon ascend, a process which involved the same short burner bursts alternated with a basket-rocking procedure by the crew as if to release suction but in fact to see how near to flight the craft was becoming. The safe operating temperature for the canopy material is 110°C. Thermometers are carried by some balloonists but the long wire necessary lies in wait for the toes of wayward boots in the fraught period during inflation and Don Cameron has abandoned the idea. On a hot day, the trapped air must clearly be made hotter than in cooler weather to maintain the difference in pressure required for an ascent. So on hot days load has to be limited and the permissible figure is worked out from a weight versus ambient temperature grid drawn for each craft. A way of overcoming this weight restriction is to use material—already available—which will withstand higher temperatures, but this costs three times as much as proofed nylon and its heat loss is greater.

On a calm summer's evening such as the one during which I flew, the inflation and launch has none of the excitement, so I am told, of the equivalent operation in any reasonable breeze. About 15kt is usually thought of as getting near the limit, although inflations in 25kt winds have been successfully carried out. If no shelter is available behind trees, the basket has to be walked or run along beneath the inflating canopy, so a launch depends on the availability of willing—and healthy—helpers.

By the time *Golden Eagle* had expanded to its full glory, several people had gathered to witness the strange sight. They were immediately recruited to hold on to the basket while Don Cameron and I clambered aboard. A few more blasts from Tim on the burner and we lifted off and drifted away over the farm house.

Having passed the trees Tim proceeded to demonstrate probably the most appealing aspect of ballooning. We descended to grass-top level in the next field and drifted slowly across in the light wind. As the fence drew nearer, an extra burn or two lifted us gracefully above it and we crossed over the farm track and into the next field. A full thirty-second blast propelled us up to 500ft or so—an Apollo-like lift-off can apparently be achieved by heating the trapped air considerably before take-off.

An airborne balloon is an excellent platform from which to observe the vagaries of wind and the effects of thermals. Normally, when drifting along, the wind cannot be felt because the craft is moving with it. But a breath of breeze can be felt when flying into wind shear before the balloon overcomes its inertia and takes up the fresh direction. The wind is diverted by obstructions and experts can sometimes use this feature to go round a clump of trees rather than over the top. Going over a ridge will cause the groundspeed to increase owing to the venturi effect.

While the glider pilot prays for thermals, his ballooning counterpart is not so keen. With the balloon in a thermal, the air in the canopy must not be allowed to cool too much. If it does, then once lift runs out or a downdraught is encountered, a rapid descent starts, and a cooled descending balloon needs a lot of heat to make it go up again. Over dusty ground it is possible to watch thermals forming, enclosing miniature dust devils gyrating upwards. Thermals often cause the craft to swing about, the basket acting like a big pendulum, and the twisting air is sometimes strong enough to start the whole thing slowly turning.

Down with a bump

Established at a steady 500ft or so it was my turn to fly. Dirty water from condensation dripped from the burner, emphasising the need for proper overalls. In the calm evening air I found I could judge burns sufficiently well to maintain a fairly uniform cruise. Judging descents and ascents was rather more difficult. Several seconds of anticipation is needed since the balloon, at 1,500lb all-up weight plus about two tons of trapped air, has considerable momentum. If the air is allowed to cool too much, the craft descends determinedly, which encourages the novice pilot to burn furiously. Sure enough the descent stops but is immediately replaced by an equally determined ascent. All this leads to the familiar fugaloid progress of the learner pilot.

Once having established a satisfactory glidepath for an approach, the rate of descent is held constant by frequent short sharp bursts of burner. When landing in a light wind, the whole apparatus lurches downwind after the basket has touched, but having dissipated its momentum it rapidly regains its upright composure. In stronger breezes things become more fraught and instant operation of the rip panel to spill out the hot air is needed to prevent basket and crew from being dragged bodily across muddy fields. A firm touch-down shows the value of a crash helmet, for the balloon, complete with burner, tends to carry on for a few feet once the basket has stopped. It is the pilot's responsibility to grab the burner cradle before touchdown to keep it under control.

Flushed with the success of my first landing, I set about trying some low-level flying, but I hadn't really sorted out the delayed reaction sufficiently and this—preceded by earnest

demands from Tim to "Burn, burn!"—led to the unplanned arrival in the corn. While I recovered my composure after this incident, we drifted on over farmland, some bulls in one field becoming a little too interested for comfort when we touched down briefly. Traffic on the country roads ground to a halt when we passed over at tree-top height as intrigued travellers studied our stately progress. A formation of four Andovers wheeled around the sky above us, wheeling a little bit harder when they saw us not far away.

Clearly, high-tension wires are the balloonist's worst enemy. The gentle breeze took us at an angle across a line of pylons, so for a good ten minutes both Tim Godfrey and Don Cameron paced the two available steps up and down the basket clutching a box of matches in one hand and a match at the ready in the other.

With dusk beginning to fall, Tim selected his landing field. Of the many considerations to be taken into account, one of the most important is the proximity of a road. A farm track passed alongside our intended touchdown point but so did a substantial wood. The few minutes of debate about the best course of action seemed rather out of aeronautical context, where decisions are usually of a more instant sort. The required descent angle looked perturbingly steep but deft use of the vent panel, which can be opened and closed to release some of the air, established us on an approach path which would have impressed a helicopter. At the same time, frequent short burns kept the balloon hot and we made a gentle touchdown with just a short bounce.

As we were in the corner of the field furthest from the road, the best plan was clearly to get the craft to the other end so that the trailer could be brought up close. Don and I climbed out—making sure we did not let go our grip on the basket—and Tim then fired the burner for a few seconds to lift the balloon a matter of inches. Looking rather like Ben Hur in his chariot, Tim kept up the short burner bursts, while Don and I pulled and heaved with appropriate slave-like efforts.

Most of the nearby village appeared to have turned out and we found we had landed near Holton—all of five miles from the starting point we had left an hour and twenty minutes earlier.

Deflation of a hot-air balloon is carried out merely by pulling the rip panel. As the hot air escapes in a long man-made thermal, the great canopy collapses sadly like a shrivelling whale. All that remains is to squeeze out the remaining dregs of air—a fairly lengthy process—before packing the canopy away. Once the rip panel is done up again, the craft is all ready for another flight.

While ballooning is an excellent way of getting virtually nowhere and taking a long time about it, there is the enormous attraction of floating over the countryside in the peace between burns and at the same time acquiring a useful background of practical meteorological experience. It is an activity which produces a unique sensation of complete detachment from the world, and a feeling of relaxation which can probably only be experienced when doing something thoroughly pointless but nevertheless thoroughly enjoyable.

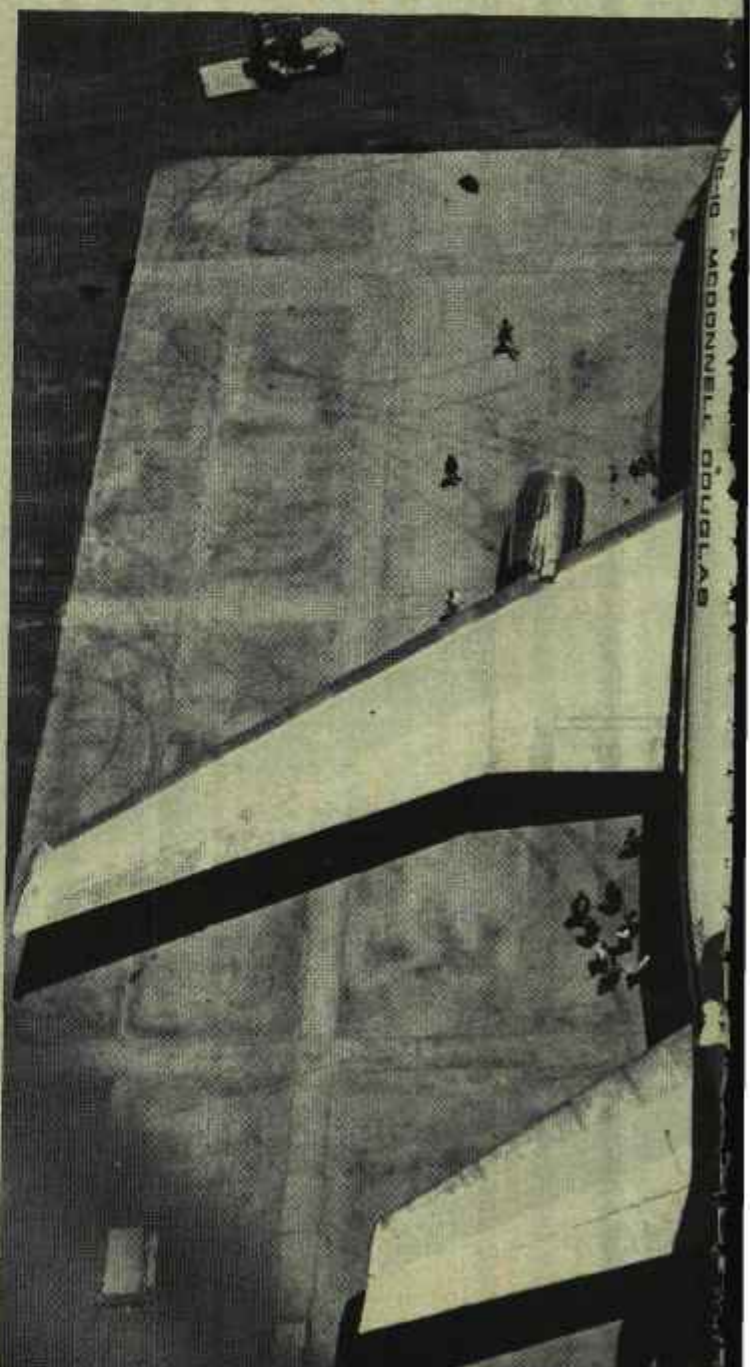
"Of course, it's all frightfully dangerous..."



