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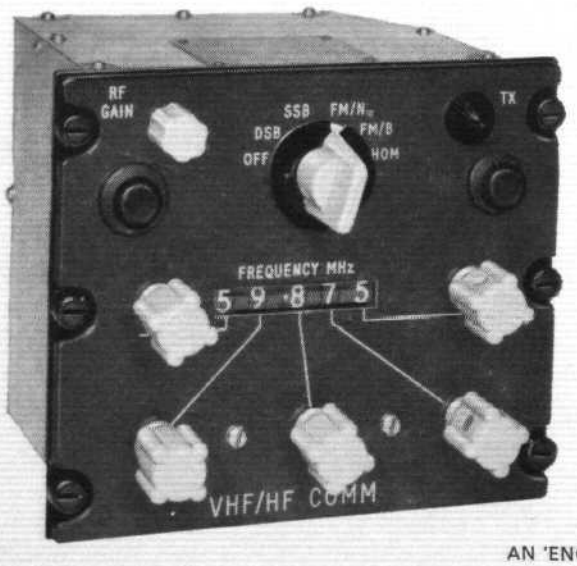

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The Ups and Downs of Space

Two manned launches in a fortnight have shown the world that America and Russia are right back in business. Precursor to one of the most advanced scientific experiments ever devised by man, the Apollo 7 flight was at the same time America's most complex and most trouble-free space mission yet flown. Following this was the flight of Soyuz 1, which represents part of a probably equally ambitious programme by Russia to develop space stations and Moon-landing techniques.

Both American and Russian manned flight programmes suffered grave setbacks within a short space of one another. Both went through an 18-month evaluation and modification programme. Both were taken by the scruff of the neck and made to work; there was no faint-heartedness or talk of cancellations, and both are now back on the rails.

But what of Europe, the so-called Third Power in Space? At the ELDO Ministerial Conference last month a working group was set up with the almost impossibly difficult job of bringing ELDO within the sphere of "a wider European technological community," and to provide a launcher-development plan acceptable to all the members—a task which has so far proved insuperable. Although Britain is represented on the working group, her declared intention is to withdraw from ELDO during 1971, just at the time when the Europa 2 launcher becomes operational. France has stated that she will withdraw if Britain does so. Thus the ELDO Ministerial Conference in Bonn on November 11, followed immediately by the European Space Conference, will be crucial to the continued existence of the European launcher programme in any form. For without Britain and France there can be no programme. The future of ELDO therefore hangs squarely on the British Government.

Long-term investment

Britain has said she will not support ELDO unless quick returns are guaranteed. How short-sighted to place such a condition on a long-term technical investment merely to satisfy a relatively short-term financial embarrassment. A Government charged with promoting the prosperity of one of the world's most advanced technical countries cannot abandon space-launcher development. If the British people had taken a similar view at the dawn of aviation they would not now have an industry with the biggest order-book of any in the country.

The arguments for retaining a European launcher capability are familiar to everybody. Continued independent development of launchers is the only way to ensure that Europe is not tied to America's or Russia's apron strings in the deployment of commercial satellites. Already America is understood to have refused to sell launchers to orbit the proposed Franco-German Symphonie operational communication satellite. Nobody—scientist, economist, technologist or politician—can possibly predict developments in space more than a few years ahead, any more than the Wright brothers could have foreseen Concorde. What can be predicted is the need for a continuing rocket programme to ensure that Europe can exploit the opportunities that will emerge. It is irresponsible to imagine that Europe could resume launcher development in ten years' time when financial climates are better. By that time Europe would be entirely dependent upon the two major powers, and the opportunity for an independent space programme would have been irretrievably lost.

Spaceflight is one of the greatest intellectual challenges, as well as commercial opportunities, of the century. Engineers and scientists who can get no satisfaction in Europe will emigrate to America, and will widen further the technological disparity between the two continents.

A

AIR TRANSPORT

Technology versus Public

By J. M. RAMSDEN

"PERHAPS THE BIGGEST CHALLENGE in the next 20-30 years is to find a way to pass on the benefits of technology to the public." These words of Mr Alan Boyd, US Secretary of Transportation, seemed to sum it all up precisely.

The former head of the Civil Aeronautics Board—which is the traditional unfriend and tormentor of the International Air Transport Association—had been invited by that civilised body to addess its twenty-fourth annual general meeting, which took place this year in Munich, with Lufthansa as host. Mr Boyd was contributing to a symposium on the future of the airline industry. Unlike the other working sessions, this one was open to the press—a move as enlightened as the invitation to the speaker.

He told the 300 delegates, nearly all of them the top men of their airlines, that the 747 and the airbuses "hold out the promise of improved air service and lower fares." IATA, he warned, should show aggressive leadership in pricing as advanced as air technology was in the development of new equipment. The time had come, he declared, for the airlines to "give the public its full share of the gains that stem from technological innovation." He was convinced that unless a change of attitude were forthcoming "IATA might not be able to survive in this advanced technological era."

If Mr Boyd had expected—as the symposium's chairman, Sir Giles Guthrie of BOAC, probably did—that these words would provoke a dozen non-American delegates to spring to their feet, he was disappointed. No doubt many members were tempted to say that it was about time Mr Boyd stopped exporting all this American public-interest demagogy and realised that the smaller national carriers had a right to fly their flags, and that fares suitable for the great supermarketers like Pan American and TWA would break them and the association itself. The IATA traffic conference at Cannes had just, after all, broken up after five weeks without agreement on 747 fares, largely because the US Civil Aeronautics Board had made it clear that it would not approve fare increases or even the abolition of the round-trip discount unless the single fares were commensurately cut. Not even the proposed bulk inclusive-tour 747 fares or the elimination of baggage-weighing—even if these could have been agreed—would have appeased the CAB. How much easier Cannes would have been if the exhausted delegates could have said to the recalcitrant Irish, who wanted (still want) ten-abreast seating, that nine-abreast at a 15 per cent higher fare was a deal; but that would not have been approved by the Civil Aeronautics Board.

In the event all the questions were about other points in Mr Boyd's paper and in the three other very good lectures that comprised the open symposium, including a paper by Col Semret Medhane of Ethiopian Airlines. He did not think that the great developed countries had done enough to investigate the needs of the developing countries. Surely all the know-how that was being put into the SST and even the HST should be capable of producing an aircraft specially designed for the developing countries? Outlining the sort of aircraft that he thought was needed, Col Medhane said that it would keep factories busy indefinitely. They didn't want "an airborne Cadillac."

Mr B. P. Toda of Philippine Air Lines had already spoken up for the smaller carriers. In his speech as outgoing president of IATA he said: "The adjournment of the Cannes conference without reaching agreement on many of the major issues must be accepted as a very serious obstacle to the work of IATA. . . . If the traffic conferences fail the rate-making function may be taken away from IATA, with perhaps fatal consequences for the organisation and disastrous effects upon the entire industry. . . . The big and the powerful [should] eschew the arrogance of power."

This could have been, and indeed has been, said after half-a-dozen CAB-induced traffic-conference failures in the last 20 years (particularly after the famous jet-surcharge wrangle at Honolulu in 1958). But IATA has not only survived the lower fares; it has done very well on them.

The contrast with the address of M Pierre Cot, director-general of Air France, was marked. Acknowledging that European airline operating costs were 55 per cent higher than those of American carriers, notwithstanding US wage levels 160 per cent higher, M Cot felt that nothing could be done about the causes, which were largely due to the traffic rights and commercial agreements that had to be negotiated, among 15 countries, and the differences in language and currency. He advocated more operating and commercial agreements.

M Cot's view of air transport through the eyes of a European was a fascinating and in many respects a progressive one. It was based in part on what he called the "soundest document available today on the structure of transport in Europe": *Passenger Air Travel—Characteristics & Forecast of Demand in Europe*, SETEC Courbevoie (France) March 1968.

M Cot remarked how, "without our noticing it, our industry is taking on the aspects of a heavy industry in some ways." The price of the Boeing SST would be equal to that of a steel rolling mill—*and* it had to be amortised more rapidly.

M Bouladon, chief of engineering at the Battelle Institute, Geneva, looked even further into the future, convincingly predicting 400-seat hypersonic airliners by about 1985 on the basis of traffic and technology to date. He foresaw floating airports, and a gap in the air transport spectrum that should be filled with V/STOL transports—most probably, he thought, the rigid-rotor compound helicopter because of its

The scene at the formal opening session, Hercules Hall, Munich. It was attended by the West German president, Herr Lübke

quietness. None of the fancy-free forecaster about M Bouladon; his paper was carefully and originally documented. On the case for V/STOL: "If you take a [present-day] plane once a week on average for a return trip, then over the year you immobilise more than 200 sq m of urban area, or eight times as much as your car. . . . The aeroplane must not follow the bad example of the motor car, which has succeeded in wrecking urban life, and find itself outlawed by society. I am convinced that the coming generation will insist on putting man first and the machine second, and will take a stern view of the far too common belief that the community at large can always be saddled with the problems we have not had the courage to solve ourselves."

The airbuses

Technology in the shape of the airbuses—DC-10, 1011 and A-300—was a leading topic of conversation during the week, with a buzz of speculation about the implications of Northwest's order—announced on the second day of the Munich AGM—for DC-10s with the Pratt & Whitney JT9D-15 instead of the General Electric CF6. This order put Pratts—who appeared to have missed both American airbuses to their competitors GE and Rolls-Royce—well and truly back into the competition.

JT9D-15 is an uprated, 45,500lb version of the 747 engine, which is the JT9D-9 of 43,500lb. Northwest wanted JT9Ds in their airbus primarily to provide engine compatibility with their 747s. How many other potential DC-10 or 1011 customers who have ordered 747s will be attracted by the idea of engine compatibility? Will Lockheed respond by offering the 1011 with Pratts as well as with Rolls?

Representatives of most of the manufacturers were around to supply the answers, including Lockheed and Rolls-Royce. Lockheed were *not* offering the 1011 with JT9D-15s or with anything other than the RB.211 and its developments. Then why had they been offering the 1011 to Northwest with the P&W engines? They hadn't been *offering* it, only responding with what Northwest wanted—to show what a relatively poor aeroplane it made out of the 1011 what with the JT9D being heavier, fatter, smokier, noisier and thirstier—and if Northwest thought that the engine would offer commonality they were going to be disappointed because the two engines would not be any more interchangeable than the JT8Ds in the DC-9-10 and the 727-200—and had they ever tried to interchange the Avons in the Comet and the Caravelle? Furthermore, the range of the DC-10-20 (designation of the JT9D version) was about 200 miles less than with the GE CF6 engines (the Douglas release appeared to compare the long-range DC-10 with the domestic DC-10, but there is a tankage difference between the two of nearly 11,000 US gallons). If anyone wanted a long-range 1011 the Dash 3 model with the uprated 43,040lb RB.211-24 was being offered. It made a better aeroplane, and cheaper, probably, too: the DC-10-20 would be about $15.9 million, with P&W paying the certification costs of about £20 million.

Nevertheless the DC-10 is now a much stronger competitor for Lockheed. There were a number of DC-8 operators with 747s on order who indicated that they might now be looking at the DC-10 afresh, among them KLM, SAS, Swissair and Alitalia—all targets for the A-300 salesmen, of whom more in a moment—and JAL. Lockheed hoped during the week to persuade BOAC to signify their preference for the long-range 1011 with RB.211-24 engines. This was regarded as premature by Sir Giles Guthrie—although his airline has stated its interest in the 1011.

There were top-level teams from both Lockheed (headed by the president, Mr Carl Kotchian) and McDonnell-Douglas (Mr David Lewis). Senior men from Rolls-Royce, General Electric and Pratt & Whitney were also there. There was nobody from Boeing—or if there was he was so discreet that nobody saw him. Discretion is definitely *de rigeur* at these occasions, because officially manufacturers are not welcome—ever since the AGM in Tokyo when brochuremanship became too aggressively intrusive. Mr. William Allen of Boeing is believed to be of the view that to send a team *non grata* is unsalesmanship. The actual position seems to be that manufacturers, provided they are wearing ties and are not intrusive, are very welcome and are even invited to the social functions. As somebody said, the airlines need technology, but it has to be socially acceptable. There were teams from both Hawker Siddeley and BAC, the latter fielding Sir Geoffrey Tuttle to lead a team carrying a mainly Three-Eleven portfolio. And there at Munich, all in the same point of space and time, were the top men of all the world's airlines and Deutsche Airbus's A-300 mock-ups—three in all, including one showing the underfloor galley arrangement. A team of technical salesmen—British, French and German—was there, working with impressive vigour and purpose. Their energetic efforts would have been well assisted with some heavyweight support from the very top, including perhaps someone of director-general status in the Ministry of Technology—if only to convince airlines that although this may be "a political aeroplane," as its American competitors call it, the governments are right behind it. The A-300 team lost no opportunities to invite delegates to inspect the mock-ups. If the A-300 does not go ahead—and Mr Hoeltje of Lufthansa was saying to the press that Lufthansa was not going to commit itself to any airbus until 1973—it will not be through any default on the part of the sales and project teams most closely concerned.

The 747 dominated the economic and operational discussions at the AGM. A special IATA "facilitation" group is visiting governments to impress upon them the impact which these giants are going to have on their airports. Forty-minute turnrounds are called for, and one of the team's exhibits shows what could be a typical scene a few minutes after engines-off

Air France were fully behind the A-300, though BEA were more immediately interested in the Three-Eleven. Alitalia's view was probably typical of the majority's. The Italian airline was following the progress of all the airbuses with great interest, but was far too preoccupied absorbing the problems posed by the 747.

The Cannes failure—which was essentially a failure to react to the 747, which will be coming into service in just one year from now—brooded over the meeting. The report of the Traffic Committee spoke of a feeling of "desperate optimism," and Mr Toda of PAL said it would be "wrong to say that the traffic conference at Cannes has failed." But as Damon Runyon might have said, it was a failure that would do until a real failure came along.

The problems were as tough as any that attended the introduction of the first jets ten years ago. Many airline chiefs, including the leading one at Munich, Herr Hoeltje, openly agreed that the 747 will reduce seat-mile costs (which was why they bought it), but only enough to hold overall cost level in an inflating world economy. Moreover, ground equipment costs (see photograph) were estimated to be more than £¼ million per 747, and airport charges are going up already to meet the capital cost of providing the gigantic new terminal facilities. Mr Hammarskjöld, IATA's director-general, registered the association's annual protest not only at the increased charges but at the "very bad discipline" shown by Governments

in the way they were being imposed. Mr Boyd said that US Government policy was that airport costs should be borne by those who benefited, the users.

A January 31 deadline has been set for agreement on 747 fares, to allow time for cooling off, and for a high-level policy-drafting group—comprised of the airlines chiefly affected—to reach an agreement which could be put to members in the form of a mail vote. Failing this there would still be time for another meeting of the traffic conference. The IATA traffic director, Mr H. Don Reynolds, referred in his report on Cannes to the "negative position of one carrier alone" which, because of the association's unanimity rule, prevented agreement. This carrier was Irish Airlines, who, at Munich, were still adamant on ten-abreast seating while everyone else (except El Al, though not so adamantly) wanted nine-abreast.

At first sight this seems a trivial difference, one that could be easily bridged by general agreement on ten-abreast—which would, after all, improve 747 seat-mile costs by 11 per cent. Unfortunately, the difference between nine-abreast and ten-abreast in payload terms is the difference between London-New York and Shannon-New York, and it is also the difference between the "ethnic" load factors available to the Irish and the market load factor available to the other carriers (with the exception of El Al, although the 747 would certainly not be a Tel Aviv-New York aeroplane even with ten-abreast). It would be nice to think that the majority favoured nine-abreast because of the extra comfort it offers to the passenger, whose tolerance of the economy-class seat has just about touched bottom. This was certainly an argument espoused by the nine-abreasters; but even that was not entirely motivated by altruism. These big aircraft just have to be filled, and because they do not fly much faster than existing subsonic jets, what would be the sales pitch? For a year or two perhaps passengers would be attracted by the novelty of flying in the biggest, but they might not take too kindly to the "people-phobic" effect of so many passengers. Some airlines were in fact in favour of eight-abreast —two-by-two throughout, with wider seats and perhaps greater leg-room. The 747 have-not airlines naturally favoured a premium on 747 fares and at least one was predicting that, for the same fare, the 707 and DC-8 would see the 747 off with four-abreast or even five-abreast seats.

Among the new problems were 747 baggage allowances and bulk fares for inclusive-tour passengers on scheduled services —the so-called ITX fare pioneered in Europe. The bigger 747 carriers want to beat the charter operators at their own game, using the great capacity of the 747 to offer travel agents North Atlantic tour-basing fares as low as £60 for blocks of 40. The official American attitude towards ITX is that it is discriminating against the ordinary passenger, who is going to be real mad if he discovers that the passenger sitting next to him is paying the same fare inclusive of a fortnight's hotel, sightseeing, and electric golf cart.

But the 747 ITX was being pressed very hard, particularly by the big carriers who have not yet, in the strong words of Mr Toda, resorted to the "stratagem of creating subsidiary companies [which] undermine the authority, usefulness and effectiveness of our association." He observed that "nothing devours iron more swiftly and greedily than its own rust."