MCDONNELL DOUGLAS DC-10 PREPARES FOR

Reading clockwise from top right, the tail section showing the 43ft long, 8ft-diameter straight-through duct, housing one of the CF6 powerplants, and above it the double-hinged rudder. The DC-10 is a wide-bodied aircraft, and a considerable amount of internal trim is fitted to the prototype which also has full test instrumentation installed. The braking system is by Goodyear. The aircraft has large-

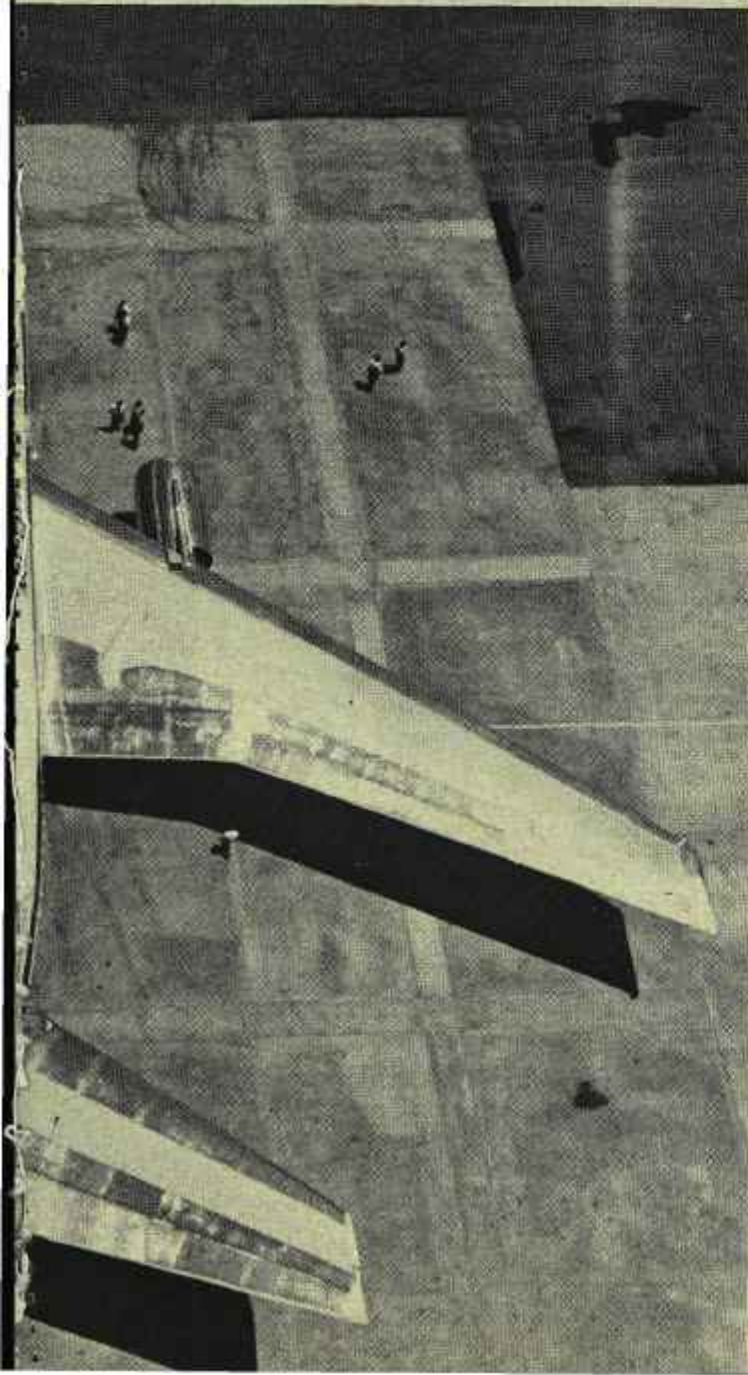
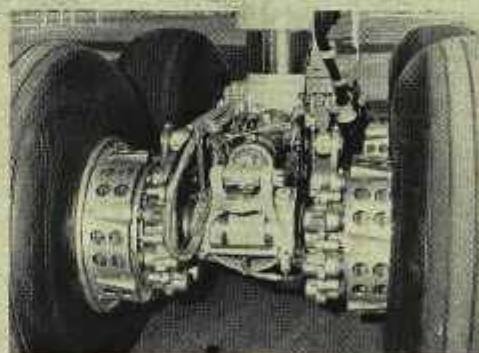
WIDE BODY AT



FIRST FLIGHT AT THE END OF THIS MONTH

area double-slotted flaps and leading-edge slats. The size of the DC-10 can be gauged from a comparison with ground equipment. Large flap-guide shrouds, leading-edge slats, and engines slung well forward on low pylons are characteristic of the DC-10. Large cockpit windows are evident in this three-quarter front view. Inside the cockpit the layout is particularly neat.

LONG BEACH

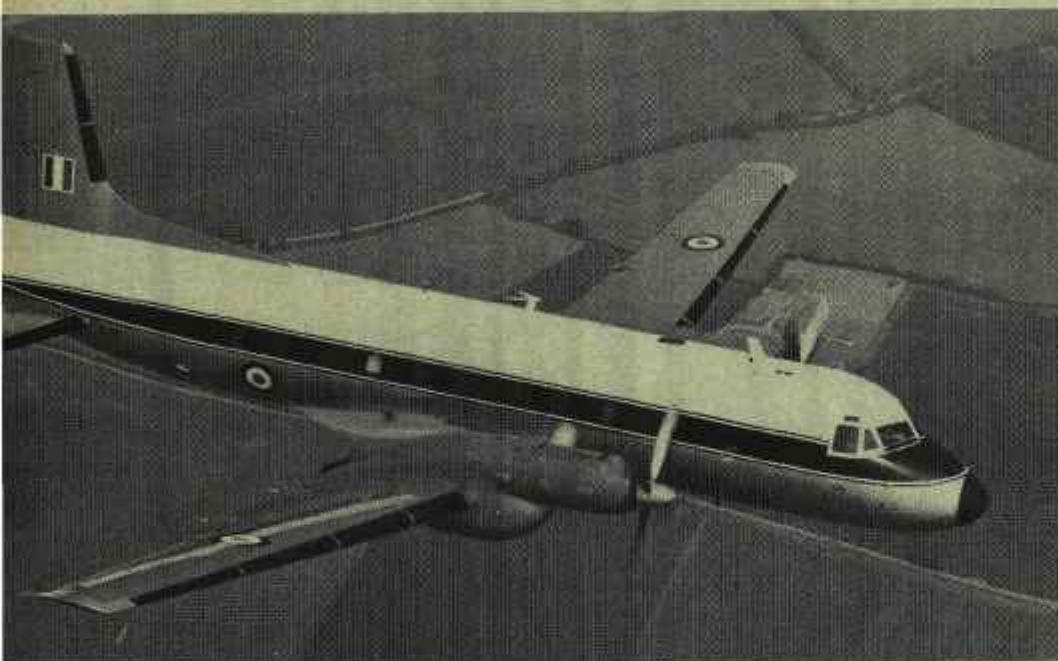


ROYAL AIRLINE

THE QUEEN'S FLIGHT OF THE ROYAL AIR FORCE



Text by
HUMPHREY WYNN
Photographs by
TOM HAMILL



Reflections on the Royal cipher (above) affixed to one of the Flight's Andovers. Left, another of these aircraft airborne from RAF Benson

BECAUSE THERE ARE FEW KINGDOMS now left in the world, and because most of these are in small countries, there are few air force units operated exclusively for Royal travel: a VIP aircraft generally suffices. Thus the Queen's Flight which the Royal Air Force operates at Benson in Oxfordshire is a unique institution, existing solely to carry the Queen, members of the Royal Family, visiting Heads of State, Ministers, Service Chiefs of Staff and selected Government officials on their business journeys. The Flight is also unique in that, although being a part of the RAF and within Air Support Command, it is an institution on its own and most of its personnel are not subject to the normal operational tours of duty which obtain in other parts of the Service. For example, some of the aircrew and groundcrew have been with the Flight for periods of up to 14 years. Once a man is selected—and no officer, NCO or airman is forced to join the Flight; he is invited—and provided he likes the job, he can remain there a long time. Since every man on the Flight is aware that he is serving the Queen and members of the Royal family in a very personal way, these two facts together make for a unique brand of enthusiasm, loyalty and energy.

The Flight has been based on Benson's pleasant green acres since it was formed there in 1936 as the King's Flight, in the days of Edward VIII; and the first Captain, Sir Edward Fielden, remained in charge of it for more than 25 years—a record length of service for this institution. A visitor to the Flight feels something unusual at Benson as soon as he reaches the hangar where its headquarters are and where a little door marked "Security" is surmounted by the Royal cypher. Having negotiated this barrier and been provided with an identification badge he finds himself in a hangar where are housed what are undoubtedly the most beautifully maintained

aircraft in the world: three highly polished red-and-silver Hawker Siddeley Andovers; two red Westland Wessex HC4 helicopters; and, unless it is away on training duties, the Beagle Basset C.1 used by the Prince of Wales, who has enthusiastically formed on his father's aeronautical footsteps.

The visitor with his badge feels rather in the same position as one of the tools in the "identikits" in the hangar, each of which has its silhouette behind the hook on which it is kept, so that at the close of the day's work a glance suffices to see if any one of them is missing. So at the end of the day a visitor whose badge is missing from its hook might find himself being searched for inside one of the Andovers or Wessex or even the Royal Basset.

The feeling of something different from the usual RAF operational unit is emphasised when the visitor reaches the other side of the hangar and climbs the stairs to an upper corridor where the aircrew and administrative staff have their offices. The crew rooms are to the right and to the left, rising in seniority as names on the office doors proclaim the Secretary, Officer Commanding, the two Deputy Captains and the Captain. The last named occupies an executive-style suite with cloakroom, lobby, an exit to the airfield and softly furnished private office. The present Captain is Air Cdre Archie Winkill, who has held this post since the beginning of 1968.

Although he was a Battle of Britain pilot, his visitors do not find themselves confronting a uniformed, beribboned air commodore: instead, a dark suit is de rigueur, consonant with the business atmosphere of carpets and curtains. This is because, by tradition, when an air commodore is appointed Captain of The Queen's Flight he takes up the post as a

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Prince Charles' Bassett in the hangar at Benson seen (right) beyond the tail rotor of one of the Queen's Flight Wessex. Below, one of the flight's Andovers en route



Swearingen Aircraft



MERLIN IV



MERLIN III



MERLIN IIB

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TAKEOFF WEIGHT	10,000 lb.	12,500 lb.	12,500 lb.
LANDING WEIGHT	9,300 lb.	11,500 lb.	11,500 lb.
USEFUL LOAD (Passengers and Fuel)	3,400 lb.	5,300 lb.	4,800 lb.
ENGINE TYPE	TPE 331-151G	TPE 331-303G	TPE 331-303G
TAKEOFF POWER	665 SHP	840 SHP	840 SHP
PRESSURIZATION DIFFERENTIAL	7.0 psi	7.0 psi	7.0 psi
AIR-CONDITIONING			
Hot	Bleed Air	Dual Bleed Air	Dual Bleed Air
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NOTE: Speed and Range are listed in mph and statute miles

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ROYAL AIRLINE...



Its highly polished wing reflecting its fuselage, one of the Queen's Flight Andovers near RAF Benson; below left, a combination of polish and elbow grease keeps the Royal cypher bright; and, at right below, one of the Wessex, giving a glimpse through the door of the interior



Continued from page 244

serving officer; but after a few months, if found acceptable, is quietly invited to retire from the Service and continue in the post as a civilian. This adds to the unique character of the Flight because its civilian boss controls six RAF aircraft and a staff of about 140 Service personnel. In accepting his post, the Captain becomes a member of the Royal household and as much of his time is spent in journeys to and from Buckingham Palace, for consultations there, as in his office at Benson.

The Captain or one of the Deputy Captains (Gp Capts B. A. Primavesi and R. C. F. Peirse—who by contrast are regular serving officers) always accompanies the Queen or members of the Royal Family when they travel by air, whether they are flying in one of the Queen's Flight aircraft, or by an airline, or in another Service aircraft, either British or from one of the Commonwealth countries. The rôle of the Captain or Deputy Captain on these flights is that of a controller or co-ordinator of the mission; he sits in a compartment located in the Andover between the flight deck and the Royal passengers' accommodation, although this configuration may vary when the Duke of Edinburgh alone is on board. Mention will be made later of the different types of "fit" which can be put into Queen's Flight aircraft according to the requirements of the journey.

Benson base

Siting of the Flight at Benson, where it has been for its whole existence (except for the war years when it became the nucleus of the No 161 Special Duties Sqn) is convenient in three respects: for positioning aircraft at London Heathrow or RAF Northolt for Royal and VIP flights starting from there; for flying in to the grounds of Buckingham Palace or Kensington Palace in one of the Wessex helicopters; and also for continuation training, since the airfield is in an area clear—albeit only just—of the UK airways system.

In the near future the Argosy force of Air Support Command, now located at Benson, will run down and the main occupant of the airfield will be the Headquarters of No 38 Group, ASC. The Queen's Flight will of course remain there.

But whatever other units there may be at Benson, the Flight is completely self-contained in its offices, hangar, workshops and stores on the airfield. The chief point about this independence is that while the work it does pertains only to Royal journeys by air, and hence the number of its aircraft is limited, there must be engineering backing in depth. This means that instead of doing its own first-line and second-line servicing like normal RAF squadrons, the Queen's Flight also does third-line servicing—that is, major overhauls of its aircraft and their installed equipment. Not only does the Flight possess this complete technical capability, but very often has to carry out overhaul or repair work against time, in order to fit in with a Royal schedule which cannot be altered, so closely is it geared-in to other arrangements. For every flight, whether carrying Royalty or the VIPs referred to earlier, the aircraft designated must "work;" there is no back-up machine available. Because of this the facilities at Benson are very comprehensive.

On the north-west side of the hangar, underneath the administrative offices, are workshops for carrying out maintenance on radio and navigational aids. There is a carpenter's shop where tables, coat cupboards and anything else required for a Royal aircraft "fit" are made. There is a catering department presided over by the stewards where Royal in-flight meals are prepared, and adjoining this is a dining-room where the Duke of Edinburgh and the Prince of Wales have lunch when they come to Benson for continuation training.

On the other side of the hangar are more engineering workshops, including one for engines, where a complete record is kept of all the powerplants in the Royal aircraft. When a part has to go back to its manufacturers for repair a careful check is made to ensure that exactly the same part is returned. It is possible in an emergency for the Flight to change an engine in one of the Royal aircraft in 12 hours, or in other words, overnight. Also on this side of the hangar is the flag store where the Royal or Presidential standards and flags of every country in the world are kept: its racks, with flags draped over



The red and white Beagle Basset with the Prince of Wales' coat of arms displayed on the fin. Below, maintenance on one of an Andover's Dart engines



them, resemble a three-dimensional dictionary of the world States. When a Queen's Flight aircraft lands at a foreign airfield the personal standard of the member of the Royal Family on board and the flag of the country being visited are flown on the top of the aircraft, being pushed out from the navigator's position behind the two pilots.

Just outside the hangar, across the road, are stores which again illustrate the Flight's self-sufficiency. Here seating of various kinds is kept for the different fits which go into the aircraft according to the purpose for which they are required and the VIPs they are carrying.

There are about five different fits for the Andover interiors, according to whether the aircraft are carrying the Queen, other ladies of the Royal Family or the Duke of Edinburgh. As Prince Philip does much of the flying himself he favours a simpler interior arrangement including cupboards for uniforms and suits, a galley, and a desk for a secretary. When ladies of the Royal Family are being carried, specially comfortable seating is provided, in chairs which swivel and—in the case of the Royal Princesses—are so designed that the headrests do not interfere with Royal headgear; in effect these are really no more luxurious than any standard first-class airline seat. In fact, the general layout of any of these aircraft fits is not as elaborate as that of many private executive aircraft. The

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theme is one of strict practicality as opposed to unnecessary opulence.

The Flight has about 24 aircrew, including air stewards and crew chiefs, the latter being responsible for the aircraft while they are on the ground away from base.

The Queen's Flight prides itself on having the highest standard of technical ability in the RAF and it is therefore self-evident that those invited to volunteer for service with the unit must measure up to stringent trade and personal standards. Groundcrew work hard and often do long hours; but, for all that, the visitor gains a strong impression of a contented bunch of men, very much aware of their unique responsibility and taking justifiable pride in their jobs. Not for them a nine-to-five routine: if an aircraft needs servicing in the middle of the night for "a Royal" the following morning, they do the job cheerfully and without complaint.

Because no backup aircraft are available it may be necessary at times to signal for a spare from remote parts of the world and obtaining this can sometimes be achieved with remarkable speed, like the 24 hours in which a replacement was requested from Fiji, despatched and received.

Aircrew necessarily stay on the Queen's Flight for longer tours than prevail elsewhere in the Service because flight safety must always be the paramount consideration and it takes a longish apprenticeship before crews become fully proficient and familiar with all the various aspects of Royal air travel. It goes without saying that these aircrew are all of well above average ability and they go out of their way to make flights interesting and informative for their passengers.

As far as the fixed-wing aircraft are concerned, notification of Royal flights is given by the Board of Trade through Notams and a "purple airway" is provided which other aircraft

are advised to keep clear of between stated times. This procedure, while it cannot guarantee absolute safety on Royal flights, gives the aircrew a measure of confidence and support, especially when instrument meteorological conditions prevail. As far as Queen's Flight helicopters are concerned, the same sort of air traffic safeguard does not at present prevail and a great deal of responsibility rests upon the individual pilot, flying at a comparatively low level, in keeping a watch for other aircraft. Recently one of the Flight's Wessex carrying the Prince of Wales was involved in an air miss as it was flying near Warminster, Wilts, in poor visibility at 1,000ft, and this incident highlights a very special problem. For some time the Captain has been concerned with the rising incidence of "near misses" and collision risks, particularly with light aircraft in the lower altitudes, and has been pressing for nearly a year for the adoption of a tighter system of control. As a result of the latest incident it is hoped that the new system proposed by the Flight will shortly be put into effect.

Queen's Flight aircrew prepare strip maps for members of the Royal Family to follow their route during flight; these proving especially popular on helicopter journeys. For major overseas tours like the recent Royal visit to Canada, route books are prepared giving names of all passengers, times at destination and local climatological information.

It hardly needs mentioning that Queen's Flight aircraft are kept in an immaculate condition, both inside and out. Their silver finish is highly polished and the red surfaces of polyurethane paint are kept bright by washing and the application of plenty of elbow-grease. Originally the Royal aircraft were painted Day-glo red, but it was found that if any loss of this surface occurred it had to be remedied by repainting, a less easy task than the refurbishing of polyurethane surfaces.

In addition to flying Queen's Flight aircraft on Royal journeys in the United Kingdom or overseas, some of the pilot aircrew at Benson provide instruction when required—for instance Sqn Ldr P. G. Pinney is the Prince of Wales' flying instructor—or supervise continuation training for the Duke of Edinburgh. The latter's fixed-wing pilot is Sqn Ldr A. W. Picking and his helicopter pilot is Sqn Ldr R. M. Kerr.

Costs

Cost of maintaining the Flight has been given as £450,000 a year: and like that on the Royal yacht *Britannia*, this expenditure of public funds for Royal transport has been the subject of some criticism. However, so long as Britain has a monarchy, the sovereign and other members of the Royal Family have to fulfil a busy round of engagements, both in the UK and overseas. Because of the time factor many of these journeys have to be done by air if they are to be done at all; and if there were no Queen's Flight such trips would have to be made in other RAF aircraft or ones from the corporations. Not only would this prove extremely expensive but it would in fact be an organisational impossibility; also there is no doubt that the additional safety factor, which the Queen's Flight is able to provide because of the familiarity of its long-serving aircrews with the special procedures involved, could never be achieved by ad hoc arrangements in other people's aircraft. There is of course also the point that, apart from sheer convenience, flying is a very much surer—and safer—means of meeting a Royal engagement than the alternative of traffic jams, police escorts and all the other attendant frustrations of modern road travel. Also anything that can be done to ease the lot of the Royal Family by helping them to relax, between engagements, in the comfortable and familiar surroundings afforded by aircraft and personnel of a Queen's Flight that they have come to know and trust, is a worthwhile recompense for their hard work.

In speaking of costs, it also needs to be pointed out that Ministerial and other non-Royal flying accounts for 40 per cent of the annual effort, which—if done by other means—would make a considerable hole in someone else's budget. With all this assorted flying, aircraft are utilised to their absolute maximum and there is no doubt that by any standards the unit is cost-effective.

The argument for retaining the Queen's Flight is a convincing one; and the fine record of the Flight itself—it has never had an accident since its formation—is the strongest evidence which can be adduced for such an argument.



Letters

Anglo-French Tit for Tat

Sir,—Congratulations on your *remarquable* article entitled "Ce n'est pas la co-opération" which puts things in their true perspective and proves clearly that the chauvinism which is basically French is something totally unknown on this side of the "English" Channel.

However, I have some remarks to make about it. I find it very difficult to believe that in 1962 Sud Aviation got the leadership in the Concorde project when it was "95 per cent British aerodynamics and 100 per cent British power." If it was so, it looks as if your interests have been defended by the Salvation Army rather than by a responsible government. As far as I am concerned, I would think that the figures were more balanced in terms of aerodynamics. So, I would find it very imprudent for Mr Davies to quote your figures. Also, the link that you establish between Concorde and an eventual entry into the Common Market is something to be argued about.

I come now to the problem of the English withdrawal from the A-300B project. The conditions laid down by the British Government prove in my opinion that they had no intention of completing the deal. I think that you are sufficiently aware of the problems involved in aircraft development to admit that a fixed contract is nothing less than unrealistic. The examples are innumerable in all the main aircraft-building countries. Also, the request for the use of Rolls-Royce engines exclusively was obviously a restriction imposed on the project regarding its potential US market.

Anyway, it is fair to say that the A-300B did not fulfil these requirements. It is no less fair to add that the hypothetical BAC Three-Eleven does not fulfil them either, even the clause concerning the engines—the "exclusive" seems to get less and less mandatory. As for the "indispensable" experience of Hawker Siddeley, the explanation is that rejecting them would have meant a supplementary delay for the project since a long time ago it had been agreed that Hawker Siddeley would be responsible for the design and manufacture of the wings. Nobody else worked on this part of the project. During all this time BAC was planning the Three-Eleven?

So on this subject again, I would advise Mr Davies to be very prudent and, in any case, not to follow your suggestion.

Another point on which I have a different point of view from yours is Dassault's Mercure market. How can you declare that a 155-seat aircraft aims at the same market as one with 250 or more seats? Let me add that the Mercure is designed to be economical down to a range of 250 miles.

Also, when you say that the Mirage G8 competes with the MRCA and that Snecma's M53 engine challenges (presumably) the Rolls-Royce RB.199, may I remind you that the Dassault Mirage G flew three years ago and that the M53 has already run on the test bed. One can also say that the next Paris Air Show should see the presentation of the twin-engined Mirage G4. Who is competing against whom?

Finally, while it is true to say that US airlines run about 60-70 BAC One-Elevens, it must be remembered that United Airlines runs 20 Caravelles and that the agreement between Douglas and Sud concerning the licence-building of the Caravelle was cut short two years before the appearance of the very similar-looking DC-9, the success of which you know about. I would also suggest you ask Pan American's Business Division its opinion about the Dassault Fan Jet Falcon, unless its order book is eloquent enough. This means that the

French aeronautical industry enjoys a certain consideration in the States. It must also be remembered that the orders for the BAC One-Eleven have not reached 200 yet and that those for the Caravelle stand at more than 270.

In conclusion, I would say that the English supremacy in Europe as far as engines and avionics is concerned is accepted by everybody. It is fair to say that in airframes, helicopters, satellite launchers and missiles, France is not your second.