The argument about baggage allowances was that the 747 would permit the abolition of weighing, and that passengers should be allowed so many pieces of baggage of a certain size into which they could pack lead or feathers—the so-called piece baggage system so successfully introduced on US domestic services, despite forebodings by some carriers, all of whom now invented the idea. The financial problem here is the loss of excess-baggage revenue—estimated to have been worth about £30 million last year to the industry as a whole. But the sheer amount of time, real estate and weighing machinery and staff needed for perhaps 1,000 suitcases per flight tolls the knell of baggage allowances in the long term. There will be big transition problems, such as the difficulty of differentiating between types of aircraft and passengers interlining between, say, a 747 and a DC-3. The idea of differential pricing for peak months also came up during the symposium. A Sabena representative suggested charging a premium for the peak of the season, particularly on the Atlantic. Mr Boyd recounted how the peak in the Florida market had almost been eliminated following promotion by the airlines of the idea that "Florida is as nice in summer as it is in the winter." He advocated more interchanging of aircraft, and marketing which approached the problem from the point of view of "how can the market best be served" rather than "let's put a brake on the market." Nor did he think that differential pricing could solve the airport congestion problem, though it might raise more revenue to finance the new facilities that *would* solve the problem. In aviation, he said, the sky was no longer the limit—"from now on the ground is the limit."

Cinderella

That Cinderella of a subject Facilitation really came alive at Munich with a presentation by the IATA facilitation team of what life is going to be like under the jumbo jets. In addition to a slideshow with taped commentary (by means of an ingenious portable projector that no salesman should be without) the team demonstrated the advantages of magnetic passport cards processed by computer, and of the two-channel RED/GREEN Customs system which permits sampling at peak times. This was started experimentally at Heathrow last week, and it has been working satisfactorily in Holland and Scandinavia for about two years. Visits by the team have been made to a number of airport authorities in the hope of persuading them "to start today to make it easier for tomorrow."

Finally, again on the subject of Technology versus the People, let us quote M Cot of Air France and Mr Boyd of the United States Government on the subject of noise. The solution, said M Cot, depends "more on American citizens than on us Europeans. . . . One can ill conceive, in fact, that Rolls-Royce or Snecma would undertake to design and construct noiseless (pardon the euphemism!) engines if Pratt & Whitney or General Electric can continue producing and selling noisy engines and less expensive ones. And who else could convince them of the contrary if not public opinion in the USA?" M Cot did not appear to have a very high opinion of European Government regard for the public interest, nor did he explain why an American aircraft firm has specified Rolls-Royce engines because they are quieter *and* less expensive. Mr Boyd replied without any commercials: "We are going to have quieter engines in the United States because public opinion demands it". It is of course IATA that is the actual interface between technology and society, and if it doesn't talk about the problem as easily as Mr Boyd does then it can still say, as its traffic director did at Munich, that it sets a standard of agreement "unequalled in any respect by any other international body known to man." The Munich AGM certainly set a standard of organisation as efficient as one would expect from Lufthansa. It will be hard to surpass in future years. The 1969 AGM will be at Amsterdam, with Dr G. van der Wal of KLM as the new president and host; the 1970 meeting will be with Iranair at Teheran.

Left, Herr Gerhard Höltje of Lufthansa, IATA's new president; centre Mr B. P. Toda of Philippine Air Lines, outgoing president; and Mr Knut Hammarskjäld, DG of the association

This DC-8-61 of Universal Airlines, the US supplemental, was photographed at Prestwick late last month when on a military charter flight. The -61 is painted white with all markings in black—including the fuselage line and tail insignia—giving it a unique but impressive appearance

JT9D-POWERED DC-10

AN order for 14 DC-10s with Pratt & Whitney JT9Ds instead of GE.CF6s has (as forecast in *Flight* for October 17, page 598) now been placed by Northwest Airlines. The order is worth about $222 million (£93 million), excluding the option which Northwest has also taken on 14 more DC-10s. Deliveries are scheduled to start in January 1973. As already explained, the reason why Northwest held out for a re-engined version of the DC-10 is the obvious wish for powerplant commonality with the Boeing 747, of which ten are on order by the airline.

With routes over the Pacific, Northwest needed a longer-range trijet than those initially available. Lockheed is offering the 1011 in an extended-range (over 4,000 miles) version with developed Rolls-Royce RB.211s for 1973 delivery, and the company said last week that they intended to remain with this engine-airframe combination because of the advantages of lower noise level coupled with the better payload/range performance with growth versions of the RB.211. Other airlines with 747s on order and no airbus commitments so far may be influenced by the advantages of a common engine.

This intercontinental version of the DC-10, which has been designated the Series 20, will be capable of operating over non-stop ranges up to 4,900 statute miles. Using a centre tank, for which provision has already been made in the design, the maximum fuel capacity will be 32,800 US gal, by comparison with the 22,000 gal of the standard domestic version. The gross weight will be 490,000lb by comparison with 410,000lb, and a third main landing gear will be installed on the centre-line (see Sensor in the issue of October 24). Northwest's DC-10 will be laid out for 46 first-class and 222 coach-class (eight-abreast) seats.

As suggested in our issue of October 17, the modification costs of the re-engineering programme will be absorbed by P&W and will involve a sum of at least $40 million (£17 million) and may be as much as $100 million (£41 million) over the period 1970-74. As the 45,500lb-thrust JT9D-15 is not an engine specifically for the DC-10 and is being produced for the 747, the development and modification costs can be spread over a large number of engines.

In announcing the order by Northwest and the extension of the DC-10 programme which this represents, McDonnell Douglas also mentions for the first time the Series 30. This will use a developed version of the GE.CF6 engine with 45,600lb of thrust. It will have a similar performance to that of the Series 20, with a maximum gross weight of 490,000lb, at which it is expected to be capable of operating from a 10,000ft field length, and will have a range up to 4,900 statute miles when carrying 270 passengers.

Firm orders for the DC-10 now total 69—from American Airlines (25, plus 25 on option), United Air Lines (30, plus 30 on option) and Northwest (14, plus 14 on option).

See also pages 728-730

QANTAS AND THE TRIJETS

THE Lockheed 1011 and DC-10 are being considered by Qantas for later use on the Sydney-London service for which the Boeing 747 is considered to have too big a capacity. The airline has four 747s on order, plus two on option. Speaking in Seattle recently, Capt R. J. Ritchie, general manager of Qantas, said, according to *Aviation Daily*, that the 250-300-seat 1011/DC-10 represented a more handleable jump in capacity for the next era. Four to six might be ordered initially, but no early decision was being made as they would not be required until the 1972-73 period. The first Boeing 747 for the airline is due to be delivered in August 1971 with entry into service on the Sydney-London route in the last quarter of that year; the next Qantas route earmarked for the big jets is that between California and Sydney. Long-term plans involve the eventual relegation of the 707-320Cs, of which 21 are on order or in service, to all-cargo work as the 747s and, possibly, the wide-bodied trijets come into full service.

707s for China Air Two Boeing 707-320C convertibles have been bought by China Air Lines, of Formosa, for delivery in November and December, 1969. They will have an interior arrangement for up to 145 passengers and will be used on trans-Pacific routes now being sought through the US CAB. If approval is obtained the 707s will be used to cover the airline's complete route structure from the USA through Tokyo to Taipei, and to Bangkok or Singapore.

SST Airworthiness Meeting The most recent US Government/industry conference on tentative airworthiness standards for SSTs was held early last month at the FAA headquarters in Washington, DC. More than 115 people attended the three days of discussions. This meeting, the eighth in a series which began in 1963, was designed to update current working SST standards prior to FAA rule-making action, which is expected in December 1969. When adopted, the rules will serve as the US standards for certification of all SSTs.

Another -320C for Caledonian A fourth Boeing 707-320C has been bought by Caledonian for delivery in January and use on long-haul charters. The aircraft is ex-Flying Tiger, two years old and has logged about 9,000hr. In April the three BAC One-Eleven 500s are due to be delivered to Caledonian for European inclusive-tour operations. The total value of the carrier's fleet, excluding Britannias, will then be £21 million. Caledonian, which has already carried 63,000 charter passengers between North America and Europe in 1968, has signed 1969 contracts worth $8 million (£3.3 million), or double the 1968 earnings.

PILOTS' DISPUTE COOLS

AT the eleventh hour last week BOAC withdrew its threat to dismiss pilots who complied with a BALPA instruction to limit flying hours to 45 per month and the scheduled duty day to 10½hr. As a result BALPA cancelled its instruction and the two sides announced agreement on many of the points which have been under discussion over the past 18 months. The agreement, reached in talks under the independent chairmanship of Prof John Wood, included neither pay nor scheduling matters.

The corporation's reversal of policy, seen as a climb-down by some pilots, followed a remarkable show of unanimity amongst the pilots. Of the 1,080 employed by BOAC, 781 had indicated to BALPA by October 30 that they were willing to face the dismissal threat. Their ire was further aroused when it became apparent that October pay cheques were not being put through by the corporation at the usual times. The talks on pay and scheduling will continue in the light of the PIB report (see page 736).

IMPROVING DATA EXCHANGE

INEVITABLY some of the perennial problems which beset the airlines and their relationships with manufacturing industry reared their heads during the SBAC/RAeS Data Exchange Symposium held last week in London. Everybody agreed with Prof David Keith-Lucas, president of the Royal Aeronautical Society, when in his opening address he said that he looked forward to the day when "data exchange" (between airlines and industry) became as well known as the Stock Exchange. But it was hardly surprising that the airline people were saying the industry asked for a lot of information which it never put to any good use; and the industry was saying how impossible it was to get data in the form it was most needed out of the operators.

The symposium was far from being a slanging match, however. Its stated aim was to make data exchange work. Prof Keith-Lucas said that data exchange dealt with the "little things," and much was to be achieved by making the "little things" work. With general recognition that the lack of efficient data exchange was seriously impeding the development of aircraft and the industry as a whole, delegates and speakers alike were conscientiously looking for the means of improving the currently confused data-exchange situation.

The first session, on October 31, was the turn of the manufacturers to put their case for the need for data exchange. Papers covering the British point of view were read by W. F. Gibb (BAC), J. A. Johnstone (Hawker Siddeley Aviation), P. W. L. Ward (Rolls-Royce), and B. Lockwood-Goose (Dunlop). They were followed by G. Colas (Sud-Aviation), J. Platzer (Snecma), and N. Litwin (Hispano Suiza) representing European industry, and by H. Bayer (AIA) for the United States.

In session two, the need for data exchange as seen by the airworthiness authorities was covered by L. S. Edwards (ARB) and F. C. Schwager (FAA). Session three, on November 1, was the turn of the operators with Dr J. Kauf (Austrian Airlines) emphasising the role of CPAM, and A. F. Barnes (BOAC) and G. W. Gilmer (American Airlines), putting the British and American points of view. The military customer's view of data-reporting systems was reviewed by Gp Capt I. J. de la Plain, RAF. Finally, a forum of leading speakers led the discussion which was opened to a lively and enthusiastic audience.

The operators were not slow to point out that they had already got together on an international scale. With CPAM and similar organisations they had carefully considered the need for uniform presentation of data and were now looking to the aircraft industries to get together in the same way to standardise the use of the data and the action taken, as a result, to improve product support.

Several speakers mentioned the need for a standardised data dictionary not only to help to establish an international language for defect reporting but also to ensure that engineers speaking the same language used the same term for the same engineering situation. The new *World Airline Suppliers Guide* came in for some criticism, mainly from the smaller manufacturers who were worried about some of the wording and how they could meet certain of the proposed warranty conditions.

BOAC CHARTER: IATA COMPLAINTS

COMPLAINTS have been lodged against BOAC by the International Air Transport Association alleging violations of IATA resolutions with regard to group charters. The corporation is investigating the complaints before submitting an answer to IATA, and runs the risk of having to appear before a breaches commission unless it can persuade the association to drop the matter.

The complaints relate to a group charter in which, allegedly, members of the group were not members of the chartering organisation, or had not been members of it for the requisite six-month period before the departure. There are also reported to be allegations that BOAC employees endeavoured to alter documents; that members of the group did not all travel together; and that name changes were accepted fewer than five days before departure.

BALPA SYMPOSIUM DETAILS

THE subject of the annual technical symposium held by BALPA this month will be: "Automation, Simulation and Data Handling in Civil Aviation." The meeting will be held at the Royal Lancaster Hotel from November 26 to 28. The proceedings on each day will be concerned with one of the subjects mentioned in the title, and the first day's papers will include contributions from Bendix and Lockheed-Georgia.

The second day's talks will cover the problems of airborne collision avoidance, tactical air traffic control, and airborne data links. Automatic weather forecasting techniques will be outlined by a representative of the US Weather Bureau. On the final day, future trends in aircraft simulation, the scope of computers in an airline and automation in the airport will be discussed.

Further details and tickets for the meeting are available from BALPA at 81 New Road, Harlington, Hayes, Middlesex.

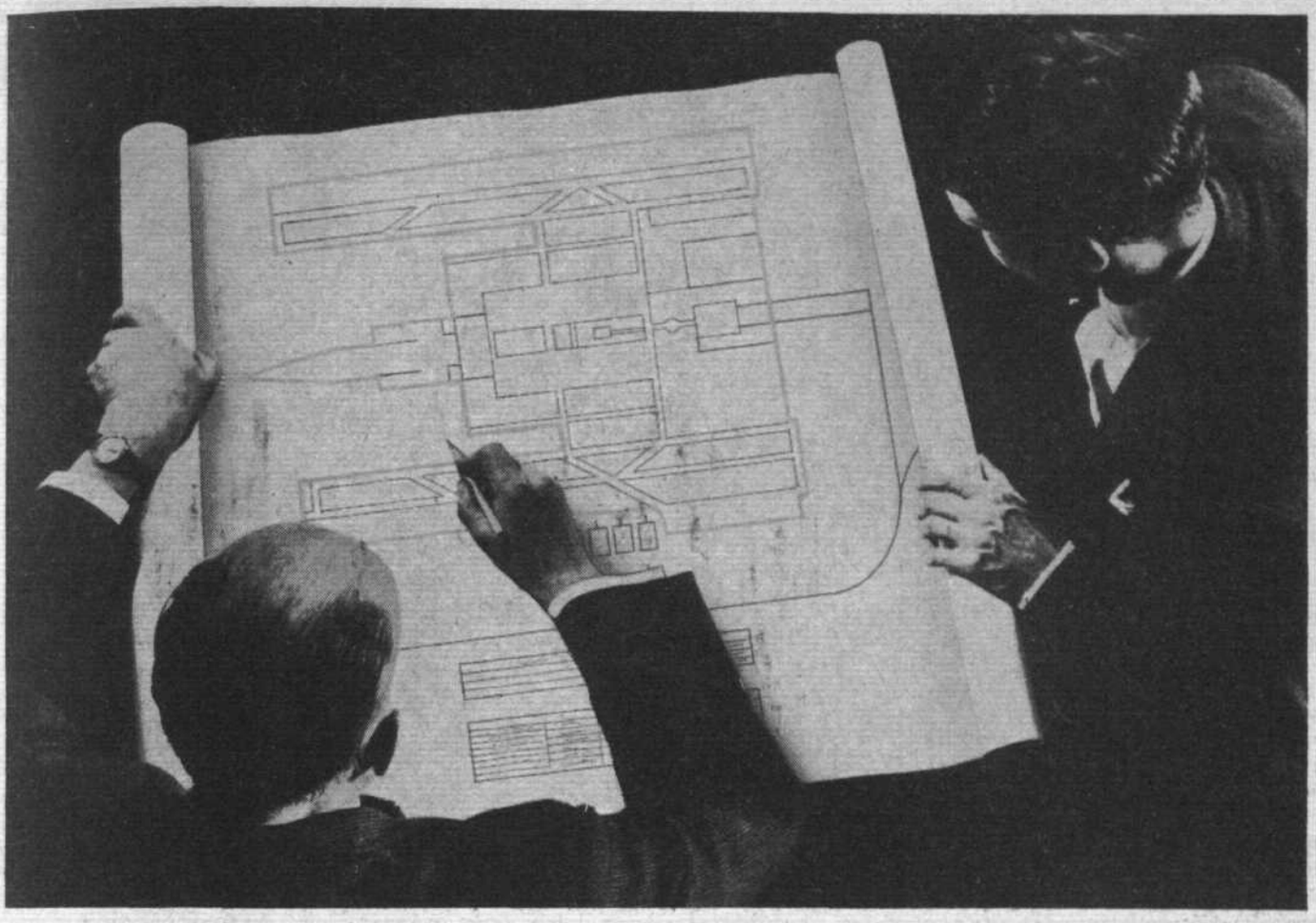
Scandinavian Operator Closes Down On October 31 the Swedish/Danish Charter and IT consortium, Internord, ceased operations. Among reasons given for the failure was the competitive need for the too-early introduction of jets (Convair 990As), with consequent over-capacity.

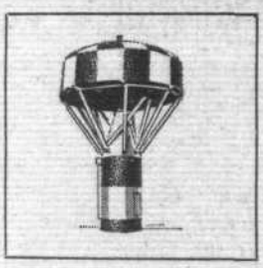
Back to Glasgow Following the settlement of the industrial dispute, BEA resumed services from Glasgow Airport, Abbotsinch, last Monday, November 4. The airline, with British United and British Eagle, had been using Prestwick as the Glasgow terminal since October 17.

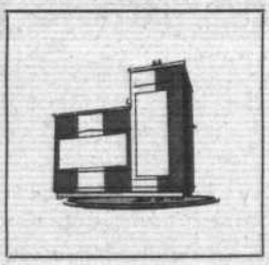
National for Miami-London? The CAB Bureau of Operating Rights has recommended that National Airlines should be selected as the US flag carrier on the Miami-London route. National, one of the first to put in an application, is based at Miami and has so far been an entirely domestic carrier.

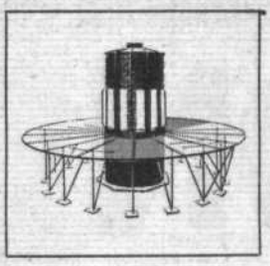
Voici Roissy The future airport for Paris has been re-named by the Paris Airports Authority as Roissy-en-France Airport so as to avoid confusion with Paris-Nord railway station. The new name is adapted from that of a village near the site of the future airport, which is expected to be operational in August 1972 to supplement Orly and to replace Le Bourget.