What a waste of time and effort this everlasting back-biting between England and France is at a time when all endeavour should be concentrated on getting a bigger European share of the world market in the face of the American challenge.

An article such as the one which promoted this letter does not contribute to this purpose in any way. Answering a so-called chauvinism by another stronger one has always appeared to me to be a disastrous policy.

Chipping Sodbury, Glos

G. VERMONT

Organising for Aerobatics

Sir,—I am a variety of Neddy who, contrary to the learned Roger Bacon's views on the species, wishes to speak up on behalf of the British public.

I, along with many thousands, attended the aerobatics festival at RAF Hullavington on July 26. Whilst accepting that our inclement weather does curtail flying I feel that the Royal Aero Club has achieved nothing by way of stimulating public interest in aviation.

A propos—why was the only apparent lavatory located so far from the major car park? Could it be that the RAeC is interested in a new land speed record?

Why were no participating aircraft on view in front of the public areas? A couple of joyriding Pipers and some team hack aircraft are not sufficient to retain a four-year-old's interest on a sunny day, let alone the public on a wet day.

Why was Herendeen's performance in the Pitts Special curtailed? An explanation over the public address system, whilst not a substitute for those stimulating rolls, would have helped.

Surely the RAeC should appreciate that the organising of a public display in anticipation of VFR conditions is just "not on" in our climate and that the British public is not made up of camels. Perhaps a transfusion of us Neddies into the RAeC is not such a bad idea.

Worthing, Sussex

R. M. KILICK

Airtours: how Independent?

Sir,—I have observed the operations of BEA Airtours from Gatwick and I think that the main body of your readers will agree that it is about time certain pertinent questions about this company were answered. If you publish this letter it is possible that these answers may be given; if not we shall never know.

(1) How much, in round figures, has been paid or contracted to be paid and to whom for their Comet aircraft and, if these aircraft are leased or hire-purchased, at what interest rate and over what period?

(2) Is it true that Airtours were allowed to modify this price downwards, after completion of the negotiations, in the light of the price paid by Channel Airways subsequently, and has there been any precedent for this in other aircraft purchases from the State corporations?

(3) What payments have been made and are being made in respect of the massive ground-support and ex-BEA maintenance equipment, ramp transport, etc?

(4) Has any payment been made in respect of Comet

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



The ex-Famagusta Yak-11 referred to by Sgt Chamberlain in his letter at right

LETTERS...

aircraft spares sent to Gatwick and Comet spares holdings and storage charges at outstations?

(5) Are the rates for handling services, etc. obtained from BEA at outstations the same as those applying to other airlines? Are the same standards of technical assistance provided by such outstations for other airlines as for Airtours—remember the inaugural Channel Airways bus-stop service fire-extinguisher incident?

(6) Has any payment been made for Operations Manuals and operational assistance from BEA Project and Development branch—particularly in reference to the reported purchase of heavy jet equipment, and what payments have been made in respect of uniforms for flying and ground staff obtained from BEA stores?

(7) In view of the moving and disturbance allowances paid to aircrew to transfer from Heathrow to Gatwick (£1,000 each), how are these and other extra costs catered for in their charter rates which are highly competitive?

(8) Why, apart from the Balpa involvement, if Airtours are a truly independent airline, are they not recruiting pilots from the independent sector instead of solely from BEA?

Horsham, Sussex

R. J. MILLER,
Capt

Mercurio Prospective?

Sir,—Most regular readers of *Flight* know how to cope with simple misprints, and the suggestion that the direct seat-mile cost of the Dassault Mercurio will be "lower by about 1.15 cents" than that of the Boeing 737-200 is unlikely to fool anyone. Equally, most readers interested enough to take a long look will realise that the positions of the 737-200 and 727-200 are transposed in the d.o.c. plot (page 154 of the July 30 issue). What I find more puzzling and more serious is that, in his long comparison between the Mercurio and the 737-200, M Bruner has got almost every figure for the Boeing not merely wrong but so wrong that the article becomes nonsense.

Perhaps our French friend might be persuaded to take a second look at the American aircraft, which actually has higher empty weight, considerably greater payload and higher gross weight than the estimates for

the Mercurio. He might also give further information on the aforementioned d.o.c. plot, which shows the One-Eleven 400 as so much worse than the DC-9-10 and Caravelle III. Most of the actual achieved costs I have seen for these aircraft (as the figures are American the Caravelle is the VI) show the British aircraft to be the cheapest. There is also the matter of pseudo-technical justification for circular-section fuselages and the strong implication that Boeing was limited by existing production machinery in designing the 737. This is quite another matter, but if M Bruner went to Seattle he would find Boeing never did anything without studying the alternatives.

Haslemere, Surrey

BILL GUNSTON

Costly Yak

Sir,—It was with great delight that I read of the ex-Famagusta Yak-11's arrival in this country. Late in 1965 with Sgt J. D. Luxton of RAF Brize Norton I attempted to recover this aircraft to the UK while serving at Nicosia.

I was assured of its airworthy condition by its proud owner despite my brief diagnosis of a bent main undercarriage and engine bearers, not to mention the propeller and various small holes. With a promise of unofficial assistance from many quarters I attempted to purchase the aircraft, but the initial offer of £25 was somewhat rudely turned down, the asking price being £1,000. At this point my interest waned considerably.

I enclose a photograph of the aircraft [see above] as it was in 1965 and have several more which may be of interest to Philip Mann.

RAF Scampton, Lincs

T. F. CHAMBERLAIN,
Sgt

IN BRIEF

Mr Vic Butler (33 Home Road, Shepperton, Middx) would like information about G. B. Redrup and his Redrup Fury axial-barrel engine, built in the early 1930s and fitted in a Simmonds Spartan.

The 24th annual reunion of 50/61 Sqns is to take place on Saturday, October 31, at Ye Olde Cock Tavern, Fleet Street, London EC4. Tickets are available from J. Lascelles, 15 Crantock Rd, Catford, London SE6.

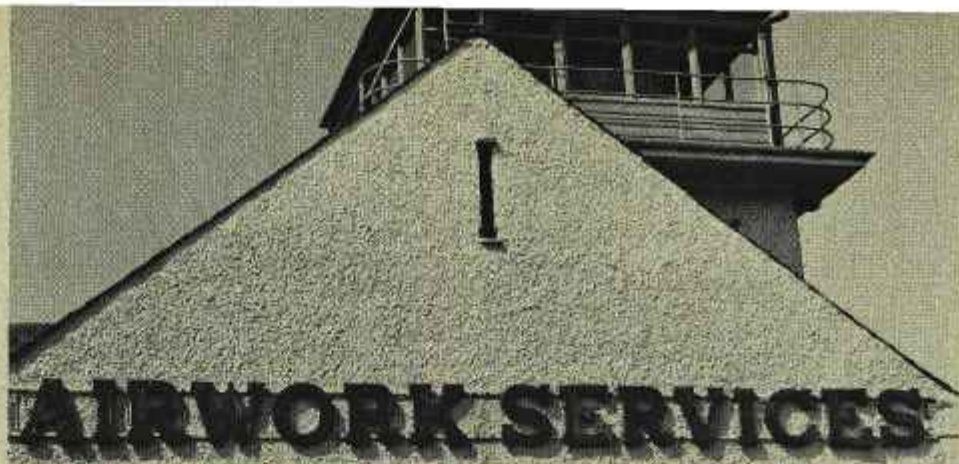
DIARY

- Aug 15** Tiger Club: Air Squadron Aerobatic Trophy; Sywell, Northants.
- Aug 16** Barnstormers Flying Circus; Barton, Manchester.
- Aug 19** Weymouth Carnival: Blue Eagles Army helicopter display team; Weymouth, Dorset.
- Aug 22** RAF air display: RAF Chivenor, Devon.
- Aug 22** Cross-Channel gyroplane race; Dover-Calais.
- Aug 22** Tiger Club: de Havilland Aerobatic Trophy, Little Rissington, Glos.
- Aug 22-23** Internationale Ostsee Flug Rallye 1970; W. Germany.
- Aug 22-31** National Gliding Championships: Open Class; Doncaster, Yorks.
- Aug 23** Barnstormers Flying Circus (venue to be announced).

Danish Dive Bomber

In early May, writes Howard Levy, in conjunction with the Danish 25th anniversary of the liberation, a Saab-built B-17A was presented to the Egekov Veteran Museum at Kvaerndrup. The P & W - powered (Swedish-built 850 h.p. STWC-3) 1944-era two-seater, formerly used as a target-towing aircraft, was reconditioned by Saab and painted in Danish Air Force colours. During the occupation, a Danish brigade in exile was formed with B-17s but never went into operation before the war ended. The photograph shows the presentation with Count Flemming of Rosenborg, president of the Danish Aero Club, and Gen Stig Noren, Commander-in-Chief, Swedish Air Force, at left. Gen J. Brodersen, Chief of Staff, Danish Air Force, is at right.





Text by **HUGH FIELD**
Photos by **TOM HAMILL**

FLYING AND ENGINEERING TRAINING AT PERTH

AS YOU TAXI IN, there is an air of pristine order about Air Training's airfield at Scone, near Perth. For a moment an ex-Service pilot might be forgiven for thinking that he was back at FTS, for there is that indefinable air of a professional school. Aircraft park between details in orderly rows in front of spotless hangars and the atmosphere is enhanced by instructors and students uniformly turned out in blazers and grey flannels.

This degree of order is no mere facade but is symptomatic of the disciplined approach to flying training which has been fostered for over thirty years at Perth. The airfield was built by the local authority in 1935 and management was entrusted to Airwork Services; subsequently, after the war years, the company bought the field outright, and since 1945 a flying school has existed under the headmastership of Wg Cdr F. D. Nugent. He had been associated with the school in pre-war days and returned to command No 11 Reserve FTS in the late forties when it was felt necessary to retain a large reserve flying element to support the regular Air Force.

Perth has always been associated with professional, as opposed to private or club, flying tuition and the school's Commercial Pilot's Licence and Instrument Rating courses were given Board of Trade approval as long ago as 1954. What, perhaps, makes Perth unique is the extent to which courses are operated for engineers; there are virtually two schools at the airfield and the engineer students live and work alongside aircraft that are in intensive daily use.

The airfield is, as a matter of policy, almost exclusively devoted to flying training, and lodger organisations, such as an air-taxi service or an independent flying club, are discouraged. Nor are the school's operations diversified by the wholesale acceptance of charter commitments, though a small amount of such flying obviously injects some welcome variety into the flying instructors' daily round.

The location of the school is, to be fair, a mixed blessing. Apart from an airway directly overhead, the airspace is relatively free and a large proportion of the activity in the area is normally generated from Perth. However, the attraction of the sparsely populated Scottish contours for military low-level flying mean that a student must, from the outset, learn the value of the Mk1 eyeball. Conversely, it is necessary for a student to acquire a basic instrument flying skill at an early stage so that constructive training can continue in less than ideal conditions. It is sometimes suggested that the United Kingdom is the finest natural flying training ground in the world because of the variety of weather to which the country is subject. Runways, approach lights and let-down aids are important prerequisites of all-weather flying, and in these respects Perth is adequately equipped, with the added convenience of major terminals within easy range for diversions.

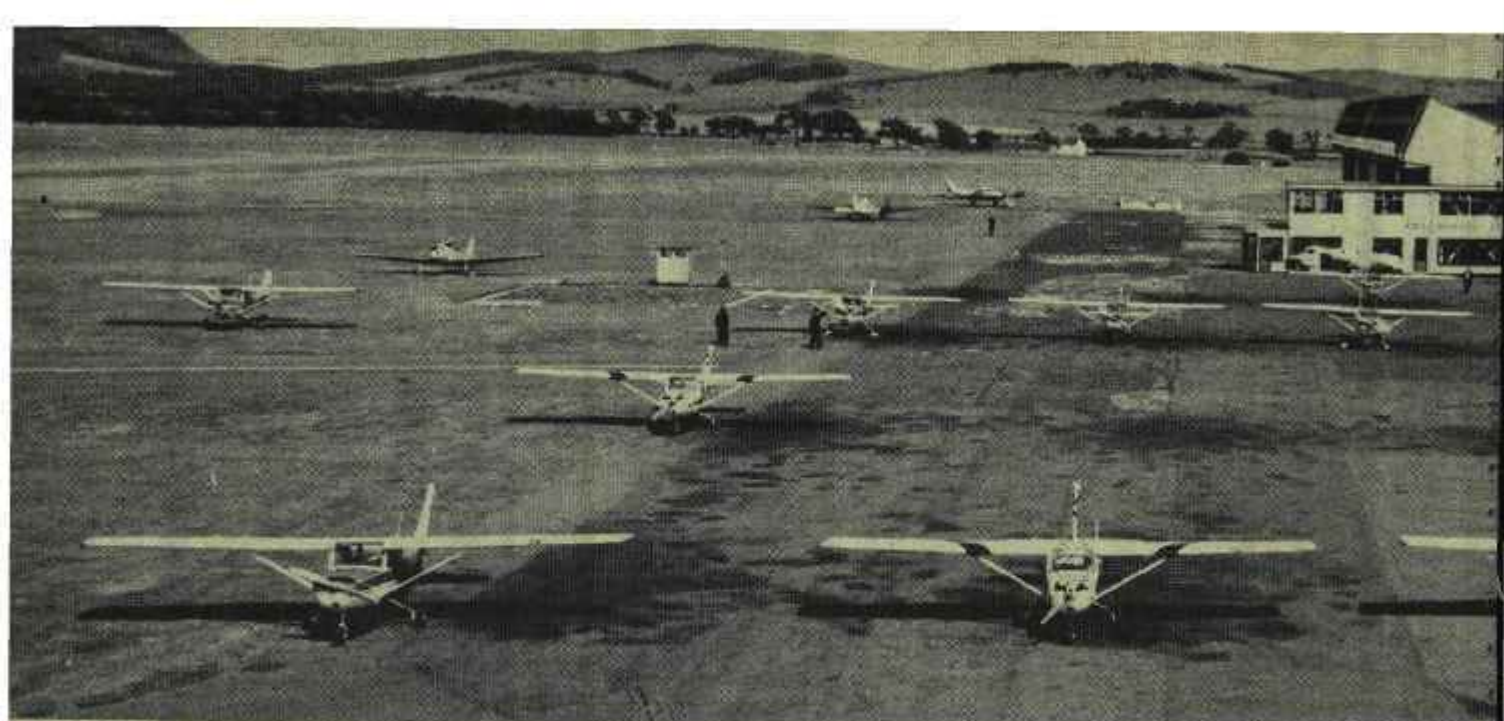
During the last few years, Air Service Training has chosen to specialise with Cessna aircraft for the school fleet, and the organisation now holds a dealership for the singles and the 310 variants. Twenty-seven Cessna 150s form the basis of the



A Cessna 310 and one of the new aerobatic Cessna 150s over the airfield at Perth. The new hall can be seen at the left of the picture.

fleet, two of these being the latest aerobatic versions. Chipmunks had previously been used for the limited amount of spinning and aerobatic flying specified in the CPL approved syllabus, and one of these will be retained at Perth so as to keep the type available to the engineer students for type qualification. School aircraft are normally replaced after five years on strength, and the instructors speak highly of the durability of the 150 as a basic trainer.

Twin conversion and instrument rating training is done on the Cessna 310, of which the school had, at the time of *Flight's* visit, six with a further one to be delivered shortly from Brussels.



252-253 FLIGHT AIRWORK SERVICES . . .

International,
13 August
1970

The sources of the school's students are many and varied with, for the time being, only a relatively small number being directly attributable to the Air Holdings parentage. Participation in the BOAC/BEA Joint Pilot Training Scheme reached a peak in the training explosion three years ago but this was carried out on a contractual basis with no investment on the part of the corporations in the school facilities. The future of training under this scheme is dependent on how BEA and BOAC see their requirements and obviously the "in-house" facility at Hamble will be extended fully before further contracts are placed with a commercial organisation like AST.

Sponsored training by the independents has been at a low level for some time but Cambrian, for example, is continuing its established relationship with the school with a new course starting in October. Overseas students attend from African and Middle Eastern countries under either governmental or airline sponsorship and Perth is shortly to manage a flying school in one African country, supplying instructors on secondment.

Apart from the flying and maintenance requirements of a flying school, extensive ground training facilities are required in order to meet the rigorous standards of the Board of Trade. For the time being the ground school at Perth, under the Head of Studies, George Oldfield, is spread in huffed accommodation. While not ideal, the arrangement nevertheless provides ample lecture rooms and use is made of some ingenious visual aids. A new ground school building has been designed but already a magnificent lecture hall has been erected as part of a new hall which is due for occupation as these words appear.

The new hall, a £240,000 investment, is designed to cater for the social needs of students for whom Perth will be home for two years. Catering for all staff and students is to be centralised in the one building, which also contains bars, libraries, television lounges and billiard rooms. The building is not truly a residential hall as, with the exception of self-contained flats for the catering manager and the matron, there is no sleeping accommodation; this is already adequately provided for up to a maximum capacity of 306 students in existing buildings.

Numerically, the engineering school handles more students than the flying school, up to 200 usually being in residence. The target for the student undertaking the full course will be the achievement of A and C licences and this makes for a very full syllabus, particularly when allowance often has to be

made for a language problem. All the students start with three months spent in the fitting shop where they learn the basic use of tools and metalwork. In the main tutorial hangar—entirely separate from the flying school premises, it should be recorded—a range of light-aircraft types is available on which all aspects of maintenance and repair can be taught. Wood and fabric is represented by a Tiger Moth, metal structures and the use of glass-fibre panels are taught on the light Cessna types and an unexpected gift of Cessna 310, whose condition made it surplus to the flying school's needs, provides practical experience of avionic installation and electrical systems.

Engine and propeller overhaul is also taught in the main hangar and when a team of students has assembled an engine they then see for themselves that it works. The school has built a mobile engine test rig with self-contained control cab and the staff feels that this lends an air of reality to the exercise.

Perth does not specifically cater for radio training but a specialist electrical course is run, the last six months of which are spent at the BUJA base at Blackpool.

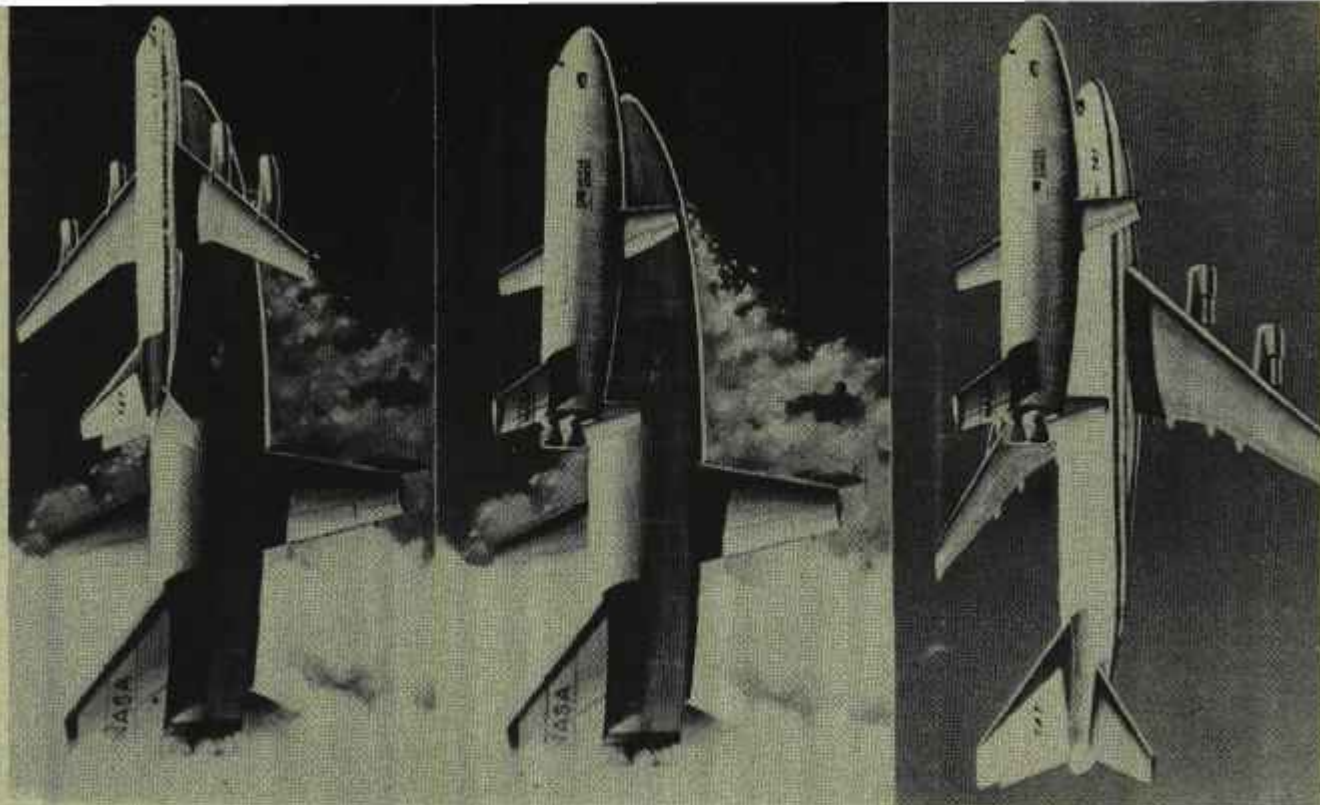
A total staff of 250 means that Perth has an almost one-to-one staff/student ratio and also that the school is one of the largest employers in the locality. Local relations are good and the school is represented in many of the neighbourhood's social and sporting activities. Not all are as profitable as the Scottish International Air Rally in which the school participated last year. Prizes and cups to a total value of £545 were brought back to Perth by a team of three students; there must be a moral in that somewhere.





Above, A typical scene on the flight line at AST. (Below, clockwise) In a ground school classroom a course is taught the principles of airways flight planning; a Tiger Moth and various Cessnas provide practical training in the engineering school where students also learn to overhaul engines; these are then tested on the school's mobile rig, seen below





These artist's impressions give an idea of the size of the two vehicles comprising the pick-a-back space-shuttle layout which is currently favoured by Nasa. Left, the booster with a Boeing 707 mounted in place of the orbiter for comparison. Centre, the actual shuttle layout. Right, the booster replaced by a Boeing 747. Two firms, McDonnell Douglas and North American, are engaged in preliminary design work on the shuttle



THE SPACE TUG

OVERSHADOWED somewhat by the more glamorous and certainly more difficult shuttle vehicle, the space tug is just as important and in many ways more versatile. Present plans call for the tug to be developed in parallel with the shuttle so that the two vehicles, complementary to one another, can provide a transportation system out to high Earth orbit or further.