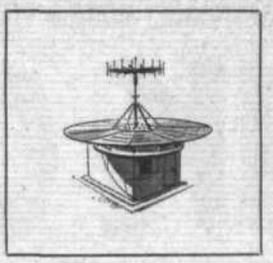
Concorde Simulator Crash The crew of the Mirage IV bomber fitted out as a Concorde flight simulator, which crashed on October 23 (see *Flight* for October 31, page 687), were in fact both saved by successful ejections in their Martin-Baker seats. Our report that the pilot had been killed, which had been understood in Paris, was in error. The Mirage IV crash is the subject of an inquiry and details were still not available as we went to press.

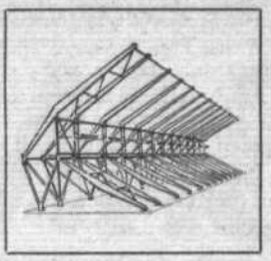












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Eagle Casts Around

THE AIR TRANSPORT LICENSING BOARD has revoked British Eagle's licence for inclusive-tour charters on the route London-Bermuda/Nassau. The revocation was made on an application by BOAC (see *Flight* for July 18, page 86) alleging irregularities in the conduct of the tour services. Last week British Eagle put on a brave face and announced that, as it proposed to start a scheduled service between Nassau and Luxembourg through its Bahamian subsidiary, Eagle International Airlines (Bahamas), the revocation was "of no real significance."

The airline also applied to the Board of Trade in London last week for designation under bilateral agreements with the USA and Canada as a carrier on the route Nassau-New York/Toronto/Montreal.

Mr. Harold Bamberg, British Eagle chairman, is also negotiating the sale of his travel interests, the Travel Trust group, to the Government-owned Transport Holding Company (the deal seemed near completion as we closed for press), and the airline has taken a stake in the newly formed Swiss charter company Tellair (see *Flight* last week, page 688).

The current bout of hectic activity within Mr Bamberg's airline and other interests must be viewed against the fact that British Eagle has undoubtedly been suffering a flat spell recently. It is of course not alone in this, but its troubles are compounded by the loss last March of trooping contracts and emigrant charter flights to Australia. Mr Bamberg has said that, although the Transport Holding Company approached him over the acquisition of Travel Trust, he feels that if the deal goes through he will be freed to devote his entire attention to the airline.

The revocation application put to the ATLB by BOAC included charges that tour operators other than those named in the licence had been promoting the tours; that tours in the USA and Europe had been offered, although this was a cabotage licence; that there had been irregularities concerning the duration of tours; and that there had been material diversion of BOAC's traffic. BOAC also claimed that it was clear that the British Eagle services were running at a loss.

The ATLB, which threw out BOAC's application on procedural grounds when it was first made (see *Flight* for August 29, page 322) allowed it the second time around; "the evidence tendered by BOAC," said the board, "left us in no doubt that British Eagle International Airlines Ltd have evaded the terms and conditions of this inclusive-tour licence by representing the service, particularly in Bermuda and the Bahamas, as little different from a scheduled service operated by themselves, and by selling carriage on the service on this basis, thinly disguised as an inclusive tour by the provision of some limited hotel accommodation in London."

The ATLB, which added that it regretted that BEIA had seen fit to tender no evidence, remarked that, had it been asked to license a service of the type actually offered, it would have refused to do so.

An indignant statement from Mr Bamberg followed the decision; he said that it "once more highlights the protectionist attitude of the present system in favour of the national airlines." He complained also of the frequency limitations suffered by British Eagle, and said that BOAC's recent application for reduced fares in the Skycoach category of their scheduled services was a direct follow-on from British Eagle's innovation in this field.

British Eagle stands to lose its Caribbean IT service—one return flight a fortnight both to Nassau and to Bermuda—on November 18, but if it decides to appeal against the decision it will be able to continue operation until the result of the appeal is known. At the same time the airline hopes to get its Luxembourg service going by the end of the year or early in 1969. The Bahamas Government has given permission for the service, and the Luxembourg Government is not expected to raise any objection. It is hoped that Eagle International (Bermuda) will be able to join in and add Bermuda to the route. No stipulation of course as to fares has been made by the Bahamas Government, and freedom from the dictates of IATA is one of the attractions of Luxembourg. Air Bahama International now offers one return flight a week to Luxembourg at £127 10s (the IATA fare to Brussels is £243 17s).

It will not be possible to use British-registered aircraft on the route, and Eagle International (Bahamas), like its sister company in Bermuda, has no aircraft. The Eagle management will therefore have to decide quite soon whether it can spare any 707s for the Luxembourg service—it has a North Atlantic group-charter programme as well to maintain next year—or whether new equipment will be needed.

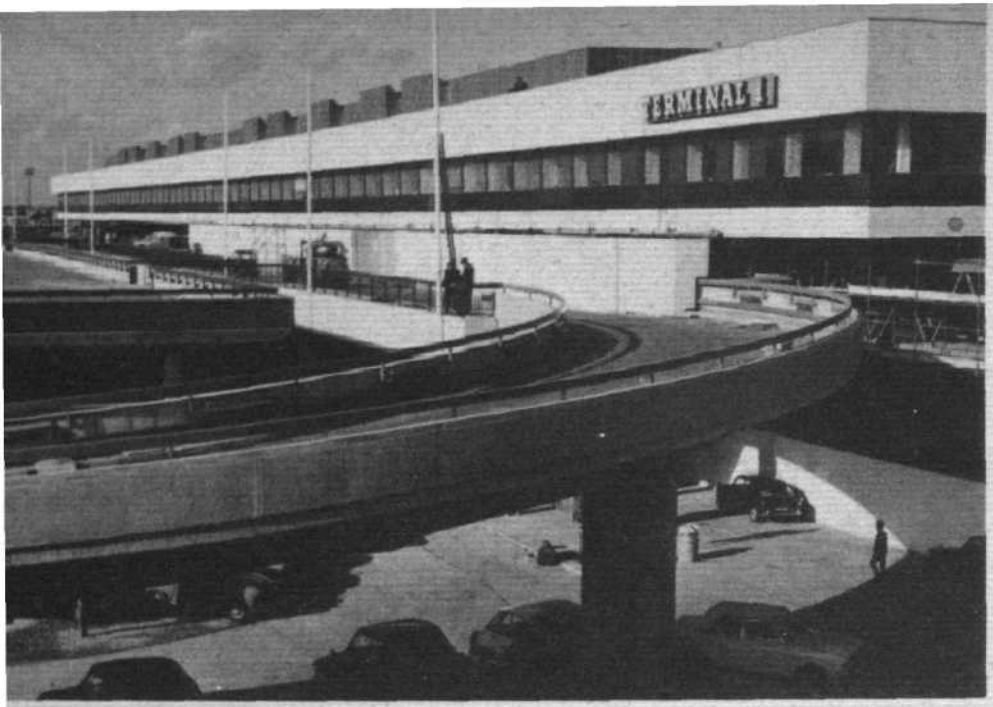
The North Atlantic charter programme reached a peak last summer of 12 return flights a week. A possible snag which has been encountered, and which could prevent a much-needed expansion of this traffic (in what is after all one of the fastest-expanding markets), is the fact that the CAB authority is held in the name of British Eagle International Airlines. BEIA is an IATA member, and IATA forbids the operation of split charters and inclusive tours. The airline is currently trying to switch the charter authority to British Eagle Aviation, a non-IATA company, but a CAB examiner has just recommended that this should not be permitted. He found that British Eagle Aviation was not a sufficiently individual entity in its own right to be considered "fit and proper" within the meaning of the act for the issue of a foreign air carrier permit. British Eagle has appealed against the CAB examiner's recommendation and is supported in this by the Bureau of Operating Rights. Part of the examiner's contention was that many management officers of British Eagle Aviation were in fact common to BEIA, and many of its aircrew were in fact employed by BEIA.

The Eagle International (Bahamas) bid for Nassau-New York/Montreal/Toronto rights is problematical. BOAC already connects Nassau with New York, as do both Pan American and Northeast Airlines. The routes to Montreal and Toronto are operated by Air Canada alone. The Board of Trade can be expected to consult with both the CAB and the Canadian Air Transport Board before it says whether or not it will designate Eagle. It will also consider the position *vis-à-vis* BOAC, and past policy towards the corporation and towards dual designation suggests that the Eagle application may well be turned down. Even if BoT is amenable towards the presence of another carrier, it cannot ignore the current rebuilding and re-equipment of Bahamas Airways, now owned jointly by BOAC and Cathay Pacific and with aspirations towards becoming a Bahamian public company.

EASTERN SELLS ELECTRAS

FIVE of the 40 Lockheed Electras in Eastern Airlines' fleet have now been sold—three to Lineas Aereas Paraguayas, of Asuncion, and two to the leasing company, International Aerodyne of Miami—with spare parts and extra engines. The deal includes the training of pilots and engineers by Eastern. IA's Electras have already been contracted for by Falconair Charter, the Swedish charter and IT carrier, and they are going to Lockheed Aircraft Service at Kennedy Airport, New York, to be modified as 121-seaters. In addition to training Falconair pilots, flight engineers and mechanics, Eastern will provide spares support and will overhaul engines.

AIR TRANSPORT...



Yesterday, November 6, the new Heathrow Terminal No. 1 was opened for limited operations. Left is an exterior view showing the ramp road up to the first-floor departure level, with the multi-storey car park on the left. Right is No. 4 pier which is now in operation for the domestic section. Each aircraft stand has its own air jetty and a forward assembly area to seat 50 people

After Concorde and the Airbus

The RAeS/Cranfield Society Symposium—Part 1

AT THE ALL-DAY MEETING held at the Royal Aeronautical Society on October 25 (reported upon briefly in *Flight* for October 31, pages 684-685), a number of important papers were read about future trends in transport aircraft development. The discussion also covered a wide field and raised several controversial long-term issues.

MR D. G. BROWN (chief project engineer of Hawker Siddeley, Hatfield) considered it to be necessary to cover the whole of civil aviation because of interrelations between developments in different fields. He made the point that, at the current rate of growth (amounting to a doubling every five years), airline operation and aircraft manufacture, which are already amongst the largest, would soon become perhaps the world's most important industry.

Aircraft development had benefited from a succession of technical leaps which had generally resulted in greater speed and range. The "hunch process" had played an important part in the past and it was still important, in spite of advances in market prediction. Inspired judgment was needed to achieve the right solution at the right time. Once a successful basic aircraft had been produced, it was essential to develop it with the objective of a family of related types. The large number of aircraft which had missed the mark and failed to achieve an adequate market emphasised the narrow choice which had to be made between under-reaching and over-reaching in technical objectives.

Mr Brown divided the market from about 1975 under seven headings. He pointed out that, in 1965, this market had been worth about £6,400 million in the western world, of which 85 per cent was met by US-built aircraft. The general aviation category amounted to no less than 26 per cent of the total value. The headings were:—

(1) Light aircraft, including agricultural; (2) executive and business aircraft; (3) third-level airliners and air taxis; (4) feeder and secondary route airliners; (5) short-haul main-line aircraft; (6) medium-haul main-line aircraft; and (7) long-haul main-line aircraft. He looked particularly at the last four categories which subdivided further into passenger, mixed passenger/freight and all-cargo aircraft. The options open to the operator involved choices in speed, size, range and airfield performance (CTOL, STOL, or VTOL).

At present, the US domestic market amounted to about half the total in the western world but the US share was expected to decline in the future. In these circumstances, non-American manufacturers should at least be able to hold their current share of the market, if not increase it. The average annual growth rates had been and were forecast as follows: 1960-65, 12.7 per cent; 1965-70, 15.3 per cent; 1970-75, 10.7 per cent; 1975-80, 9.2 per cent.

An important feature of the transport-aircraft market was that about 60 per cent was in the short-haul category—less than 1,000 miles. There was, however, a tendency for long-haul equipment to penetrate down into the short-haul market. In the 1980s the short-haul proportion was not expected to change significantly. This meant that, in that decade, the split between different types of aircraft was forecast as follows:—

	Aircraft	*Traffic*
VTOL	20%	16%
SST	9%	3%
Feeder	12%	15%
Conventional short-haul	30%	39%
Other categories	29%	27%

This emphasised the relatively small importance of the SST market. For the next technical step, to hypersonics, the effect of speed and size of vehicle would be aggravated. One hypersonic airliner would probably have the productivity of six supersonic aircraft and of 13 subsonic types. The effect of a single accident on the fleet of an individual carrier using supersonic aircraft would be serious. To an airline using hypersonic aircraft it would be catastrophic.

The medium-haul market (1,500 to 2,500 miles) had until recently had few aircraft designed specifically for it, in spite of the importance of the US transcontinental routes. However, the Boeing 727 and the new US airbuses were aimed at this primary application. The European Airbus came in the same category. The size was dictated by the subsonic plateau in block speed and in aircraft utilisation which dictated about 300 seats for the mid-life point of about 1978.

Before leaving conventional aircraft, a final important feature of European air-traffic development was brought out by Mr Brown. This was the growing importance of inclusive-

tour business. If present trends continued, ITs would amount to 40 per cent of the total European market by 1970 and perhaps 60 per cent by 1990. From a peripheral activity, ITs might become a major part of the market, requiring specially designed equipment.

Turning to VTOL and STOL, fields in which he is particularly interested, Mr Brown expressed the view that, from the aspect of practical feasibility and solution of the noise problem, we were today on the edge of a technical breakthrough. The currently emerging problems of conventional air transport, congestion and surface competition made this particularly timely. It was interesting that the recent congestion problems in the USA were forcing the pace—hence the recent rapid growth in interest in STOL, which was, however, probably only an interim solution. VTOL offered better prospects in the long term. The high-speed VTOL aircraft, in particular, looked the most attractive from the aspect of both economy and noise.

In a comparison of such a vehicle with an equivalent conventional aircraft, on a representative short-haul application, the following differences had been estimated:—

Average trip time	2 hours less
Block time	25% less
Prime cost	66% more
Total operating cost	45% more
Direct operating cost	10% more
Cost to passenger	4% less
Total effective fare	12% less

(allowing for the value of the passenger's time)

Turning to the difficult problem of noise, Mr Brown pointed out that, with conventional aircraft, some 28 sq miles of London today suffer noise levels of 90 PNdb or more. With VTOL sites, for the type of vehicle envisaged, this level of noise could be confined to areas 3,000ft in diameter round the selected sites. It should be possible to position these so that the overlap of community areas was minimal. If this sort of VTOL vehicle could be brought into service in the later 1970s, it might be possible to avoid developing a third London airport altogether.

In a comparison of ground facility investment for alternative vehicles, the VTOL figure was put at £700 million, compared with £1,000 million for STOL, £1,100 million for conventional aircraft and £4,100 million for a high-speed surface transport system. If it could be achieved on the envisaged time scale, a 65 per cent penetration of the European short-haul market by VTOL should be possible by 1990.

Concluding his review with a rapid survey of other markets, Mr Brown expressed the view that, for as far ahead as could be seen, adaptations of passenger and mixed passenger/cargo aircraft would meet the requirement for all-cargo. In the feeder category, there was a clear requirement for a 30- to 60-seat turbofan capable of operating from 3,000-4,000ft fields. The main problem in this category was the right engine, if the required economics were to be achieved. In the third-level airline and air-taxi market, which should be particularly attractive to European manufacturers, there was a growing requirement which complemented that for executive aircraft in the 4-20-seat sizes, with ranges of 1,000 to 3,000 miles. A 10,000lb executive jet looked an interesting possibility. Indeed the whole general-aviation market in Europe was promising if there was a repetition in due course of what had happened in the USA. The ultimate of personal travel might even be achieved. The designer's "pipe dream" for so long, it might, in the end, be brought into the realm of the practical by the development of fully automated systems.

to be continued

New London HQ for Eastern The European regional, UK and Ireland sales offices of Eastern Airlines have been moved to new, larger, headquarters at 80 Haymarket, London, SW1.

BUIA Appointment Captain Geoffrey Thomas, formerly general manager of Jersey-based BUA(CI), which has been absorbed into BUIA, has been appointed assistant to the managing director, Mr Alan Bristow.

Invicta Cargo Sales Mr M. T. Cullen has joined the commercial department of Invicta Airways of Manston as cargo sales representative. He was previously with British Eagle on technical sales and recently left the sales organisation of the other Manston-based carrier, Air Ferry, which ceased operations at the end of October. Invicta have ordered two more Viscounts for delivery next year; this will bring their fleet up to four Viscounts and four DC-4 freighters.

Montparnasse Group Chairman Mr Franz Roth, Swissair's vice-president, engineering and maintenance, has been elected chairman of the Montparnasse group of European airlines. This was formed in Paris last year with the aim of achieving closer technical collaboration—particularly in relation to the Boeing 747. The group consists of the two technical consortia, KSS (KLM, SAS and Swissair) and Atlas (Air France, Lufthansa, Alitalia, Sabena and UTA), as well as of several other carriers, including BOAC. The members exchange information with the object of standardising specifications for future aircraft types and thus reducing the cost of introduction.

ACCIDENTS AND INCIDENTS: OCTOBER

FATAL ACCIDENTS

Date	Carrier	Aircraft	Location	Fatalities		Total Occupants		Circumstances
				Pass	Crew	Pass	Crew	
Oct. 8	Aerovias del Valle	B-N Islander (TI-1063-C)	Puerto Cortes, Costa Rica	9	1	9	1	On approach
11	CSA	Il-14	Nr Prague Airport	8	3	37	3	After take-off
25	Northeast Airlines	FH-227 (N-380N)	Lebanon, NH, USA	30	2	39	3	Struck 2,700 ft mountain during descent

NON-FATAL ACCIDENTS

Date	Carrier	Aircraft	Location	Injuries		Total Occupants		Circumstances
				Pass	Crew	Pass	Crew	
Oct. 10	TAA	Viscount (VH-TVK)	Mascot, Sydney	—	—	24	3	Nosewheel jammed in raised position.
12	Pan African Airlines	DC-4 (N-3934C)	Lagos Airport	—	—	—	—	Nosewheel collapsed during engine run.
22	Pan American	B.727 (N-325P)	Stuttgart Airport	—	—	48	6	Starboard U/C jammed in raised position.
	Turkish Airlines	DC-9	Vienna Airport	—	—	74	3	Landed short of runway, struck radar scanner.
26	BEA	Vanguard (G-APEN)	Belfast Airport	—	—	?	?	Overran runway.