The tug is the only space vehicle at present foreseen which would connect and be compatible with all present and future vehicles and systems. Its earliest use, as the link between the shuttle and the space station, would be to ferry people and cargo between the two craft in Earth orbit. While the shuttle could be made to ferry cargoes directly from Earth to the space station, various constraints indicate that this is uneconomic and that a separate vehicle (equivalent as it were, to a re-useable upper stage) could do the job much more efficiently, albeit with the penalty of a second transfer of men and materials.

Studies for the tug are underway at both the Marshall Space Flight Centre, Alabama, and the Manned Spacecraft Centre, Houston; the former is particularly concerned with the many possible uses of the vehicle.

The space tug owes its versatility to modular design. The Marshall Centre studies are based on the use of three main modules—crew, cargo and propulsion—which could be used in a number of combinations, depending on the nature of the mission. Since the tug, when assembled, can never be brought

back to Earth for refurbishment (in this respect it is, like the Apollo lunar module, a true space vehicle) a lot of thought has to be given to maintenance techniques, though the necessity to ferry the sub-assemblies of the tug into space in the first place ensures that this aspect receives due attention. In fact all the components of the tug will be designed for compatibility with the cargo compartment of the shuttle.

The tug could be established in orbit in a number of ways. In the early applications it would be placed in Earth orbit as a space-shuttle payload. It could also be launched as the fourth stage of a Saturn V. In later and more advanced missions it could be flown from Earth orbit to the Moon as the payload of a nuclear-powered shuttle. As launched by Saturn V, the propulsion module would be mounted atop the S-IVB stage, and the guidance, navigation and control systems, which at present are contained in the annular instrument unit carried on the S-IVB stage, would be contained within this module.

The core of the tug is the propulsion system, which, like that of the shuttle, must be designed for re-useability. The primary element of this dual system would weigh about 50,000lb, burn liquid hydrogen and liquid oxygen, and be used to generate the main velocity changes such as planetary injections, braking, orbital-plane changes, or for lunar landings. The secondary system would weigh about 10,000lb, burn nitrogen tetroxide and UDMH (unsymmetrical dimethylhydrazine) and would be used for creating the small velocity changes necessary in docking and fine trajectory corrections.

The crew module, much smaller than the propulsion module, would weigh about 10,000lb. It could ferry up to 12 men from low-Earth orbit, take two men to service satellites or help with the assembly of a space base or nuclear shuttle, house three or four men on the Moon for 30 days or longer, or act as a "lifeboat" for the shuttle.

The cargo module is basically a crew-module shell (top and bottom) with a cylindrical centre section; its size, therefore, would depend upon the bulk of the cargo envisaged. For the checkout of a satellite, for example, the tug might be equipped as a test laboratory for first- or second-line maintenance; the satellite would be grasped with special manipulator arms and placed inside the cargo hold, which would then be pressurised so that it could be inspected in a "shirtsleeves" environment.

The propulsion module, together with suitable deep-space scientific and guidance package, could also be used for the exploration of the planets.

Closer to home, the tug could help to expand lunar exploration. The Saturn V vehicle (using the tug's propulsion system as a fourth stage) could place nearly 100,000lb payload in orbit around the Moon, about 30 per cent more than that of the three-stage Saturn V. Such a flight would involve two Saturn V vehicles; one would be used to insert a 50,000lb space station into orbit around the Moon, while the other would have as payload a manned Apollo command and service

module, a space-tug crew module and the cargo module.

Europe, of course, has an interest in the tug as a possible collaborative programme with America. Last April the Eldo council approved a proposal to make a study of an unmanned tug, with cryogenic propulsion and having particular application to the transport of payload from the shuttle to geostationary orbit. Two industrial tenders have now been accepted, and each will be the subject of a six-month, \$200,000 study.

The first group, whose tender was made by Hawker Siddeley Dynamics, includes the Bell Telephone Manufacturing Company (Belgium), Air Liquide and Engines Matra (France), Erno and Dornier (Germany), Fiat and Montedel (Italy), Fokker-VFW (Holland) and Contraves (Switzerland); participation by the last-named firm will depend on the Swiss Government joining the programme.

The second consortium is led by Messerschmitt-Bölkow-Blohm, and its partners are British Aircraft Corporation and Elliott Automation (Britain), Etudes Techniques et Constructions Aérospatiales (Belgium), Selenia (Italy) and Snias (France). Both studies are directed by Eldo in collaboration with Nasa.

In addition Eldo has accepted a tender by a consortium formed by MBB and SEP (Société Européenne de Propulsion, France) for a study, worth about £50,000, leading to the definition of the main characteristics for the propulsion system.

ERTS CONTRACT

Nasa has awarded General Electric a \$50 million contract to develop equipment for the Earth Resources Technology Satellite system (ErtS). Work will be directed by Nasa's Goddard Space Flight Centre, and will include development of two flight spacecraft, equipment and services needed for a ground data-handling system, a spacecraft receiver and ground platforms for experiments in remote-site data-collection systems.

The first programme devoted exclusively to studying Earth resources from space, the ErtS spacecraft will test new sensors and the techniques needed to carry out geological and ecological surveys of the Earth. The resulting system may prove to be one of the most socially useful space projects yet devised. Data obtained will include information on crop species and health, soil and rock types and moisture content, coastal shoaling, surface-water distribution and water pollution. Suitably instrumented, the satellite could also warn of forest fires, icebergs, destructive locust migrations and could possibly predict earthquakes.

The two spacecraft will be modifications of GE's 1964 Nimbus weather satellite, with an experiment payload consisting of a three-camera, return-beam, vidicon multi-spectral television system being developed by the Astro-Electronics Division of RCA, and a four-band multi-spectral radiometric scanner to be built by Hughes Aircraft. Also to be included is a video tape-recorder/reproducer, at present under development by the Defence Communication System Division of RCA. These sensors will obtain image data in various bands of the visible and infra-red spectrum using spectral ranges selected with the help of potential customers, and previously studied by instrumented Nasa aircraft and verified by a space experiment carried on Apollo 9.

The ErtS spacecraft will also carry receiver/relay equipment to collect data from remote, unmanned data-gathering platforms and transmit it to ground receiving stations. Eventually as many as 1,000 ground platforms may be used in this experiment. GE will be responsible for the design and construction of the first six of these platforms.

ErtS-A is scheduled for launch during the first half of 1972. The 1,800lb spacecraft will be placed into a circular Sun-synchronous, near-polar orbit about 565 miles above the Earth by a Delta rocket. An operating lifetime of one year is anticipated.

Key tracking stations for acquiring ErtS data are located at Fairbanks, Alaska; Corpus Christi, Texas; and Greenbelt, Md.

The operations control centre and the data-processing facility for the missions will be at the Goddard Space Flight Centre. From here the substantial quantities of Earth resource data will be processed into a usable product and made available to user agencies and principal investigators. The ErtS programme is under the overall direction of Earth Observations Programmes at Nasa headquarters.

INTELSAT 3F-8 LOST

The eighth and final launch in the Intelsat 3 series of communications satellites, on July 23, resulted in the loss of signals during the apogee burn shortly afterwards. Intelsat 3F-8, in its station over the Pacific, was to have been a spare for the existing Pacific or Indian Ocean satellites, and had been placed in a highly elliptical transfer orbit immediately after launch. It had then been left in this path for 27hr in order to determine its orbit and the time at which circularisation was to take place, according to the usual technique. At 0215GMT on July 25 the apogee motor was fired for the 25sec circularisation. Telemetry was received for 14.5sec, after which transmissions ceased, and all further attempts by tracking personnel at Cape Kennedy, Hawaii and Carnarvon to contact the satellite failed.

This launch represented an investment of about \$13 million, of which \$5 million will go to Nasa for the cost of the long-tank Thor Delta and for initial tracking services, the balance being the cost of the satellite, built by TRW and its subcontractors.

A total of six second and third-generation communication satellites now provide a global communication service to the 76 member nations of Intelsat, the International Telecommunications Satellite Consortium. Intelsat 3F-6 and 3F-7, together with Intelsat 2F-3 as a spare, service the busiest region in the world, between North America and Europe. Intelsat 3F-4 and Intelsat 2F-4 provide the Pacific service (between America and the Far East) and Intelsat 3F-3 over the Indian Ocean provides the Europe-Far East link.

The Intelsat 3 series has now had three losses out of eight launches (two being due to faults involving the Thor Delta launch vehicle). Although the satellite was insured, Comsat Corporation (the managing body for Intelsat) will probably not be able to benefit, since it is understood that the policy was effective only if both 3F-7 and 3F-8 failed; Intelsat 3F-7, launched on April 22, is fully operational, though due to yet another launch failure its station-keeping fuel is sufficient for rather less than the design lifetime.



Nimrod shows its paces

By JOHN BENTLEY

LAST WEEK for the first time the Press was allowed to fly in the Hawker Siddeley Nimrod maritime reconnaissance aircraft during a brief demonstration of some of its capabilities. The aircraft was one of seven being operated by No 236 Operational Conversion Unit, No 18 (Maritime) Group, Strike Command, from RAF St Mawgan, near Newquay in North Cornwall.

Before the flight the AOC-in-C Strike Command, Air Chief Marshal Sir Denis Spotswood, spoke about the philosophy behind the formation of Strike Command and its different groups. The creation of No 18 Group, he said, provided strong, central control of the operational, technical and administrative elements of the fighting potential of UK-based maritime reconnaissance forces. The formation of individual groups within the command allowed the RAF to maintain this overall control and at the same time to provide what he called "role expertise" within the specialised groups.

Sir Denis said that it had been a big task to achieve a revised Command

organisation and at the same time to maintain the high standards in individual groups which had been previously set. He thought the reorganisation had gone extraordinarily well. "We have," Sir Denis said, "made considerable progress in exploiting the inherent potential of Strike Command units to a greater degree than would have been possible if they had remained under the old Command structure. The new system also provides opportunities for considerable economies."

"We are also working towards a philosophy of using aircraft in rôles for which they were not initially designed. We have gone a long way towards anticipating a multi-rôle organisation and multi-rôle equipment. When we have not too many aircraft," the AOC-in-C continued, "we must be in a position to use what equipment we have to meet the situation which is pertaining."

On the maritime side, Sir Denis said, the RAF was organised so that it could switch all its resources to any pattern of operations which the situation demanded. During the Russian fleet exercises in the

North Atlantic earlier this year the RAF took full advantage of the opportunity to exercise its skill in long-range maritime reconnaissance—the first time that the Nimrod was able to show its paces on a realistic basis. Also during the exercise, Lightnings performed intercepts at more than 500 miles range from land, using the tanker force Victors for refuelling and certain communications tasks. High-flying reconnaissance was also practised.

The AOC-in-C said that the Nimrod would be used in other-than-maritime rôles, but did not say what these would be. He did say that the aircraft offers opportunities for the RAF to develop new techniques in the non-maritime reconnaissance field.

Following the briefing we made an all-too-short flight in the Nimrod itself. The comparison with the Shackletons which it is replacing could hardly be greater and it is no surprise that the crews who train on it (all ex-Shackleton so far) are delighted with their new machine. A detailed description of the aircraft and its systems was published in our issue of January 22, 1970, but a brief reminder of the extent of the total system will not be out of place.