BOAC's Prices and Pilots' Incomes

AFTER OUTLINING THE BRIEF HISTORY of the current BOAC pilot/management dispute the Prices and Incomes Board report* somewhat peevishly complains that halfway through its study the whole situation was changed. This occurred when the BOAC pilots, after their two-week strike in the summer, managed to secure an agreement with BOAC on payment by the flying hour rather than on a flat-rate basis.

It is this agreement, reached in July under the independent chairmanship of Prof John Wood of Sheffield University, which the PIB examines in detail. Listing first the statutory and company limits on monthly flying time which are in existence now, the report reveals that BOAC is unhappy with the BoT regulation in ANO, 1966, which limits flying hours to 100 in 28 consecutive days. The corporation would prefer to see the limit raised to 110.

The report recognises that there are limits on flying time which arise because of scheduling considerations (BOAC's route structure), but finds BALPA's charge of commercial misjudgment in BOAC to be fully answered by the corporation.

Finally, in its consideration of flying-time limits, the PIB looked at limitations arising from scheduling agreements in force between BALPA and the corporation. These include a maximum limit in any 28-day calendar period of 75hr (against the 100hr laid down in ANO, 1966). The current scheduling agreement also includes provision for pilots to have at least one seven-day period at home in each 28-day cycle—known as "planned stand-off." This fixed period is designed to allow pilots to plan at least 25 per cent of their domestic life with a high degree of certainty.

The report goes on to say that in the areas where scheduling was limited by BALPA/BOAC agreement there was scope for modifying the limits without infringing BoT requirements. It was in this area where the pilots and management had not been able to agree on the monetary values of changes to the scheduling agreement—hence, ultimately, the need to go to arbitration under Prof Wood.

Details of the Agreement

The Wood agreement, which the report outlines, provides for two main changes in the present system: First an hourly rate of pay is substituted for an annual salary; secondly pilots (in order of seniority) will be allowed to bid for specific "blocks" of work in each month. This is known as the "bidline system." Under it the senior pilots in each rank are able to choose the amount of flying which they do and hence determine how much money they will earn each month. Their junior colleagues take what blocks of work are left. The bidline system has been in use for several years in some US airlines —its advantages, as the PIB report says, being that inequality in pilots' workload are reflected in their pay. Another advantage, from BALPA's point of view, is that a bidline system encourages the management to make the fullest use of its pilots and increases the corporation's efficiency. Any such system, however, applied to BOAC, would mean a considerable reduction in the total number of pilots. This aspect is covered fully later in the PIB report.

A disadvantage (apart from that inherent to any junior pilot) which was not noted by the PIB was that by allowing a pilot to decide his own workload the system could encourage voluntary overwork in the pursuit of money, thus bringing yet another financial factor into the problem of air safety.

The Wood agreement outlines relaxations which could be made in the rostering system—a shortening of the agreed time-off between flights, an extension of present time limits—and mentions that BALPA would be prepared to drop the planned stand-off if the bidline system was introduced. This point, the PIB report says, is not explicit in the Wood agreement. The report continues:—

"The second matter which was not made fully explicit in the Wood agreement is the provision for a minimum guarantee . . . some blocks may provide lower earnings than at present. The agreement provides accordingly for a minimum guarantee. Prof Wood's covering report says that '. . . in the course of negotiations BOAC undertook to *try to ensure* that the minimum guarantee in the new structure will be *as close to current pay levels as possible*.'"

The words in italics (italicised by *Flight*) are, ironically enough, precisely the type of loose phrasing in recent BALPA/BOAC agreements which have led to subsequent disputes. There is all the world of difference between agreeing to try to attain a minimum and agreeing to attain the minimum. In this respect the pilots appear to be making a rod for their own backs.

The PIB report then considers the implications of the Wood agreement—in particular the costs to BOAC and the redundancy levels involved. The bidline system, it is noted, "adds to the existing differential for seniority. It is also true . . . that below the level of minimum guarantee, there is no financial incentive to take on extra work. . . . We consider therefore that the system should be subject to review and change should new anomalies come to seem too great. . . ."

The PIB considered that it was important to look at the relationship between costs and savings which the new system would bring. As the minimum guaranteed salary would not be less than what a pilot already earned, it followed that, because some pilots would work more hours while some would work less (for the same minimum pay) there would be a rise in the total salary bill which was difficult to calculate. Finally, the Board came out with a figure of 10 per cent increase on the salary bill.

Against this the Board estimates that pilot redundancy would be in the order of 15 to 20 per cent, with an additional 2 to 3 per cent loss as a result solely of the change to a bidline system.

The report goes on ". . . the early implementation of the Wood agreement, if it is not to be attended with increased costs, depends essentially on any agreement reached between BOAC and BALPA with regard to redundancy. Pay and redundancy are interlocked and there cannot be a movement on the first, which does not entail extra cost, without also a movement on the second.

"We are of the opinion that the savings achievable, given acceptance of redundancy, should make it possible to increase the earnings of the remaining pilots, to meet the cost of the minimum guarantee and any likely level of compensatory payments, and to leave an appropriate share for the Corporation. The savings accruing to the Corporation should benefit the public generally as tax paying owners of the Corporation and the consumer. The latter cannot benefit from reduced fares so long as these are controlled by the agreements of the International Air Transport Association, but the consumer could benefit from better service within the limits set by the agreements of the IATA."

The PIB report goes way out of its depth when it deals with the size of crews for particular aircraft. After briefly considering the engineers' and navigators' functions, the report concludes that there should be no automatic relationship between pay and the weight and speed of an aircraft. "A change in pay should reflect changes in job content identified through techniques of job analysis. . . ." If "job content" as it applies to a pilot could be defined easily there would have been far less industrial trouble among pilots in many airlines during the past five years.

J.B.B.

* Cmnd 3789: Pay of pilots employed by BOAC. HMSO, price 3s 6d net.

BOAC's Prices and Pilots' Incomes

AFTER OUTLINING THE BRIEF HISTORY of the current BOAC pilot/management dispute the Prices and Incomes Board report* somewhat peevishly complains that halfway through its study the whole situation was changed. This occurred when the BOAC pilots, after their two-week strike in the summer, managed to secure an agreement with BOAC on payment by the flying hour rather than on a flat-rate basis.

It is this agreement, reached in July under the independent chairmanship of Prof John Wood of Sheffield University, which the PIB examines in detail. Listing first the statutory and company limits on monthly flying time which are in existence now, the report reveals that BOAC is unhappy with the BoT regulation in ANO, 1966, which limits flying hours to 100 in 28 consecutive days. The corporation would prefer to see the limit raised to 110.

The report recognises that there are limits on flying time which arise because of scheduling considerations (BOAC's route structure), but finds BALPA's charge of commercial misjudgment in BOAC to be fully answered by the corporation.

Finally, in its consideration of flying-time limits, the PIB looked at limitations arising from scheduling agreements in force between BALPA and the corporation. These include a maximum limit in any 28-day calendar period of 75hr (against the 100hr laid down in ANO, 1966). The current scheduling agreement also includes provision for pilots to have at least one seven-day period at home in each 28-day cycle—known as "planned stand-off." This fixed period is designed to allow pilots to plan at least 25 per cent of their domestic life with a high degree of certainty.

The report goes on to say that in the areas where scheduling was limited by BALPA/BOAC agreement there was scope for modifying the limits without infringing BoT requirements. It was in this area where the pilots and management had not been able to agree on the monetary values of changes to the scheduling agreement—hence, ultimately, the need to go to arbitration under Prof Wood.

Details of the Agreement

The Wood agreement, which the report outlines, provides for two main changes in the present system: First an hourly rate of pay is substituted for an annual salary; secondly pilots (in order of seniority) will be allowed to bid for specific "blocks" of work in each month. This is known as the "bidline system." Under it the senior pilots in each rank are able to choose the amount of flying which they do and hence determine how much money they will earn each month. Their junior colleagues take what blocks of work are left. The bidline system has been in use for several years in some US airlines —its advantages, as the PIB report says, being that inequality in pilots' workload are reflected in their pay. Another advantage, from BALPA's point of view, is that a bidline system encourages the management to make the fullest use of its pilots and increases the corporation's efficiency. Any such system, however, applied to BOAC, would mean a considerable reduction in the total number of pilots. This aspect is covered fully later in the PIB report.

A disadvantage (apart from that inherent to any junior pilot) which was not noted by the PIB was that by allowing a pilot to decide his own workload the system could encourage voluntary overwork in the pursuit of money, thus bringing yet another financial factor into the problem of air safety.

The Wood agreement outlines relaxations which could be made in the rostering system—a shortening of the agreed time-off between flights, an extension of present time limits—and mentions that BALPA would be prepared to drop the planned stand-off if the bidline system was introduced. This point, the PIB report says, is not explicit in the Wood agreement. The report continues:—

"The second matter which was not made fully explicit in the Wood agreement is the provision for a minimum guarantee . . . some blocks may provide lower earnings than at present. The agreement provides accordingly for a minimum guarantee. Prof Wood's covering report says that '. . . in the course of negotiations BOAC undertook to *try to ensure* that the minimum guarantee in the new structure will be *as close to current pay levels as possible*.' "

The words in italics (italicised by *Flight*) are, ironically enough, precisely the type of loose phrasing in recent BALPA/BOAC agreements which have led to subsequent disputes. There is all the world of difference between agreeing to try to attain a minimum and agreeing to attain the minimum. In this respect the pilots appear to be making a rod for their own backs.

The PIB report then considers the implications of the Wood agreement—in particular the costs to BOAC and the redundancy levels involved. The bidline system, it is noted, "adds to the existing differential for seniority. It is also true . . . that below the level of minimum guarantee, there is no financial incentive to take on extra work. . . . We consider therefore that the system should be subject to review and change should new anomalies come to seem too great. . . ."

The PIB considered that it was important to look at the relationship between costs and savings which the new system would bring. As the minimum guaranteed salary would not be less than what a pilot already earned, it followed that, because some pilots would work more hours while some would work less (for the same minimum pay) there would be a rise in the total salary bill which was difficult to calculate. Finally, the Board came out with a figure of 10 per cent increase on the salary bill.

Against this the Board estimates that pilot redundancy would be in the order of 15 to 20 per cent, with an additional 2 to 3 per cent loss as a result solely of the change to a bidline system.

The report goes on ". . . the early implementation of the Wood agreement, if it is not to be attended with increased costs, depends essentially on any agreement reached between BOAC and BALPA with regard to redundancy. Pay and redundancy are interlocked and there cannot be a movement on the first, which does not entail extra cost, without also a movement on the second.

"We are of the opinion that the savings achievable, given acceptance of redundancy, should make it possible to increase the earnings of the remaining pilots, to meet the cost of the minimum guarantee and any likely level of compensatory payments, and to leave an appropriate share for the Corporation. The savings accruing to the Corporation should benefit the public generally as tax paying owners of the Corporation and the consumer. The latter cannot benefit from reduced fares so long as these are controlled by the agreements of the International Air Transport Association, but the consumer could benefit from better service within the limits set by the agreements of the IATA."

The PIB report goes way out of its depth when it deals with the size of crews for particular aircraft. After briefly considering the engineers' and navigators' functions, the report concludes that there should be no automatic relationship between pay and the weight and speed of an aircraft. "A change in pay should reflect changes in job content identified through techniques of job analysis. . . ." If "job content" as it applies to a pilot could be defined easily there would have been far less industrial trouble among pilots in many airlines during the past five years.

J.B.B.

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Letters

Scotland and the BAA Report

SIR,—Mr Ron Read is always fun—whichever end of the stick he is grasping at any particular moment.

In his entertaining letter published in your October 17 issue, in which he does me the honour of quoting—out of context—a number of observations which I have made on airport/city-centre distances, he firmly grasps the wrong end of several sticks which he shakes with endearing fervour.

Of course I agree with him that all air travellers want to see new airports as close as possible to the city centres which they serve. But—and I have always stressed this in context the nearness to a traffic centre which a *new* airport can be set depends essentially upon a compendium of many other basic requirements as well. They include operational suitability and safety; means of access; noise and other community interests; space to develop; costs of construction and of operation; and employment prospects.

The location of airports is—as everyone knows—a most complex business of wide social interest. Clearly, for a new airport a balance must be struck between all the essential requirements and interests. To some, limited, extent the most desirable city centre distance may have to be "traded off" against, say, noise disturbance or cost of construction.

In the West of Scotland, clearly the £7 million currently invested in Prestwick, together with its excellent 9,800ft runway, the minimum noise disturbance which it causes, its good weather, and its experienced staff, all add up to a national asset of substantial importance, not only to Scotland but also to the UK as a whole.

On a cost/benefit basis Prestwick stands high. In a National Airports Plan the needs of the various major centres of population for adequate air services will, I hope, eventually be met by an adequate number of carefully located airports. Such a plan would include several classes of airport, each related to the ability of air transport and the populations together to support viable operations. The various classes of airports should include those for inter-continental, continental and regional services—each of the former embracing the latter. Prestwick fits the first, Glasgow the second, and there can be no doubt that, with the steady growth of aviation in all its aspects, the West of Scotland will require two airports if its population is to be properly served.

Access is, of course, the feature of Prestwick which primarily requires improvement. For rather less than the cost of an unnecessarily long extension to the Abbotsinch runway, Prestwick could be provided with fast access to the centre of Glasgow. If the money is unwisely spent, then the West of Scotland will be in danger of ending up with one airport at which noise restrictions will, before long, be inevitable and through which the really heavy-loaded long-distance aircraft will not be able to operate.

The picture must be looked at as a whole, not in part.

London, SW1 PETER G. MASEFIELD,
Chairman, British Airport Authority

BEA's Competition

SIR,—In the very week that *Aeroplane* is announced as merging with *Flight* (I wonder what competitor Roger Bacon will recommend?) your Straight and Leveller picks up a paragraph from a letter I wrote to the *Financial Times* on the rail link to Heathrow, and gaily makes fun of it because it refers to "a monopoly, with all the powers it implies."

The question is asked as to what my choice for a second air carrier between London and Manchester would be. The question has no relevancy to the subject, but that is the way with funsters. The answer is simple. There is no need for a second air carrier between London and Manchester. The competition is clear too: British Rail, with a remarkably efficient electrified rail service (why not let in a private-enterprise train at the most effective time to teach 'em a lesson?); a well organised road passenger network using the motorways; and the private car.

The point I tried to make is that, willy nilly, the proposal is that the Victoria air terminal will have to be used, and the rail link too, and no alternative method of getting passengers to the airport will be allowed.

London W1 AUBREY C. PING,
Chairman and Managing Director, British Air Services Ltd

Wanted: Advice on Ditching

SIR,—With reference to the forthcoming *Daily Mail* Transatlantic Air Race, I would like to receive, from members of the Goldfish Club, advice on how to ditch both fixed- and retractable-undercarriage aircraft. All information sent to me will be made available both to *Flight* and to the race organisers.

We hope to use in the race a low-wing single with retractable gear (funds permitting), but we shall be carrying out practice flights over water with ordinary club training aircraft with fixed gear. In fact, Mr Neville Andison and myself recently took a Victa Airtourer of the Sunderland Flying Club from Newcastle direct to Stavanger. Due to headwinds, we returned via Denmark and Holland and, although we didn't ditch, we did land on the sea bed! While we were en route from Groningen to Rotterdam the weather deteriorated and we had a u/s IF panel, so we decided to land at a light-aircraft strip not marked on our maps. It turned out to be a crop-spraying strip on the recently reclaimed polder of East Flevoland in the Zuider Zee. When the weather improved I filed a flight plan to Amsterdam Centre from a newly constructed farmhouse, and I was interested to see an old ship's anchor in the middle of the lawn. I wonder if G-ATCL has the honour of being the first British aircraft to land in this new province of Holland.

Border Radar, RAF Boulmer, Northumberland RAYMOND SELKIRK
(Radar controller)

Condor Deliveries

SIR,—Further to the letter from Mr E. T. Wilson (October 24), Rollasons have in fact delivered seven Condors since the beginning of this year.

We are well aware of these rather poor figures and your correspondent can be assured that we are doing our best to improve on them. We are, however, only a little company; and, faced with large competition from a nationalised industry on a difficult market, we simply cannot afford to put all our eggs in one basket.

Croydon, Surrey D. M. J. JONES,
Sales Manager, Rollason Aircraft and Engines Ltd

Being seen—and Heard

SIR,—From S. W. Stoneham's letter in your October 17 issue I don't think that he can have read all the correspondence correctly.

First, the 707 was seen to be *below* the Cessna and *climbing*. If it was on an instrument approach it would be letting down from the beacon.

Secondly, Stansted's and Wethersfield's patterns overlap, and each has knowledge of the other's traffic. If a 707 wants to extend its approach to go anywhere near Wethersfield permission has to be obtained from that airfield. Therefore, even if an aircraft is on Wethersfield's frequency (and obviously unable to contact Stansted at the same time), it should be told of any known traffic.

Nevertheless, the case for extending the aerodrome

LETTERS...

traffic zone to encompass the area where numerous instrument let-downs are taking place should be a top priority.

Air traffic should know of all aircraft in its vicinity—especially in IMC.