Weapons system

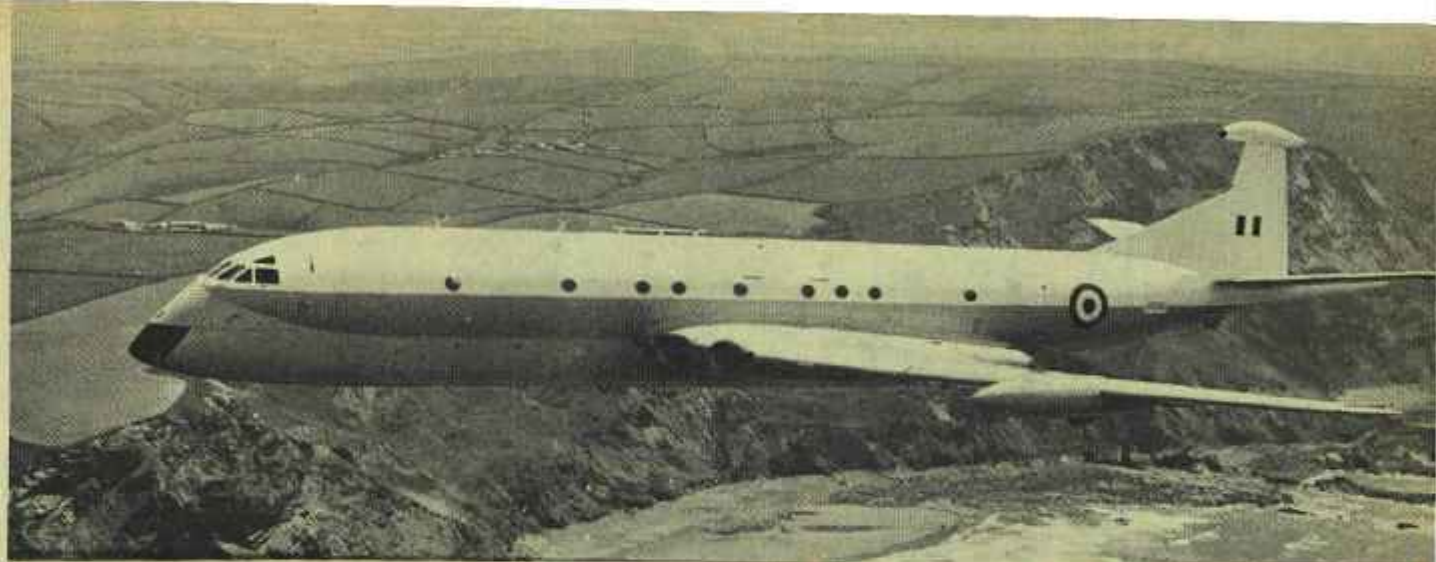
The weapons system platform is based on a Comet 4C fuselage, modified to take Rolls-Royce Spey 250 engines instead of Avons, and having a considerable volume of extra armament space added below the main fuselage. The crew of 12 have the latest British anti-submarine and surface target detection equipment in the Nimrod, including passive and active sonar devices (the majority of which we were not allowed to see), electronic, ionisation and magnetic-anomaly detectors and an air-to-surface radar which is accurate enough to pick up reflections from a biscuit tin floating in the water.

Biggest step forward in the weapons system is the inclusion of an airborne digital computer which takes its inputs from the navigation system and the target detection system and presents information about the Nimrod's position, track and groundspeed to the navigators as well as the position track and speed of identified targets. In addition the computer works out the weapons-release point and displays this to the tactical navigator, even giving him a visual countdown to the exact point where he must press the weapons-release button.

Unlike current American anti-submarine systems now being developed, the system is not entirely automatic. The point is that the signals received from both passive and active sensors require intelligent human interpretation before information is passed to the computer. If sensor detections were passed to a computer in a raw state it would need a great deal of circuitry to ensure that target presentation was accurate to a 90 per cent certainty, and that level is not good enough anyway. So the human being remains in the loop.



Weapons-bay doors open, Nimrod flies across St Mawgan, with, on the skyline the waste heaps from the china-clay mines



A crewman, working under an air electronics officer, operates one individual sensor and when he has pinpointed a target he transfers the sensor output into the computer, which from then onwards will receive updated information automatically.

This computer also receives navigation information from the Decca Doppler Type 67, and the Elliott E3 inertial platform, from which the present position of the aircraft is constantly computed. Track and distance-to-go to selected waypoints are also available. When a target is injected from one of the sensors, the computer treats this as a moving waypoint and presents to the tactical navigator a bearing and distance-to-go to the target, wherever it moves.

At the same time the tactical navigator can see the past track of the Nimrod, the present position and a symbol indicating the aircraft's future track and speed. He can also see the position of the target itself, the predicted weapons release point (depending on which weapon is selected), and the pattern of

any sonobuoys dropped in the sea. This latter is useful because it shows the relationship between the target and the pattern of sensors dropped. If the target moves to a point in the pattern where indications from the sensors would become unreliable, then another batch of sonobuoys would be launched.

The track and distance to target may also be set directly into the Smiths autopilot so that the tac-nav can virtually fly the aircraft himself, or, more normally, the information would be fed to a cross-pointer display in the flight deck, which would be followed by the pilots so that they would fly to the weapons release point before breaking away for another attack.

The display can also be made to show the position of both friendly and hostile undersea, surface and air targets—useful when working with a large task force. The weapons system also allows the crew to use Martel missiles and bombs against surface targets.

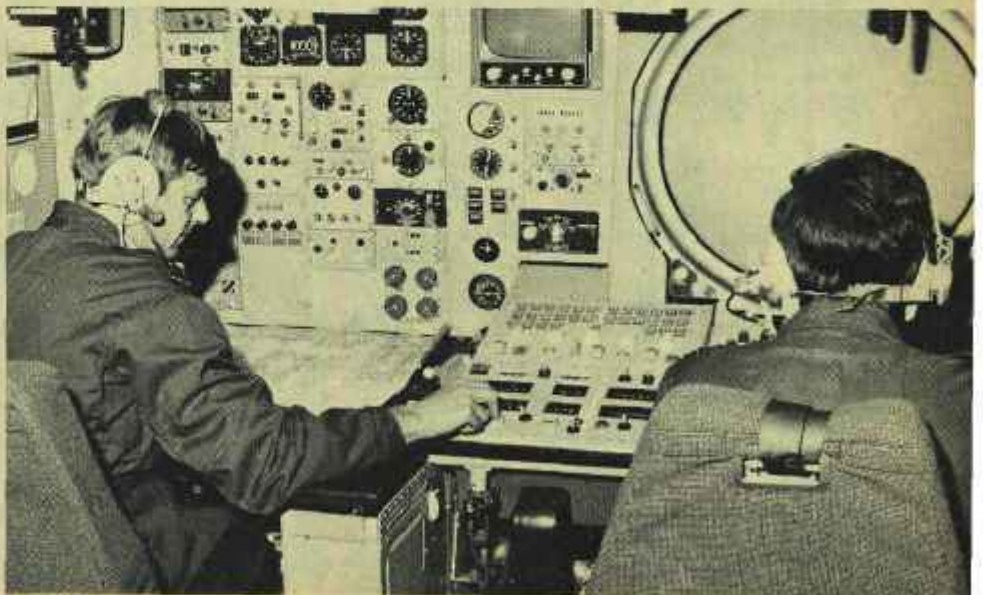
In the rear fuselage are stored the numerous flares, sonobuoys and markers

which are the stock-in-trade of a maritime aircraft. When these are launched—via built-in tubes—the Nimrod has to be de-pressurised.

During our flight the crew demonstrated the use of sonobuoys in tracking and attacking a simulated target. Everything happens much faster than it does in the Shackleton, but the extra speed of working is compensated for by the excellent conditions inside Nimrod. The sensation of flying low over the ground and water in something as big as a Nimrod has to be felt to be believed—it is not particularly uncomfortable, but "g" forces towards the back seem considerably higher than the 1.75 limit which is the normal maximum.

During the search and attack phase two of the Speys were shut down with absolutely no noticeable effect. After our last attack the captain, Sqn Ldr Alcock, throttled the third engine back and made a 2,000ft/min climb at a steady 200kt for 2,000ft. The acceleration when the other three engines were wound up was more like that of a Phantom.

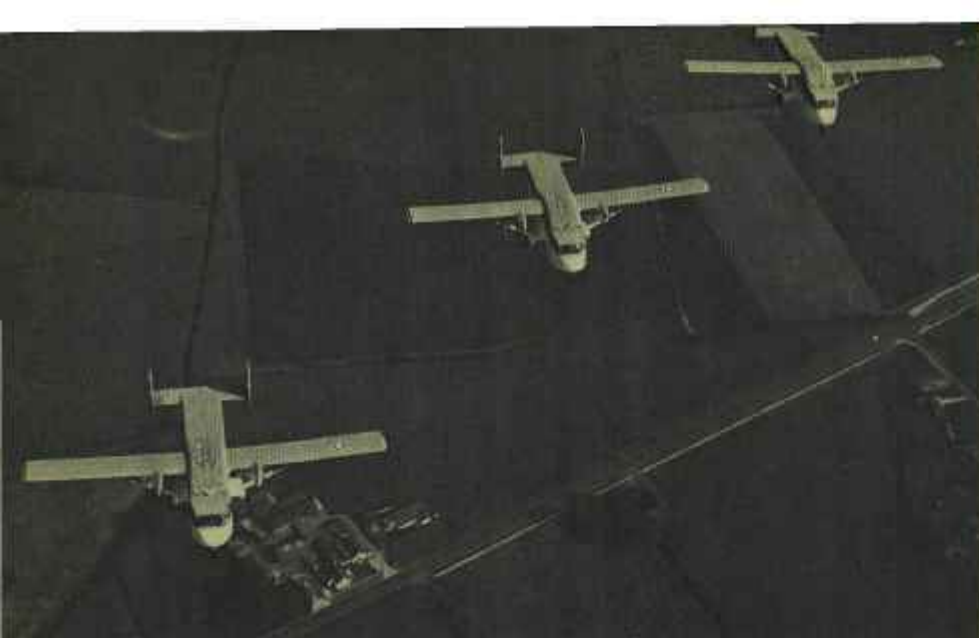
Above, in the side-view the Spey intakes hardly look larger than those of Avons, because they are outscaled by the increased fuselage depth.



Right, the heart of the search and attack system is the side-by-side console for the routine and tactical navigators



DEFENCE



Three Short Skyvans left Belfast on August 4 for Indonesia. The Indonesian Air Force has bought them for use on civil social services in West Irian—formerly West New Guinea ("Flight," August 6, page 187)

New Spanish-US Defence Pact

SPAIN IS TO BUY 36 USAF McDonnell Douglas F-4Cs under a five-year defence agreement which will allow continued American use of the air bases of Torrejon and Zaragoza, and the Polaris submarine base at Rota. Spain will also be receiving two C-130 Hercules, three Lockheed P-3 Orions and eight helicopters.

The agreement comes into force on September 27, extending the 17-year-old US presence in Spain and maintaining the co-operation of Spanish space tracking stations. To facilitate payment for the equipment, which includes a number of tanks and naval vessels, Spain has been given a \$20 million grant, and will receive \$125 million in export-import bank credits.