Stansted, Essex L. RICHARDS

How Sensible is All-cargo?

SIR,—Sir Anthony Milward may have been quoted out of context in your report (page 556, October 10) of his RAeS lecture on air cargo, in which he expressed disbelief that all-cargo airlines were "either practical nor sensible."

I am chairman of Trans Meridian (London) Ltd; we are an all-cargo airline, have been so for the past seven years, and have recorded a net profit for each of these years. This, in my opinion, qualifies our business as practical and sensible.

The only other all-cargo airline outside Europe is Trans Mediterranean, of the Lebanon. While I don't know for certain whether or not they are profitable, they run some ten all-cargo aircraft; and every time I meet Abu Haidar, their energetic chairman, he certainly appears more affluent than ever, and I would hazard a guess that his profits far exceed the modest sums that have enabled me to acquire the Flying Tiger Line CL-44s in order to increase our all-cargo fleet from its present three DC-7CFs.

I agree that the quick-change concept is at best a compromise, as with most of the UK independents who look to the cargo business as a means to keep their aircraft busy during the winter months. This is not the answer to the cargo business and may be the reason Sir Anthony looks at air cargo with the eye of a sceptic.

However, if one concentrates on cargo, it is profitable. We, for instance, would be delighted to take on all BEA's cargo network today, and pay the corporation a substantial sum of money for the privilege of so doing. Many large airlines do just this, Lufthansa being one example, Austrian Airlines another and Alitalia a third. All of them use independent airlines to move their cargo and appear happy with the arrangement.

I could not, however, agree more with the argument that a differential landing fee for all-cargo aircraft ought to be applied. How one can ever achieve this with a State-owned monopoly running the major airports is another question.

Since BEA's losses on its all-cargo operations have been both substantial and increasing, perhaps my offer to run these services and eliminate the losses may appeal to Sir Anthony. I know we can make good our promises; and if the idea merits investigation I would be only too happy to prove him 100 per cent wrong in his argument, and enhance BEA's profits in 1969 in the bargain.

London SW1 T. D. KEEGAN, *Chairman, Trans Meridian (London) Ltd*

SIR,—Sir Anthony Milward says he feels most strongly that there is a case for differential landing fees for cargo aircraft at British airports.

I would draw the attention of Sir Anthony and your readers to the fact that a differential landing fee for all-cargo aircraft exists at Glasgow Airport, that fee being 50 per cent of the standard fee.

Abbotsinch, Renfrewshire R. A. READ, *Airport Director*

Head-up Work-saver

SIR,—On page 625 of *Flight* for October 17 you suggest that the head-up type of instrument presentation increases the pilot's workload. Although this is obviously not the impression the writer intended to give, it ought to be stressed that the display of information in head-up form is designed to simplify the pilot's task and reduce his workload.

Until recently, the use of the head-up display system was confined to military aircraft, but the complexity of modern commercial transport aircraft has created a demand for such a display for civil use, particularly during the critical final phases of flight.

Feltham, Middx J. H. SYKES, *Director and General Manager, Specto Avionics Ltd*

Diary this week: page 740

THE AVIATION CANVAS

ONCE again the Kronfeld Aviation Art Society's annual exhibition is long on nostalgia and short on the aviation world around us. Only one artist (Roger Steel) attempted to deal with the most exciting aircraft of today—Concorde—and it was a pity that his scene outside a hangar, though full of atmosphere, did not come off so far as the aeroplane was concerned. My own favourite, from rather brief impressions obtained at a preview before the pictures had been hung, was Roy Nockolds' *Jumbo;* on a broad canvas, the orange balloon floats in utter tranquillity over a misty evening landscape. (Monochrome reproduction would be unfair—as indeed it is, though in a lesser degree, to the works illustrated opposite.)

The awards, to be made on November 5, include the *Flight* Tankard for professional artists, and the Kronfeld Challenge Trophy for non-professionals. The Tiger Moth figures strongly in the exhibition; the Harry Cooper Memorial Trophy is being presented this year for the first time for the best painting of the type (in future years it will be awarded for the best light aircraft). Gerald Coulson's Tiger in *Sunday Morning* is enjoying itself upside down over an English landscape; John Young's Tiger (*The Stalwart*) is technically excellent, if a shade too photographic.

There are two outstanding gliding pictures—Brian Withams' *Grounded*, in which a Slingsby T-53 crew sits out a storm under the wing of their aircraft, and Margaret Kahn's Ka-6E over a cumulus-shadowed landscape. In a very different style is M. E. Cole's cheerful and Dufyesque *Wycombe Regionals '68.*

Watercolours figure more strongly than last year, and an outstanding example is T. S. Halliday's *Lightning Refuelling*—the best of the Lightnings I saw. Moving back to earlier aircraft, Edmund Miller's *Mustang* is particularly convincing over a well-suggested sea of cloud. L. R. Williams' *Night Gladiator* catches the elusive atmosphere of moonlight.

There would be many others worthy of mention if space permitted. By the time these words are read the judging will have taken place, and some temporary solution will have been found to the old controversy about which is more important, technical accuracy or the conveying of atmosphere, and whether they are compatible. Several artists went for accuracy and missed it (how difficult a subject the aeroplane is in this respect!). It would be interesting indeed to know what proportion of the entrants relied on (or even slavishly copied) photographs. One artist's curved propeller blades seemed to indicate that he surveys his subjects through a focal-plane shutter. The extent to which reliance on the camera is permissible is a matter for debate; as a visual notebook it may be allowable, but to attempt to do what a camera could do much better may be painting but is not art. DAVID WOOLLEY

The exhibition is open at the Kronfeld Club, 74 (basement) Eccleston Square, London SW1, until November 17 (many exhibits will remain until the end of the month). Opening times are: Wednesdays, noon to 10 p.m.; other weekdays, 6.15 to 10 p.m.; weekends, 3 to 5 p.m. Admission by catalogue, 1s.

THE STALWART *John Young*

MUSTANG *Edmund Miller*

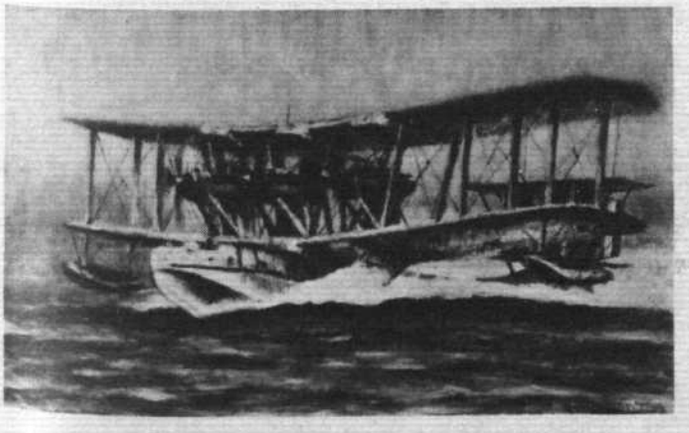
FIVE FROM THE KRONFELD

(See "The Aviation Canvas" opposite)

NIGHT GLADIATOR *L. R. Williams*

LIGHTNING REFUELLING *T. S. Halliday*

IRIS *Richard Jones*



GROUNDED *Brian Withams*

SPORT AND BUSINESS

Minor improvements are made to the Beechcraft Duke for 1969; the type is now in quantity production. Further details on this page

Beechcraft for 1969 A wider choice of revised-style interiors, and the availability of a refrigeration-type air-conditioning unit, are new features of the 1969 Beechcraft Duke. Power, weights, speed and handling are unchanged.

Higher permitted undercarriage-down flying speeds (for all models from the Bonanza to the Baron) have been approved to make descent speeds compatible with the approach patterns of jet aircraft. Visible changes in the range for 1969 are of a minor nature, being confined to details of furnishing.

Nipper News Nipper Aircraft have announced a number of important improvements in their aircraft, a comprehensive after-sales service, and the availability of their new transceiver. From early December all Nippers will be supplied with fixed windscreens and sliding canopies, and the seat backrest is to be lengthened. The powerplant (1,500 c.c. or 1,600 c.c. VW) and the improvements incorporated will, for the time being, not affect the price, which will remain at £1,650. The company's rental scheme, which has proved extremely popular, will be continued. Nipper Aircraft has recently taken over 20,000 sq ft of hangar space at the East Midlands Airport, where they are now offering light-aircraft hangarage and maintenance.

Development of the Nipper Radio, a 24-channel lightweight transceiver, is now almost complete and first deliveries are likely in December. Built to Class 1 requirements, it is expected to operate over from 118Mc/s to 132Mc/s with a mean output of approximately 2½W. Price of this set, with 20 crystals, will be £200 (less 20 per cent when fitted in a Nipper), with additional crystals available at £2 each, and the recommended headsets at £14. A suitable dry battery is available at 19s 6d.

Type Checks are Important—on gliders as well as on powered aircraft. This is the most significant point in the Board of Trade accident report* concerning the crash of a Kranich-Messerschmitt Mk 2 glider at Walney Island, Lancs, in July 1967. When manœuvring for a landing following a short air test, the glider entered a spin from a low height. After three turns the rotation stopped but there was insufficient height for a recovery from the ensuing dive before the aircraft struck the ground in a steep dive; both occupants were killed.

In their analysis of the accident the investigators report that there was no evidence to show that the pilot had received any briefing or instruction on the Kranich; neither was there evidence that he had ascertained the stalling speed or characteristics during previous flights. The investigators say that this type of glider is said to require a fairly large amount of rudder to initiate a turn, especially at low airspeed, and that experience has shown it to be possible for a pilot unaware of its handling characteristics to be misled into using opposite aileron to counteract the effects of rudder being held on whilst in a turn. This could cause the glider to spin if it should stall.

Hansa Jet Cat 2 Approval The Federal German Aviation Agency has approved the HFB 320 Hansa Jet for automatic approach and landing in Category 2 weather. The equipment was calibrated at the National Aviation Facilities Experimental Centre (NAFEC) at Atlantic City, NJ, USA.

*Board of Trade CAP 309, obtainable from HMSO, price 2s 3d.

Impossible Weather for VFR can arrive very rapidly, and pilots should always bear this in mind when about to embark on a flight even when it is over a short distance along a route that may have been flown only a few minutes earlier. A recent Board of Trade Accident Report* describes how a sudden snowstorm during a flight in gathering darkness put a pilot into circumstances beyond his experience. The aircraft (a Cessna 210D) took off at night from Cranfield to go 16 miles to the owner's own landing strip at Harrowden. Shortly after leaving Cranfield it encountered heavy snow, and the pilot was killed in a high-speed crash into a field.

The report concludes that, while turning at a low height in poor visibility, the pilot allowed the aircraft to descend and strike the ground. Records showed that he had completed 10hr 50min of simulated instrument flying in a Link trainer, and that of some 625 hours' flying experience 9hr 40min had been at night, including 2hr 40min of night-time dual. The pilot also held a twin rating, but no instrument or night rating—in fact, he had been visiting Cranfield for the purpose of discussing with the chief flying instructor the requirements for a night rating.

If You Fly near Military Airfields then the Board of Trade United Kingdom Notam No 713/1968 is required reading. This pamphlet describes in detail the procedures and information for civil aircraft flights into the Military Aerodrome Traffic Zones (MATZ) which have been established around 25 airfields participating in the trial scheme.

*Board of Trade Report CAP 308, obtainable from HMSO, price 2s 3d.

DIARY

Nov 7 Institute of Transport (West Middlesex Group): "Producing and Selling the RB.211," by K. J. Bhore and J. R. Wheatley; Centre Airport Hotel, Longford, Middlesex, 6.15 p.m.

Nov 12 RAeS Graduates' and Students' Section: "The Jaguar," by I. R. Yates; 4 Hamilton Place, London W1, 7.30 p.m.

Nov 12 RAeS Dublin Branch: "Tomorrow's Aircraft Today—An Airline View of the 747," by A. J. Walls; Lecture Theatre, Shell-BP House, Fleet Street, Dublin 2, 8 p.m.

Nov 12 RAeS Boscombe Down Branch: "Colour and its Effects," by F. J. Heath; Lecture Hall, Boscombe Down, 5.30 p.m.

Nov 13 RAeS Brough Branch: Fifteenth Cayley Memorial Lecture: (main Society lecture) "Air Reconnaissance," by Air Cdre E. D. Crew; Kingston Room, Royal Station Hotel, Hull, 7 p.m.

Nov 13 RAeS Rotorcraft Section: Half-day symposium: "Some Technical Aspects of the Boeing Helicopter," by E. Hooper; "International Co-operation on Aircraft Airworthiness Requirements," by M. Joffre; 4 Hamilton Place, London W1, 2.15 p.m.

Nov 13 Institution of Electronic and Radio Engineers: a.g.m., followed by address on "Electronics in the Nation's Economy," by Ieuan Maddock; London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London WC1, 6 p.m.

Nov 13 RAeS Chester Branch: "Rebuilding and Flying Historic Aeroplanes," by Air Cdre A. H. Wheeler; Lecture Theatre, Grosvenor Museum, 7.30 p.m.

Nov 13 RAeS Hatfield Branch: "Bird Flight," by J. T. Nayler; HSA Senior Staff Restaurant, 5.30 p.m.

Nov 13 RAeS Southampton Branch: "The Jetstream," by C. F. Joy; Lancaster Lecture Theatre, Southampton University, 8 p.m.

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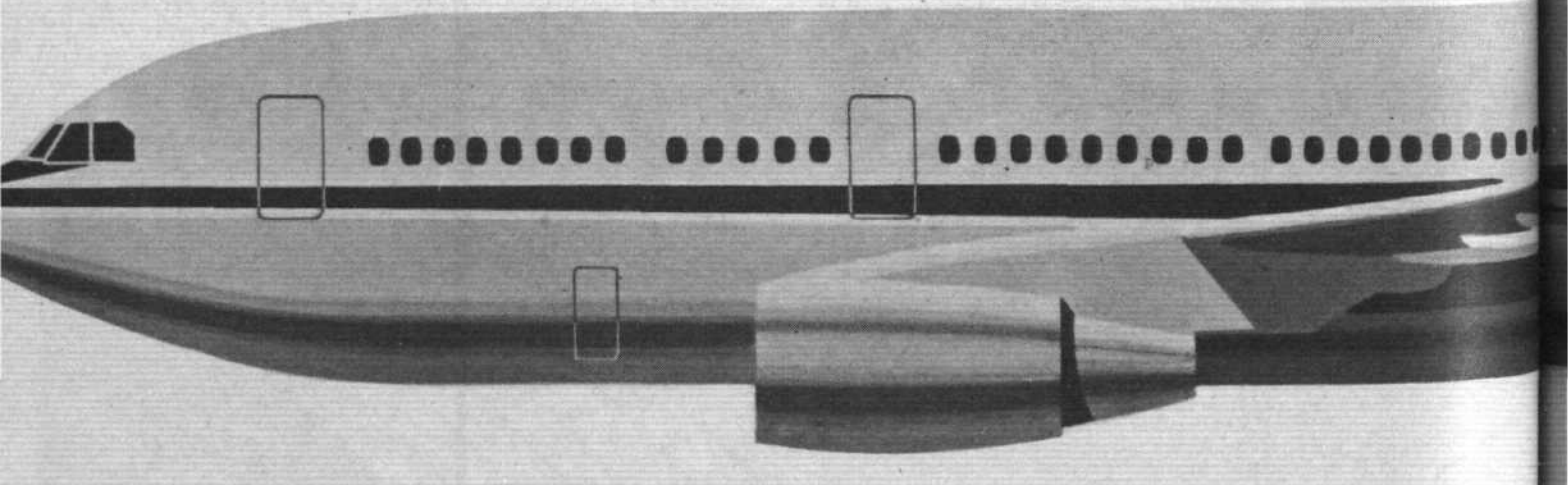
and it will give you sub

ıole new generation of jumbo sized aircraft is
; bred across the Atlantic. These answer the
lem of coping with passenger traffic that will
doubled by 1973. These jumbos are long range
aft, built for the trans-Atlantic and trans-
nental routes.
e European Airbus, however, is being built solely for short/medium haul operations, and as such it is the only one.

In service by 1973, it will be the only answer to the traffic problem on the world's high density short/medium haul routes.

Partly because of its size, but mainly because it was designed to be at its most efficient on really



A.300-economy

um haul 250/300 seate
antially higher profits

short stages, the A-300 Airbus will bring dramatic improvements in profitability. It is an aircraft that is capable of revolutionising the whole profit structure of short/medium haul operations.

Airbus International
37, Boulevard de Montmorency, Paris 16e, France.
Sud Aviation : Hawker Siddeley Aviation : Deutsche Airbus

comfort-quietness

ONE-ELEVEN 500 INTO SERVICE . . .

internal services radiating from Berlin to cities in West Germany. Although German internal traffic has doubled in the two years since Pan American introduced the 727, and BEA's share of the total has dropped from around 40 per cent to less than 30 per cent, Mr Pat Gillibrand (BEA's Berlin-based energetic general manager in Germany) is confident that the Super One-Eleven will enable BEA quickly to recoup its former position and to achieve expanding profitability. Specifically matched to the short-haul task in Germany, where all routes are less than 400 miles and the maximum permitted ceiling in the air corridors over East Germany to Berlin is only 10,000ft, BEA's Super One-Elevens are expected to be considerably more economic to operate than bigger medium-range jets.

BEA has been operating in West Germany continuously since the formation of the airline in September 1946 when it began to serve the Hamburg-Berlin route under the terms of the Anglo-US-French agreement at the end of the Second World War. During the Berlin blockade of 1948-49, BEA was also the appointed managing agent for the British Government and was responsible to the RAF for the direction and operation of the 25 British charter companies taking part in "Operation Plainfare."

Today BEA's German route network creates over 20 per cent of the airline's total revenue. The intensity of the operation can be gauged by the constantly busy apron at Berlin Tempelhof, where there are at present around 90 Viscount movements daily. By next spring these will all be Super One-Eleven jet movements. As Super One-Eleven deliveries and crew conversion build-up, the Viscounts and stop-gap Comets (introduced on August 1 this year to cope with the increased summer traffic) will be progressively withdrawn until full integration of the Super One-Eleven is achieved with about a dozen aircraft in April 1969.

BEA is basing the Super One-Eleven fleet at Manchester (where maintenance will be undertaken) and the type will operate from there on services through London to Munich and Berlin. From Berlin the aircraft will radiate to Bremen, Cologne/Bonn, Düsseldorf, Frankfurt, Hamburg, Hanover and Munich. As recently announced (*Flight*, October 3) BEA and Air France ratified an agreement on September 24 to pool their services on the German domestic routes from April 1 next year. The former Air France services on the Berlin-Frankfurt and Berlin-Munich routes will be operated by BEA Super One-Elevens in BEA-AF markings and with mixed cabin crews.

From next summer BEA intends to introduce the Super One-Elevens onto the Manchester-Glasgow route and on Irish Sea routes linking London, Manchester and Birmingham with Dublin. Super One-Elevens will also operate internationally from Manchester to Paris (via Birmingham), Brussels, Copenhagen and Zürich.

ARTHUR NORMAN

DEVELOPMENT

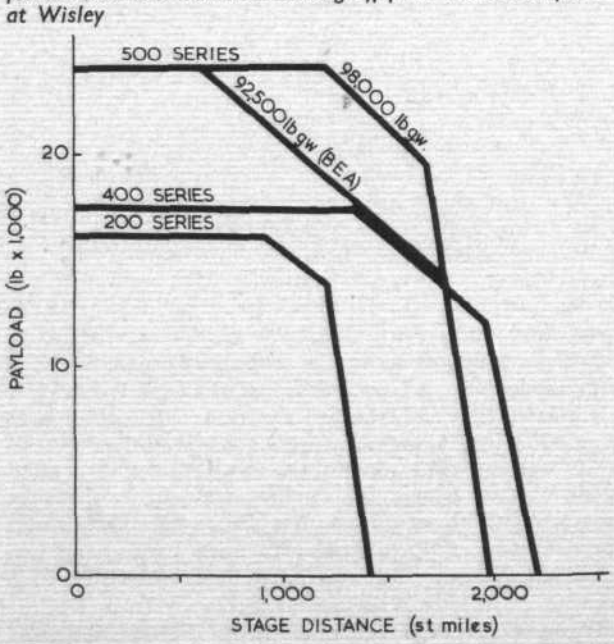
SUCCESSFUL COMMERCIAL AIRLINERS have invariably evolved from early conception as a well-matched engine-airframe combination with both developing together in a logical family relationship to suit developing markets. BEA's new Super One-Eleven is a classic example of this axiom. Moreover, it is the consolidation of the 22-year fund of design and operational experience now accumulated by the partnership between British Aircraft Corporation and British European Airways, which has now evolved four generations of short/medium range airliners since the formation of the airline in 1946.

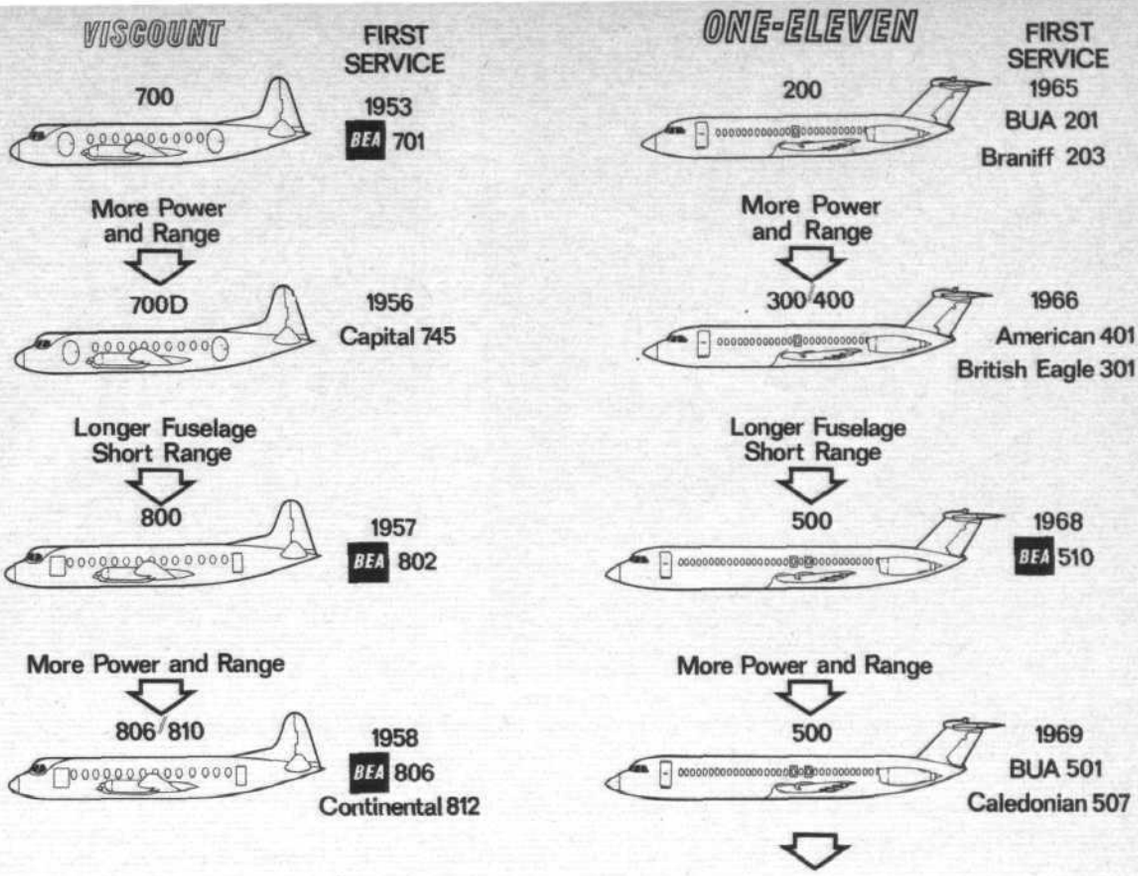
BEA's first scheduled flight on September 1, 1946, was made with the Weybridge-built Viking, which formed the backbone of the airlines operation in its formative years. In 1953 BEA introduced the Vickers Viscount which established the "turbine age" of air transport throughout the world and set new standards of passenger comfort and technical performance for commercial air transport as a whole. Two years later this basic Viscount 700 was given a more powerful version of the Rolls-Royce Dart and was designated the Viscount 700D. In 1956 the Vickers/BEA partnership evolved the enlarged Viscount 802 which in turn led to the more powerful Viscount 806 for BEA and the Viscount 810 for other operations. It is particularly interesting to see how closely the development of the One-Eleven family parallels that of the Viscount (diagram opposite).

In February 1961 BEA introduced a third new Vickers airliner, the Vanguard turboprop—the first real airbus. With a capacity for up to 137 passengers, the Vanguard was planned to be the last word in low operating cost, short-haul airliners, and still boasts the lowest unit costs of any BEA type—17.8 pence/ton-mile at 2.1 pence/seat-mile on an average stage length of 379 miles. For Vickers, the Vanguard ushered in important new technical developments which have been of lasting value to successive generations of airliners to emerge from Weybridge—notably the large-scale use of the structural machining technique, today used widely in the One-Eleven.

The BEA order for the One-Eleven 500 in January 1967 brought the total number of aircraft purchased by the airline from BAC and its predecessors over the past 22 years to 161—53 Vikings, 70 Viscounts, 20 Vanguards and now 18

BAC actually stretched the original 400-series development aircraft (G-ASYD) to make it an aerodynamic prototype for the 500. It is seen here taking off from the test airfield at Wisley





The One-Eleven family has evolved in a manner remarkably similar to that followed by the Viscount a decade before. The twin turbofan has more than 50 per cent higher capacity than the four-engined turboprop and a 200kt higher speed—yet the overall sizes remain remarkably similar (these drawings are all to the same scale)

One-Eleven 500s—with a total value, including spares, of £81 million. BEA's total investment in the One-Eleven is £32 million.

Design development As with the Viscount, the larger derivatives of the One-Eleven were studied from the outset. The catalyst for the firm definition of the stretched One-Eleven 500 came during 1966 when BEA progressively consolidated the specification for a Viscount replacement to serve the UK and German routes.

Initial studies of the developed One-Eleven for BEA began early in 1966, and in the ensuing months, as the basic One-Eleven design was refined and service experience expanded, the 500 project was substantially improved and the final specification agreed in September 1966 bore little resemblance to the original proposals. Several existing and potential One-Eleven customers at home and overseas had also shown strong interest in a larger model for some of their more dense traffic routes. Satisfying these requirements axiomatically became the twin objectives of the programme and the main design targets were bigger payloads and lowest costs over short distances.

The BAC One-Eleven 500 is the first dimensionally stretched development of the One-Eleven design. It has 25 per cent more seats and 15 per cent lower seat-mile costs. These major improvements were achieved by stretching the fuselage to take four more rows of seats and by extending the wing span and fitting the latest Rolls-Royce Spey 25 Mk 512-11s (as developed for the Hawker Siddeley Trident 2E). The bigger wing and more powerful engines largely counteracted the various effects on performance caused by an all-round increase in operating weights.

Design development has been the responsibility of Mr E. E. Marshall, technical director of BAC Weybridge Division and Mr K. Bentley, assistant technical director and One-Eleven 500 project design manager. Mr W. Chapman is the assistant production manager with special responsibility for co-ordination of 500 design liaison and production.

Because the One-Eleven 500 embodies much of the One-Eleven 400 the reliability of its tailor-made engineering and internationally accepted equipment standard has been fully demonstrated. The engineering similarity of all the One-Elevens enables an airline to have, perhaps, more than one version so as to optimise capacity for individual routes yet still preserve the benefits of common equipment, spares, maintenance and training procedures.

The normal maximum seating capacity of the BAC One-Eleven 500 has been increased from 79 to 99 seats (up to 109 seats is approved). With full galley and toilet services, the unobstructed passenger cabin is retained for complete versatility of layout. BEA's Super One-Elevens have 97 passenger seats. Underfloor hold volume is 33 per cent more (from 534 cu ft to 711 cu ft) although the total volume of BEA's aircraft is actually only 645 cu ft, because of an enlarged avionics bay to accommodate the extra equipment specified.

The larger capacity is complemented by higher permitted operating weights and so engine power was increased and aerodynamic improvements made to result in a better mission performance. The maximum take-off weight for the Super One-Eleven was originally specified at 91,000lb (4,000lb over the One-Eleven 400) with maximum landing weight and maximum zero fuel weight increases of 6,000lb and 7,000lb respectively. (The certificated weights are higher still, as described later.) The BEA Super One-Eleven now carries its full 97 passenger payload on stage distances of up to 1,150 miles.

The take-off thrust has been increased by 600lb per engine by the installation of two 12,000lb-thrust Rolls-Royce Spey-25 Mk 512-14 turbofans. The new middle-distance derivative of the One-Eleven 500 (first ordered by BUA) has a further increase in gross weight to 98,000lb and is to be powered by Spey-25 Mk 514DWs of 12,550lb thrust with water injection. A particular merit of the Spey over its immediate competitors is that a reduction of cruise altitude from 25,000ft to 5,000ft increases the specific fuel consumption by only 4.5 per cent (compared to 13.5 per cent by its competitors)—this is particularly important to BEA because the permitted ceiling in the Berlin corridors is only 10,000ft.

The enhanced performance of the 500 was obtained by increasing the wing aspect ratio from 8.0 to 8.5 (2.5ft extensions were applied to each tip) and by the more powerful engines. This aerodynamic refinement and the additional power gave a 4 per cent higher take-off weight from a given airfield and an 8½ per cent greater allowable weight during the climb-out.

Because of the exhaustive structural programmes already undertaken with two complete test airframes and numerous detail specimens together with diverse service records, the existing One-Eleven structure proved to be an excellent datum for

BAC's Hurn factory has built more turbine-engined short-haul aircraft than any other in the world. There are two lines of One-Elevens—400 series (left) and 500 series (right)

ONE-ELEVEN 500 INTO SERVICE . . .

extrapolations in size and load carrying. Structural principles have remained unchanged in the One-Eleven 500. The principal structural modifications are in the fuselage, which is 13ft 6in longer overall (100in ahead of the wing and 62in behind). The two sections were located to cause minimum effect on the main structural features; to enable the entire empennage structural and aerodynamic configuration to be retained geometrically unaltered; and to maintain the c.g. within the limits. Secondary changes included the addition of two Type III (36in × 20in) overwing emergency exit doorway (one each side of the centre fuselage). Some local strengthening was necessary —notably in the centre fuselage and wing junction to cater and in the fin and tailplane to avoid noise fatigue damage from the more powerful engines. The higher wing bending moment led to a thickening of the integral stiffeners of the machined panels of the top and bottom surfaces of the wing torsion box. The flaps are stronger too.

A further programme of drop testing on a One-Eleven 400 main undercarriage established its maximum shock absorption capabilities as a prerequisite to incorporating improvements to meet 500 requirements, the nose gear being unchanged from the 400. Improved mainwheel brakes are fitted.

Systems are basically the same as in the 400. Minor changes were made to the air-conditioning to increase the airflow; these comprised the fitting of increased capacity heat exchangers and cold air units, resetting the flow control units and detailed modifications to a number of valves. For the same reason a higher capacity version of the same APU has been installed.

Flight Development On February 4, 1967, eight days after contract signature, BACs own One-Eleven 400 development/demonstration aircraft G-ASYD was returned to the Hurn factory for conversion to One-Eleven 500 external shape (having already logged 770 flying hours in 476 flights). By April 28, the revised airframe was structurally complete. Adaption of the systems followed, together with the installation of flight test instrumentation. Engine runs were completed on June 22 and systems cross-function checks on June 28.

Flight development of the One-Eleven 500 began on June 30, 1967—six weeks ahead of programme—with the first flight of G-ASYD in its new guise as the 500 aerodynamic prototype —the programmed first flight target date was beaten by 42 days. Mr Roy Radford, BAC Weybridge assistant chief test pilot, was on this maiden flight and he has been responsible for the entire One-Eleven 500 flight development programme.

Comprehensively instrumented to record 800 parameters simultaneously and continuously throughout flight, the test gear installation for 'YD included automatic cameras, 50-channel trace recorders and three magnetic tape recorders, each with 13 channels, weighing in all about 1,200lb.

From July 3 the aircraft was transferred to BAC's civil flight test centre at Wisley. Continuing initially with its original Spey-25 Mk 511 engines, 'YD was fitted with the more powerful Mk 512 engines five months later, and was used for the bulk of the certification handling and performance schedules, flight flutter testing and initial autopilot development. Based at Wisley, the aircraft has also spent several periods at Torrejon near Madrid to carry out certification performance work.

On February 7 this year the first production One-Eleven—BEA Super One-Eleven G-AVMH—joined the flight development programme at Wisley, ten weeks ahead of schedule, and similarly instrumented to G-ASYD. Initially used for confirmatory checks of the "design envelope" points established by 'YD, this first representative production aircraft was also used to confirm the strength and performance at the specification maximum design weights which had not been fully possible on the prototype.

Since then this aircraft has been used as the basic development vehicle for the special features for BEA, and for the past four months 'MH has been principally engaged on automatic approach and landing system development using Bedford, Gatwick and Liverpool to obtain ILS facilities of the necessary standard. This latter task has principally involved the development of the autopilot system from Category 1 certification obtained in August to Category 2 capability requested by BEA. Flight development is scheduled for completion by the end of the year. With the same basic Elliott-Automation autopilot as the Super VC10, there has been positive read across from this earlier and most successful operational automatic landing programme—notably that of the bank stabilisation of localiser performance, an airspeed crossfeed facility linking airspeed with elevator control, and phase advance stabilisation of glide-slope performance.

On July 8 this year, the date fixed twelve months before, Super One-Eleven G-AVMI was handed over to BEA for crew training. "Base training" has been operated from Wisley, the aircraft visiting Hurn and Tees-side for circuit pattern and night flying training. For "route training" the aircraft has been stationed at Manchester.

BEAs Super One-Eleven pilot management team—Capt Jimmy Munro, Flight Manager; Capt Eddie Smith, Assistant Flight Manager; and Capt Peter McKeown, Chief Training

Captain—has been intimately involved with BAC in all phases of the Super One-Eleven flight test programme. Capt Munro was aboard on the maiden flight of G-AVMH. Mr Peter Marsh has been the BAC pilot in charge of conversion training.

The tremendous air-mindedness of the German people, stemming from the distance between the major cities of the nation, was strongly emphasised at the time of the first public appearance of the Super One-Eleven in Germany—on July 13-14 at the Berlin Tempelhof open weekend. Over 7,000 Berliners walked through 'M1 shown jointly by BAC and BEA.

On August 15 the BAC One-Eleven 500 was awarded a full and unrestricted passenger transport category ARB Certificate of Airworthiness. This was the culmination of an intensive programme of nearly 800 flying hours of home and overseas flight testing and route proving. At that time G-ASYD had logged 387 flying hours in 308 flights in the 500 development programme. The total certification task was complemented by the first three BEA production One-Elevens: G-AVMH, 'MI and 'MJ which together logged 394 flying hours.

The only problem of any significance encountered during the entire programme was a slight overpowering of the rudder in one of the extreme sideslip design cases. This was corrected by modifying the control feel law. In consequence the 500 needs slightly more rudder in the turn than the 400. By contrast, control in the pitching plane has exhibited a slightly better landing flare.