The pact is said to include a slightly vague commitment by the US for the defence of Spain, thus, according to the US Senate, becoming a treaty requiring ratification by the Senate. The signing appears to have been brought forward apparently because of growing Senate opposition to the content of the agreement. The Spanish opposition leaders believe that such important agreements should be dependent upon free popular referendum. The US Under-Secretary of State, Mr Alexis Johnson, has said in a statement to the Senate foreign relations committee that the agreement is not a mutual defence arrangement.

Poseidon Underwater Trial

THE NEW MULTIPLE-WARHEAD (MIRV) Poseidon missile was successfully test-fired from the US nuclear submarine *James Madison* on August 3. This was the first undersea launch of the 34ft rocket, which carried dummy warheads and was targeted 2,760 miles downrange. Washington considers this test to be a distinct step in its efforts to improve the US undersea striking power.

A Soviet vessel watched the firing from only 3,000yd and then made an attempt to pick up launch debris. In its hurry to do so, the Russian ship nearly

collided with one of the American observation vessels and cut across the bows of another. The US State Department is considering lodging a formal protest with the Soviet Union over the incident.

Far East Rescues

MORE THAN 450 emergency and mercy missions have been flown by the search and rescue helicopters of No 103 Sqn, RAF, operating from Changi and Seletar on Singapore Island and from RAAF Butterworth in Malaysia, since it took over this rôle in the Far East in 1964. Primary task of the squadron is to locate and rescue aircrew who have crashed either in the sea or on land, and several such operations have been accomplished by the Whirlwinds and supporting Shackletons during the past six years.

The rugged terrain over which the Whirlwinds operate in the Far East—dense jungle, swamps and mountainous country—and the need to operate over the sea on many of their sorties, create extra hazards for the crews and 103 Sqn has pioneered the use of a 250ft multi-tape lift which permits rescue among 200ft trees—too high for use of a normal winch cable.

Within five minutes of an emergency call being received from the squadron operations room, a Whirlwind is airborne and heading for the emergency area.

Casualties have included soldiers struck by lightning while on patrol, a water-skier who suffered a heart attack, sportsmen and others with broken limbs and other injuries, jungle rambblers badly stung by hornet swarms, and others in distress who have been picked up exhausted from the sea and jungle.

RAF medical officers are frequently carried on missions and occasionally have had to abseil down through the trees to examine and treat the injured men on the ground before a rescue lift can begin.

Many of the search and rescue sorties develop into joint missions, linking up at sea with RAF launches from marine

craft units and with the FEAF Jungle Rescue and Parachute team joining in land rescue operations. Shackletons of No 205 Sqn are also used for long-range search and as radio links, and these aircraft can drop survival equipment, including rubber dinghies, food, water and medical supplies, to any survivors they locate.

Instructors from the Jungle Survival School have abseiled down from SAR helicopters into dense jungle to saw and blast out clearings among the trees for the aircraft to land and pick up injured and sick men.

FAA Command Changes

VICE-ADMIRAL M. F. FELL, CB, DSO, DSC*, is to succeed Vice-Admiral Sir Richard Janvrin, KCB, DSC, as Flag Officer Naval Air Command from November 12, and, coinciding with the appointment, certain changes in Fleet Air Arm command structure have been announced.

The present organisation ashore in the UK consists of two flag officers: the Flag Officer Naval Air Command, with headquarters at RNAS Lee-on-Solent, who is in overall command of the FAA in the UK; and the Flag Officer Naval Flying Training, with headquarters at RNAS Yeovilton, who is responsible for bringing Naval aircraft and crews to the required state of efficiency for service aboard ship.

From November 12 the latter post is to be abolished and the duties taken up by the new Flag Officer Naval Air Command, who will have a commodore as his chief of staff to help administer the increased workload. Headquarters for Vice-Admiral Fell will move to Yeovilton at the same time.

Vice-Admiral Fell is at present Flag Officer Carriers and Amphibious Ships and Nato Commander Carrier Striking Group Two. A qualified Fleet Air Arm pilot, he has commanded HMS *Puma*, HMS *Loch Killisport* and HMS *Ark Royal*. He was Flag Officer Gibraltar in 1966.



Straight and Level



SIR ANTHONY MILWARD of BEA, in a message to staff, notes that the new President of the Board of Trade is the eighth civil aviation minister since he became chairman in 1964.

Hello, is that Milward?

— Speaking.

Oh, Noble here. How are you?

— Who?

Noble—you know, the new President of the Board of Trade. N-O-B-L-E.

— Ah yes, of course. Welcome to civil aviation, Mr No-ball.

Thank you. Now about these routes you want to give to the independents. How about London-Paris, London-Amsterdam, and one or two others?

— I have never heard such a preposterous suggestion in all my life. Certainly not. We shall give up nothing.

You have heard of Section 3(5) of the Air Corporations Act, no doubt?

— Since you put it so nicely how can I refuse you, Mr— I'm so sorry, what was the name again?

duced sonic boom. However, supersonic jets would be allowed to land and take off at speeds below the speed of sound. Mr Shaffer added that

From "The Guardian," July 31

● One of my favourite Americans translates the Ministry of Defence decision to respar Pembroke instead of buying new Islanders as follows: "The RAF will pay more and wait longer to get an aeroplane which will not last as long and will cost more to operate."

But, he says, don't worry about the way the Neddies spend our money. In America "we would have appointed a task force to study the award, spent six months preparing a nine-volume report, had that criticised by a second task force, announced the decision, then appointed a third task force to justify the decision in the face of the political outcry."

The British just say that's it old boy, we're going to spend the money on re-sparring Pembroke.

● Watching that wonderful programme on television about the recovery of Brunel's *Great Britain*, and her return after 130 years to her home port of Bristol, I started wondering about the aeronautical archaeology that lies at the bottom of the sea.

I believe, for example, that there is an Empire Flying Boat, G-AFCJ, on the ocean bed, probably intact, off Cape Finisterre. Its recovery, and that of many other extinct aircraft types on the sea



That's me sitting on the beach down there

bed, would be —er, simple compared with that prodigious salvage of the *Great Britain*.

Anyone got a register of sunken aircraft, so I can start diving?

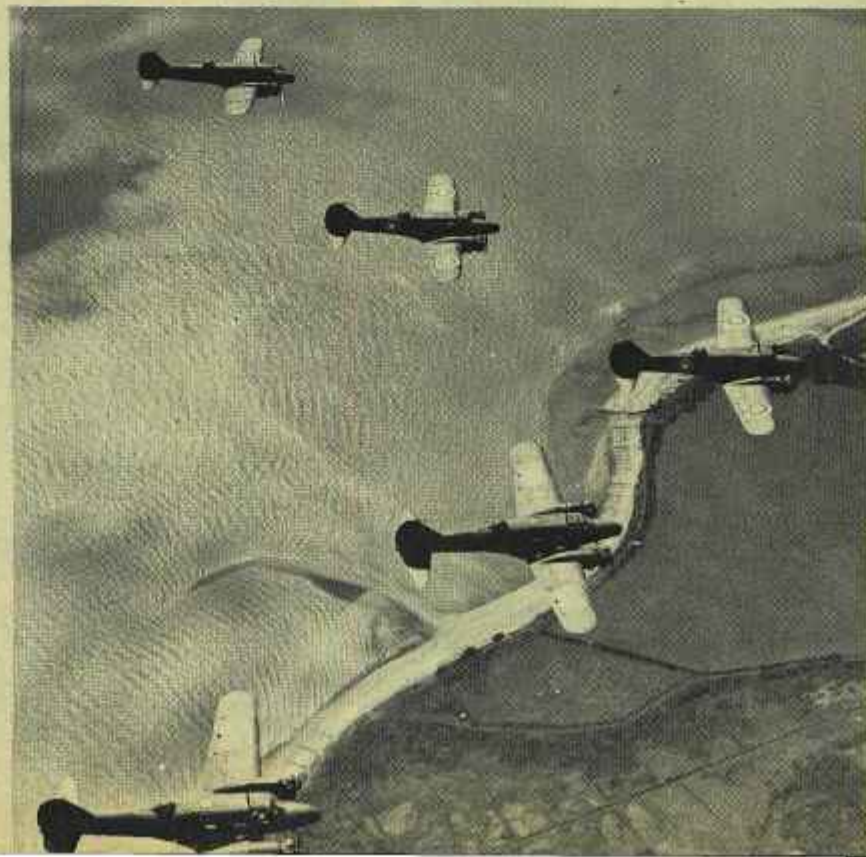
● From last week's *Flight* on the future of BUA: "In the event the unions could

do little but tag along behind the employees and call off the strike."

If the unions carry on like this they will soon be up against the employees as well as the employers.

Roger Bacon

Yes, it's Roger Bacon arriving for his holiday





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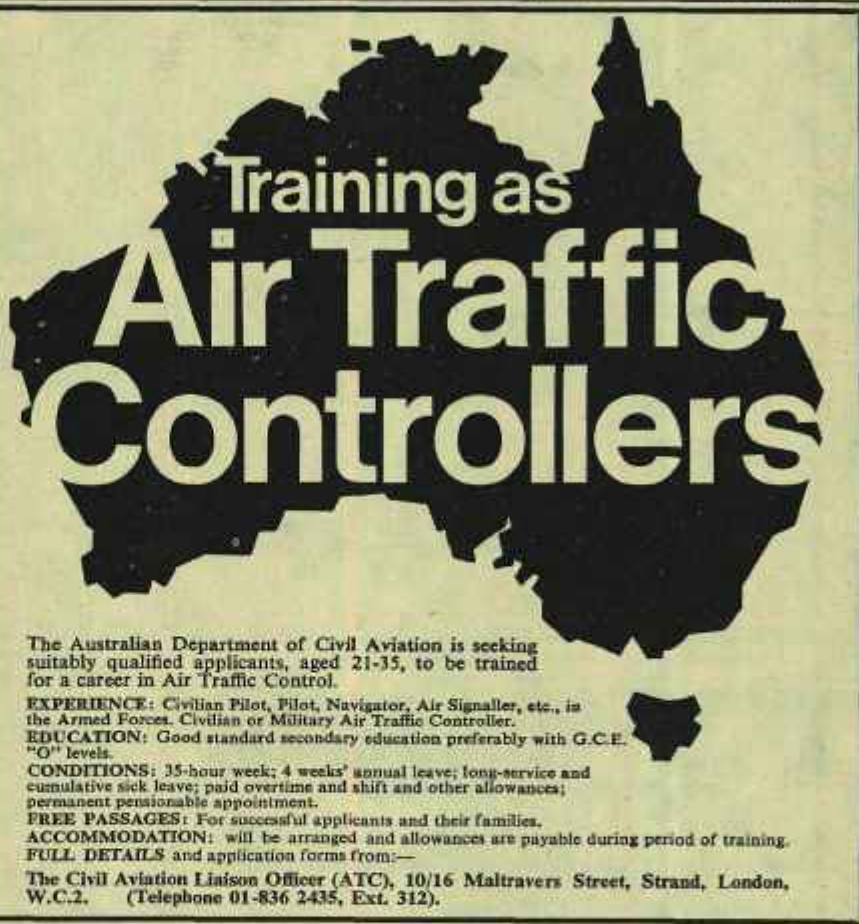
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Classified Advertisements continued from page 9

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