BAC ONE-ELEVEN WORLDWIDE SALES

Operator	*Ordered*	*Delivered*	*In-service date*
Aer Lingus	4	4	June 3, 1965
Aloha	3	3	April 29, 1966
American Airlines	30	30	March 6, 1966
Austral	4	2	November, 1967
Autair International	10	3	March 1968
Bahamas Airways	2	0	
Bavaria Fluggesellschaft	2	2	January 1968
BEA	18	4	November 1, 1968
Braniff	14	14	April 25, 1965
Brazilian Air Force	2	1	
British Eagle	5	5	May 9, 1966
BUA	15	10	April 9, 1965
Caledonian Airways	3	0	Spring 1969
Channel Airways	6	2	June 1967
Engelhard Industries	1	1	September 1967
Helmut Horten	1	1	January 1966
LACSA	1	1	May 1967
Laker Airways	4	4	February 1967
Lanica	1	1	April 1967
Mohawk	17	15	July 15, 1965
Paneuropa	1	0	
Philippine Air Lines	4	3	May 1, 1966
RAAF	2	2	January 1968
TACA	2	2	December 28, 1966
Tarom	6	1	June 16, 1968
Tenneco	2	1	April 1966
VASP	2	2	January 1968
Victor Comptometer	1	1	September 1966
Zambia Airways	2	2	January 1968
	168	117	

The third production BEA Super One-Eleven G-AVMJ, first flown on May 15, was kept at Hurn as the airlines definitive acceptance aircraft and BEA took delivery of this, the first of its fleet, at Hurn on August 29—more than a month ahead of the contract delivery date.

The Super One-Eleven had been demonstrated to have met or exceeded handsomely the entire range of its contractual performance, weight and operating route mission guarantees. In particular the take-off distance is up to 8.3 per cent better and landing distance 6.7 per cent better. Cruise speed is 24kt faster, while payloads achieved to meet specified mission guarantees are up to 3,800lb better than promised.

In addition to exceeding its guarantees, the Super One-Eleven was certificated at higher than specification design weights as follows:—

	Specification	Certification	Increase
Maximum Take-off Weight	91,000lb	*41,950kg (92,483lb)	1,483lb
Maximum Landing Weight	84,000lb	*39,000kg (85,980lb)	1,980lb

*At BEA's request these weights certified in kilogrammes.

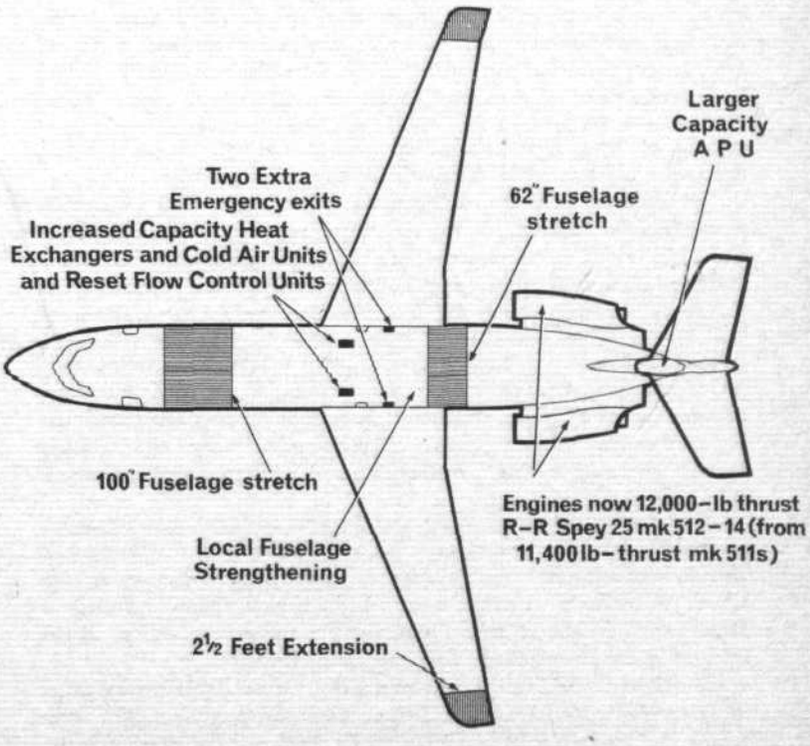
Consistently ahead of programme ever since the programme got under way in the early months of last year, this new bonus of achieved performance has provided an excellent start for the One-Eleven 500 airline programme overall.

BEA carried its first fare-paying passengers by Super One-Eleven in Germany (with G-AVMJ), on Sunday, September 1—over two months early—on the Berlin-Hamburg and Berlin-Bremen routes. Full scheduled Super One-Eleven services begin in Germany on November 17. BEA and BAC held the fleet-naming ceremony on September 18 at Farnborough while G-AVML took part in the flying demonstration during the week. Sir George Edwards, chairman of BAC, formally handed over G-AVMK, the fourth production aircraft, to Sir Anthony Milward, BEA's chairman, Lady Freda Milward conferred the fleet name "Super One-Eleven," which had been chosen by a BEA and BAC staff competition as the airline's marketing name for its version of the new aircraft.

Further Development The next major step in the development of the One-Eleven family has already been taken and BAC is now offering the One-Eleven 500 with a greater payload-range for the expanding inclusive tour market. It is significant that the newer and rapidly increasing list of inclusive tour holiday resorts on the Mediterranean, the Black Sea and North Africa lie within a 1,000- to 1,500-mile radius of the northern European traffic centres in the UK, Germany and Scandinavia. This heavier weight 500 will also carry up to 109 passengers and be capable of non-stop journeys of up to 1,570 miles with a flight time of about 3½ hours. Maximum take-off weight has been increased to 98,000lb (5,500lb more than the specialised shorter-range 500). This has enabled the range with maximum payload to be increased by 57 per cent; a typical payload of 99 passengers and baggage, plus full freight, can be carried up to 1,570 miles (with full airline reserves) compared with 1,000 miles of the BEA One-Eleven 500. The powerplant is the Rolls-Royce Spey 25 Mk 512-14DW (Developed Wet) engine with water injection and maximum take-off thrust up from 12,000lb to 12,550lb at sea level and which can be maintained at ambient temperatures of up to 25°C. The first pair of these engines were fitted to G-ASYD in July and high temperature performance with water injection was measured at Madrid in mid-August in order to obtain clearance for operation in ambient temperatures of up to ISA +35°C.

Overall this new development of the One-Eleven 500 is fully competitive with all the opposition in terms of prime cost, aircraft-mile and seat-mile operating costs. Progressive

Major engineering differences that distinguish the 500 from the 400 are annotated in this drawing



development continues and further aerodynamic improvements are now being evaluated on 'YD for possible incorporation on later One-Elevens.

Programme Management Although the Super One-Eleven is a comparatively simple development of the Series 400, computer-based management techniques played an important part in keeping the 18-month design-development-delivery programme on schedule—delivery was actually one month ahead of contract, and revenue flights were begun within two days of delivery.

The flight development programme was expedited by the use of the most modern computer-compatible airborne data recording systems, used in conjunction with big third-generation computers in the design organisation at Weybridge. Data reduction during performance testing programmes at Madrid was made on the spot, using an Elliott-Automation 903 desk-size transportable computer to ensure the minimum number of flights. Concurrently, production has been streamlined through the extensive use of computer-based management techniques. The progressive integration of these techniques continues.

BAC's Hurn plant—a factory of the Weybridge Division—which earlier handled the bulk of Viscount production is Europe's most productive commercial aircraft assembly centre. This plant has built and delivered more short-haul turbine airliners than any other factory in the world. Every One-Eleven rolled off the twin final assembly lines at Hurn for the last two years has been delivered on or ahead of contract. The Hurn One-Eleven programme continues to benefit progressively from the more recently introduced management techniques complemented by computerised stock control.

Advanced computer-based management techniques are already in widespread use, from the initiation of new design development through to the automatic stock control and reorder processes of production. Sophisticated production control methods for in-house, subcontractor and vendor manufactured components are strictly applied for on-time delivery.

ARTHUR NORMAN

BESPOKE FOR BEA

AS ONE OF THE WORLD'S great initiating airlines, BEA has invariably been in the not always enviable position of having its aircraft exclusively tailored to its own operational requirements. With the Super One-Eleven it is getting the best of both worlds. Although BEA has played a key role in the conception of the One-Eleven 500, it has not, for once, had to worry too much about pioneering. Although BEA is the first operator of the One-Eleven 500, it is the 25th operator in the One-Eleven family and so enjoys the consolidation of the immense benefits of the diverse and rapidly expanding fund of service experience built up throughout the world over the past 3½ years.

BEA's basic layout is for 97 seats at 33/34in pitch all-tourist (compared to 99 seats in the standard One-Eleven 500). There are two toilets at the rear, galley and bar units forward and an extra bar unit at the rear (in place of two seats). All passengers are seated ahead of the engines in nineteen rows of five-abreast plus two extra seats at the rear opposite the bar unit. Two lavatories are at each end of the cabin as are the two entrances.

The visual impression of the Super One-Eleven cabin is completely new and exclusive. With bold colours on the seats in harmony with the softer tones of the fixed furnishings, the decor contrasts with that of previous European airliners and provides a vital new tool in BEA's selling armoury. It has been designed by Charles Butler Associates of New York, who have worked with BAC on the interior design and styling of four generations of turbine airliners over the past decade—and are now doing a similar job on Concorde.

The interior colour scheme of the Super One-Eleven is composed of various shades of turquoise, light blue and white with a strong combination of red and gold on the seats. Butler has given the various elements of the decor some particularly descriptive names. Flooded with an abundance of natural light, the overall result is a bright, attractive and inviting cabin that is exclusive and quite different from anything BEA has had before. Other detail changes in the passenger cabin for BEA fleet compatability are a revised passenger oxygen system and emergency equipment, a water chlorination system, vacuum cleaner outlets and a Philips portable taped-music player.

The two-pilot flight deck of the Super One-Eleven is basically unchanged from the existing layout. However, a number of British instruments and equipment have been fitted to enable BEA to achieve compatability with the Trident—notably a Smiths SF5 Flight Director and Type 5 compass director, flight and airframe instruments, and the fuel gauging.

Having fully proved the value of the Decca display navigator in over two million flying hours experience since 1952 with the Viscount, Comet and Trident, BEA has included the latest Decca Omnitrac display comprising a Mk 16 receiver, Omnitrac digital computer and flight log. This equipment is particularly valuable for the extremely precise flying necessary in the 20-mile wide Berlin air corridors. All BEA Super One-Eleven flying will be within Decca coverage.

BEA's Super One-Elevens have an all-tourist-class interior layout with 97 seats. The interior is more colourful than on any previous BEA aeroplane

A programme leading to low-weather minima operation and fully automatic landing is also well under way. On the central pedestal of the cockpit are the controls for the Elliott-Automation 2200 monitored autopilot and the automatic landing system. These include auto-throttles and a flare computer which, together with the monitored radio altimeter, will permit automatic landings in Category 2 weather minima conditions (100ft 1,200ft RVR or ¼-mile). Detail changes in the avionics, electrical, instrument and warning systems have been made to conform with the flight deck changes, the Decca and Category 2 installations, and the British equipment items substituted to achieve fleet compatability. A Plessy-Davall flight data recorder is fitted in the rear fuselage.

In BEA, development engineering of the Super One-Eleven has been the responsibility of Mr Bob Morgan, (chief project and development engineer) and his team, with Mr W. E. Coe, Super One-Eleven type engineer resident at Weybridge. As so often in the past, numerous other detail improvements suggested by BEA have also been incorporated in the continuing development of the One-Eleven 500.

Boeing's new Chinook CH-47C is backed by more than 325,000 hours of flight experience.

The CH-47A and B models have proved that the Chinook is tough, reliable and productive.

Now the C has added power to give it a lift capacity of 10,886 kg, a flight radius of 315 km, and a maximum speed of 304 kph.

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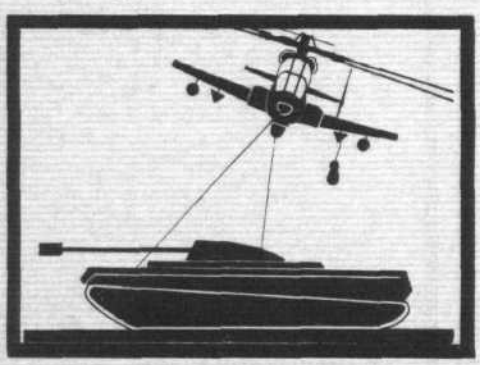
BOEING HELICOPTERS

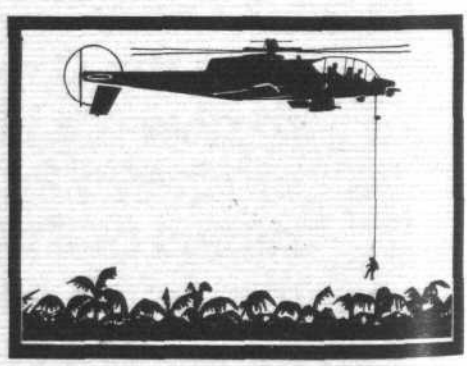
Call it a flying machine...or basic air vehicle...or winged helicopter. But think of it as a *versatile foundation*—this AH-56A. That's what it is: a base for configuration changes that make it the "best buy" for six major types of military missions.



In one form, AH-56A will be the world's most advanced gunship helicopter. Packing deadly armament, it will escort troop-carrying helicopters and soften landing sites. Weapons: machine guns, grenade launchers, rockets or antitank missiles. Speed: above 250 mph.

With equipment changes, AH-56A will excel at reconnaissance and surveillance. For these jobs, the craft's speed and agility are enhanced by its unique navigation system, 26,000-foot service ceiling, and long range relative to load. (This new-generation vehicle has a self-deploying ferry range of 2,510 miles.)

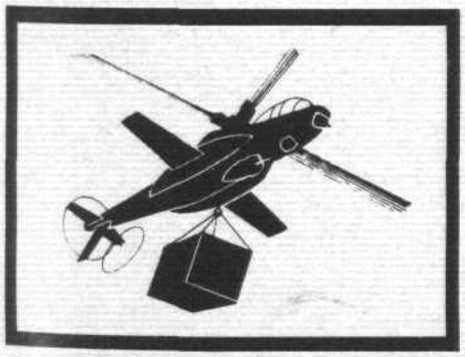
Certain airframe changes can turn the basic AH-56A into an excellent craft for search and rescue work. Extremely stable and maneuverable because of



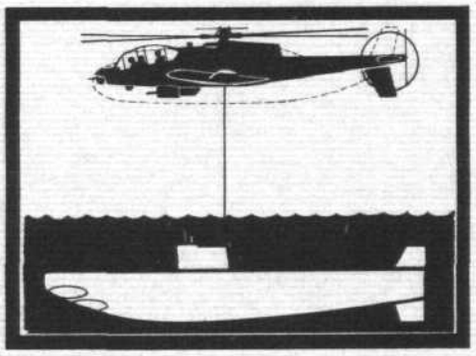
the Lockheed Rigid Rotor design, it can decelerate from 200 knots to a hover in 17 seconds, then accelerate rapidly after making a pickup.

The new 6-in-1 flying machine

Another mission capability is supply-and-retrieval. Here its VTOL (shown) and V/STOL performance become

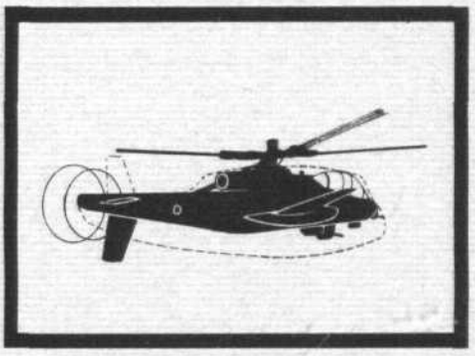


vital, for the AH-56A can take aloft 14,000 pounds of payload after a short, rolling takeoff (about 900 feet).



With other alterations to airframe and power plant, the AH-56A can be turned into an ASW hunter-killer configuration capable of high speed and extended endurance.

Finally, the vehicle's dynamics system will support an adapted airframe that can carry 30 passengers, thereby adding new speed and versatility to transport operations.



What is the AH-56A? A very employable flying machine, built by Lockheed-California Company to be adaptable for many missions. It's a new breed of winged helicopter that will never run out of jobs.

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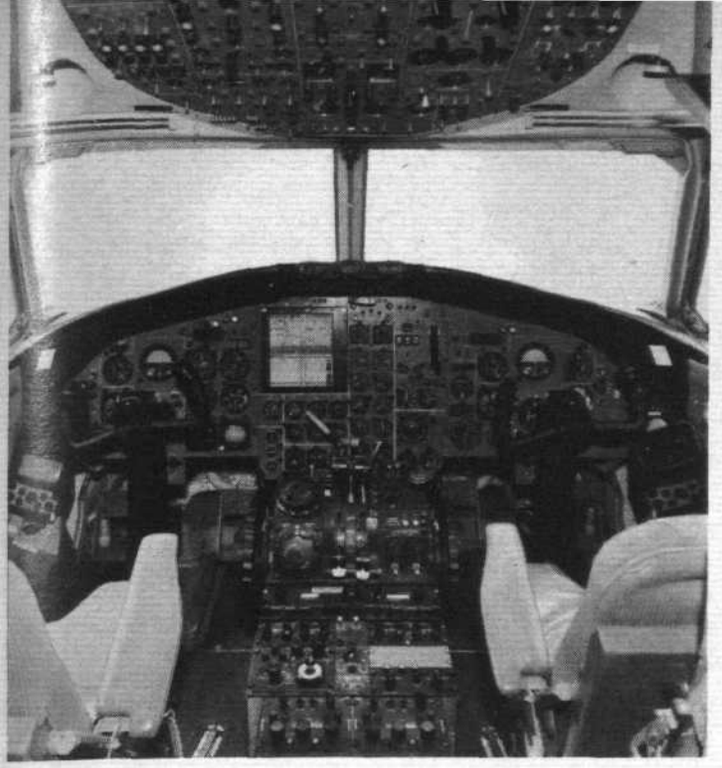


Prominent on the panel of the two-man flight deck of the Super One-Eleven is the Decca pictorial map display, which works off an Omnitrac Mk 16 computer

ONE-ELEVEN 500 INTO SERVICE . . .

Flying the One-Eleven 500

By CAPT R. E. GILLMAN*

INEVITABLY THERE IS A TEMPTATION to compare the One-Eleven with the ubiquitous Viscount. There we had a small short-haul airliner which proved spectacularly successful in the international market. Here we again have a small short-hauler from the same stable, very handy to fly and offering economic attractions that have already produced an impressive order list.

That everything about the One-Eleven 500 is businesslike is confirmed as soon as one arrives on the flight deck, for it is immediately obvious that a great deal of thought has gone into the layout of the controls, indicators and switches, bearing in mind that it is already a two-pilot aeroplane.

Something of the order of 9,000 r.p.m. are requried to get the machine rolling, and it then becomes apparent that the undercarriage is somewhat firm. The nosewheel steering is positive in its control, which is supplemented by a limited amount of direct steering control from the rudder. On long taxi tracks with slight bends, and during the take-off roll, one tends to use the rudder steering alone. Here it is an advantage, as directional control can be achieved precisely with the feet, leaving the hands free for the control column.

Two take-off flap settings are used by BEA, according to the runway concerned. Where the take-off distance is the more limiting factor, then 18° of flap is used; but when the net flight path is critical, and the take-off distance permits, then 8° of flap with its longer ground roll and better gradient of climb is set up.

For simplicity's sake, a standard tailplane setting of 3° nose-up is employed regardless of aircraft loading, and this requires the pilot to bear in mind that a lightly loaded aeroplane, being more tail-heavy, will rotate that much more easily. In fact, the control column loads at unstick are never high, and at 74,000lb gross weight an unstick distance of 3,000ft is ample.

Depending on c.g. position, as one comes out of ground-effect after lift-off a slight trim-change may occur, and this must be countered to achieve V_2; thereafter one continues rotation to hit V_2 plus 30kt for the noise-abatement climb. However, if a pitch attitude of 20° is arrived at first, as may happen in a lightly loaded aircraft, then this is held—for under those conditions the noise limitations will not be exceeded.

At the noise-abatement cut-back point the flaps are raised to 8° (if they are not already there) and the power reduced to the pre-determined thrust index; very little out-of-trim condition results. At 3,000ft climb power is restored and, as the speed increases, flap is fully retracted and an acceleration to the 300kt climbing speed is undertaken.

During a climb out of Wisley at 12,000 r.p.m. and a t.g.t. of 505°C, the v.s.i. registered 2,000ft/min initially. By 20,000ft this was down to 1,200ft/min and at 30,000ft it had dropped to 600ft/min at a fuel flow of 3,200kg/hr. Levelling-off at this height and reducing the power to 11,000 r.p.m., the speed settled at 265kt IAS and the fuel flow was 2,000kg/hr.

Rudder loads at this speed are very high, and in pitch it is expedient to use the elevator first and trim out residual loads with the powerful adjustable tailplane. In this axis the aircraft is extremely stable.

The ailerons are manually operated, and after about a quarter of their travel are assisted by differential spoiler action, resulting in an impressive rate of roll. However, having flown both the 300 series and the 400 series, I got the impression that directional stability had not been improved by the stretch to the 500 series.

By increasing the power to 11,700 r.p.m. the speed rose to 295kt indicated, with an appropriate 0.77 Mach, which is the M_{MO} indicated (Mach 0.78 true). At this power the fuel flow was 2,600kg/hr.

At the higher Mach numbers a nose-down trim asserts itself; an automatic Mach trimmer takes care of this, a caution light flashing during its operation. At Mach 0.79 or 345kt, a high-speed warning is given in the form of an intermittently ringing bell. Extension of the air brakes at this speed gives a slight nose-up couple and some buffet. When the throttles are closed for the descent there is an adequate supply of pressurising air provided that the anti-icers are not in use, and at Mach 0.73 the rate of descent is around 2,000ft/min.

Levelling off at 17,000ft, the aircraft was slowed down for the stalling tests. There is no pitching moment on initial extension of the Fowler flaps, but as they turn down past the 3° point a progressive nose-up couple develops. By 18°, and with the falling speed, this changes into a slight nose-down couple which persists with further flap lowering; but the total effect right up to the 45° landing flap setting is not severe. Extension of the undercarriage does not influence the trim at all; once the doors are closed the loss in speed is only 5kt. In the flaps and gear-down condition the elevator is light and crisp, giving the sort of pitch control which makes it easy to reduce the speed by the classic 1kt/sec.

The weight was now down to 32,000kg (75,000lb), and at 113kt static interference from the igniters could be heard in the earphones. Actuated by the deformation of the airflow around the intakes at high angles of attack, sensory vanes initiate the switching on of the relight igniters purely as a precautionary measure, and the static interference which they produce gives the first warning of the approach to the stall. Five knots later the stick shakers produced a high-frequency vibration of the control columns. Just before the stall some buffet became apparent and the port wing started to drop, but it was held by the ailerons without difficulty. At 100kt the warning horns sounded and the stick push occurred.

The initial force was around 100lb until the column passed the neutral position, whereupon it fell away quickly to some 20lb before tailing off. The pusher action had caused the nose to pitch down sharply to just below the horizon, and it was

*Senior training captain, Trident Flight, BEA.

Super One-Eleven attitude after lift off is normally limited to less than 20° for passenger comfort, though the aircraft climbs well at even lower speeds a nearly flat attitude is adopted prior to the landing flare

necessary to follow through manually in order to achieve the 20° nose-down attitude desirable for rapid recovery. The subsequent pull-out had to be made with care to avoid beating the phase-advance system and suffering a further push. BAC claim that it is impossible for the One-Eleven 500 to get into a super stall when it is trimmed within the normal c.g. range.

Back in the circuit at 1,000ft, light turbulence was ridden very well provided one was careful in the use of the ailerons, to avoid breaking out the spoilers. Rash use of aileron led to over-controlling; it was found easier not to use the rudder, but to accept the slight amount of sideslip associated with turns made on aileron alone. Pursuing this further, I found that when carrying out a very high rate of roll at 135kt the induced slip resulted in a strange and sudden resistance as the ailerons passed through their neutral position; when this was passed, the aileron loads fell off again, and the final timing through a roll of 60° was in the order of 5sec. By using rudder assistance this can be reduced still further; and, by the eradication of the slip, the aileron impediment disappears.

On the landing approach at 122kt (V_{AT}+10kt) at the now reduced weight of 30,000kg (66,000lb) the excellent pitching stability made accurate speed-holding easy, and the centre line was maintained with the judicious use of aileron.

Landings are best made with power—prolonged hold-offs do not give the best results. As the throttles are closed, with the stick eased back to maintain about 2° nose-up pitch, she settles nicely. However, if the rotation is overdone, the situation can often be corrected by allowing the control column to come forward gently, thus lifting the mainwheels and cushioning the contact. Using normal reverse thrust, lift dumpers and the Hytrol brakes, the landing run is impressively short.

Not unnaturally, where a twin-engined aeroplane is concerned, pilots are interested in the engine-out performance and the loss of ancilliary services. With an engine failure at V_1 the rudder displacement required to keep straight is surprisingly large on an aircraft with turbofan engines tucked into the side of the fuselage; but the foot loads themselves are moderate and easily held without trimming. It is important not to allow large angles of sideslip to develop if the best gradients of climb are to be achieved; and, on this aeroplane in particular, the turn-and-slip instrument needs to be watched carefully at this stage.

If one snatches at the control column in turbulent conditions it is possible to bring on the stick shakers at V_2—particularly if they are set a little high.

So far as the ancilliary services are concerned, the powered controls are, of course, of major concern. Should a total hydraulic failure occur, manual reversion is possible. In this mode the elevator has no self-centring capability and there is some backlash either side of the neutral point; thus it is easy to over-control in pitch. However, an electrically operated trim tab eases the task considerably.

For the landing it is better to revert to the emergency elevator control, which has no "q" feel but a fixed feel set for 180kt. As one slows for the approach, a marked nosed-own pitching develops and has to be held manually as there is no tailplane trimming to assist. The out-of-trim force can become very high under certain load conditions, but the more positive control in this mode is to be preferred to full manual reversion. The emergency elevator is powered by a completely separate hyraulic system with its own reservoir.

I enjoyed flying this aeroplane; it is compact, handy and without vices. I would think that its operating economics will endear it to managements too.

EN ROUTE WITH BEA

By NEIL HARRISON

THE CITY CENTRE location of Berlin's Templehof airport, and the 10,000ft maximum ceiling limits on the 200-mile long corridors from West Germany, impose some of the most difficult operating circumstances in the world for short-haul jets. Pan American has flown Boeing 727s on the routes into the city for several years, and BEA has recently used Comets, but according to estimates the new Super One-Eleven should just about pull off the best economic deal possible within the current state of the aeronautical art.

As with the other jets, the maximum take-off weight of the One-Eleven is limited by the length of the Templehof runways (the longest is only 5,266ft) and by the conjested surroundings (final approach on the one instrument runway is between towering blocks of flats). Nevertheless, it is expected that the BAC twin jet will carry a full load of passengers on all the routes to West German cities even when summer temperatures rise to over 90°F—as they frequently do during a Berlin summer. The significant limitation in the capability of the aircraft so far as BEA is concerned is on longer routes from Berlin—such as to London where only about 70 passengers and baggage can be carried because of the take-off weight restriction. But this is still well in excess of the break-even load factor. In the air-transport conscious city of Berlin there are no noise abatement restrictions, but BEA has voluntarily introduced a minimum-noise climb technique to be used after all take-offs.

For an on-the-spot appreciation of the operation I recently had the privilege of riding on several of the *ad hoc* commercial services within Germany. Capt Jimmy Monro, the Super One-Eleven flight manager, was on the flight deck with Capt Philip Priest in command. The first sector was from Berlin to Düsseldorf, and we had about a 50 per cent load factor. Because of the short-coupled rear-engined layout of the aircraft, and the predominantly aft c.g. position (especially with a light payload and a fair amount of fuel), the cabin staff are instructed to ensure an even seating distribution—with a preference to have people well forward (that is the quietest part of the cabin anyway). The bright decor gives a pleasantly light effect to the cabin; the tube effect is not obtrusive because there is plenty of upper-level roominess about the cabin. The

seats are comfortable, but firm, and there is ample leg room. At the front of the cabin the starting of the engines was completely inaudible; and there were no disconcerting changes in the air conditioning flow nor any flickering of the lights—thanks to the APU. The ride during taxying is comfortable—but with some bounce up front due to the relatively long distance from the mainwheels. Pilots also must be exceedingly gentle with the nosewheel steering for the same reason—it is easy to throw a dainty hostess off her feet if she happens to be standing in the front vestibule.

Speeds for take-off at the gross weight of 35,514kg (78,000lb) with 8° flap were: V_1, 128kt; V_r, 131kt; V_2, 139kt; and the best gradient, 169kt (both engines) and 202kt (one engine out). The noise abatement technique for all flights is to climb at V_2+30kt and then at a given time after brakes off to cut the power to a predetermined percentage and retract the flaps from 18° to 8° if the higher setting was used. The climb is thus continued to 3,000ft, before opening up again for the en route climb. The cutback time is pre-computed on the basis of power available, and it varies according to local circumstances (in the case of our take-off from Berlin it was 75sec after brakes off, but at Düsseldorf it was after only 60sec). Power was cut to 53 per cent in each case. Even after power cutback the Super One-Eleven has a rate of climb of about 750ft/min with a full payload. I was told by Capt Munro that in no circumstances is the rate of climb less than 500ft/min, and in the event of engine failure, the remaining unit is opened up to full climb power and the aircraft climbs about as well as when performing the noise abatement technique.

From a seat in the cabin the take-off is a pleasant experience. The acceleration is rapid, and the howl of full-power on the Speys is only just faintly audible. At lift off there is hardly any sensation of the attitude (limited to 20° for comfort), while the noise drops to an outstandingly low level.

En route climbing speed is 300kt IAS up to Mach 0.73 indicated (achieved at about 25,000ft). Following a gross-weight take-off it is necessary to maintain about 25,000ft until fuel burn off permits a further climb to 33,000ft and an increase to Mach 0.77 indicated for the cruise (around 16,000ft is the normal cruise altitude on the German routes outside the corridors). At 10,000ft in the Berlin corridors it is normal to cruise at 323kt to 333kt according to payload (the heavier the slower). All Super One-Elevens so far have been well over their cruise performance guarantees, and Capt Munro said that he had never heard of the max cruise setting of 11,850 r.p.m. on the h.p. compressor being possible without exceeding the max cruise IAS. In the cruise the Super One-Eleven rides with a nicely firm "mini-VC10" feel. The noise level is a little higher than during the dramatically quiet initial climb—due to the rush of air over the fuselage—but it is at a fairly unobtrusive level. The cabin remains thus reasonably quiet almost over its entire length. The handling technique in turbulence is to slow the aircraft to 280kt and to take out the height locks.

Descent is begun with a power reduction while Mach 0.73 indicated is held, and then 300kt at lower altitudes. An early approach check is to re-start the APU (unless it has been left on as is usual on very short sectors) in order to provide an even supply of air conditioning and electricity during main engine power changes. For landing at Düsseldorf the V_{AT} was 118kt and the decision height 300ft. In fact it was a hazy day, but no cloud and we made a smooth arrival. Touchdown requires very little change of attitude and not much backwards movement on the wheel as the power is reduced.

Rivals at Berlin Templehof: a Pan American Boeing 727 is glimpsed from the front entrance of a BEA Super One-Eleven about to depart for Düsseldorf

ONE-ELEVEN WORLD REPORT

WITH A TOTAL ORDER BOOK worth over £200 million the BAC One-Eleven is already Britain's most successful airliner programme and, with the sales tempo quickening, is set to become Europe's top money-spinning transport aircraft.

The value with spares of the 168 BAC One-Eleven sales announced to date is £212 million—a figure already well in advance of the £117 million achieved by the Viscount during a production lifetime of 13 years in which 438 aircraft were built. BAC's launching investment in the One-Eleven is over £30 million which has been matched by a British Government "partnership" launching investment of £18.75 million (including £9 million for the One-Eleven 500—*Flight*, August 22) which; this being repaid by an agreed formula through a levy on each aircraft sold.

In the first ten months of this year BAC has sold 33 One-Elevens—nearly half for export; last year 38 were ordered, with 14 for export. Out of the total sales to date 104 (62 per cent) worth £130 million have been for export (exports of Viscounts totalled £147 million—83 per cent of total sales).

The biggest sales of the One-Eleven so far have been in the US. In the face of strong competition from the home industry 68 One-Elevens worth over $200 million with spares have been sold to four airlines and three business corporations, against a tariff barrier of 10 per cent, making it Britain's biggest dollar earner. (Ninety-four Viscounts worth $120 million with spares were sold in the US when the duty was 14 per cent.) By comparison, 64 One-Elevens have been sold to seven British airlines. One-Elevens have now been ordered 52 times (including 20 re-orders) by 29 customers (14 of them Viscount operators)—23 airlines, four business corporations and two governments in fleets ranging from one to 30 aircraft.

Now in its fourth year of intensive service, the world-wide fleet of nearly 120 aircraft has made over 700,000 flights, carried 30 million passengers, and flown more than 200 million miles. Over 650 daily flights are being made to nearly 200 cities in 50 countries.

Over 550,000 flying hours have been logged—increasing at a rate of 3,600hr per week—giving an overall average flight time of around 47min compared with the design duty cycle of 45min. The highest flight time by an individual aircraft is 10,300hr by Braniff's N1543—this was the first aircraft delivered to the US in April 1965. This aircraft and Mohawk's N2111J delivered in May 1965 will both pass 15,000 landings later this month.

The One-Eleven programme will continue to evolve to meet new markets. The One-Eleven 475, planned for 1970, marries

ONE-ELEVEN 500 INTO SERVICE . . .

the 400 fuselage with the wings, landing gear and more powerful engines of the 500, thus providing an exceptionally good take-off and climb performance and non-refuelling capability for ultra-short sections out of small airfields. A year or so later, in 1971-72, it is planned to market the One-Eleven 600, which will incorporate a further all-round increase in size to carry up to 131 passengers over increased ranges with even better economics while retaining all the elements of the basic One-Eleven design. With an aft-fan added to the Spey 25 Mk 512 engine, the One-Eleven 600 will have an "advanced technology" powerplant giving around 18,000lb thrust at a lower specific fuel consumption than today and with reduced take-off noise levels.

A good measure of the exceptional versatility of the One-Eleven is the success it has achieved in widely different types of operation in three-and-a-half years of intensive and reliable service with all types of operational environment, fleet size and journey length. Whether making ten 45min flights per day as one of a fleet of 30 aircraft (American Airlines), twelve 25min flights per day as one of a fleet of three aircraft (Aloha) or averaging a sustained utilisation of eight hours per day on networks which include sectors of over 1,300 miles (VASP in Brazil and AUSTRAL in Argentina), the One-Eleven is making money and winning friends.

Braniff now operates its 13 One-Elevens through 14 eastern and middle-west states ranging from Minneapolis to the Mexican border. There are some 1,000 departures per week and all 13 aircraft in the fleet have logged over 10,000 flights, which is equivalent to over 11 landings each day since delivery.

Mohawk Airlines has a dense network of One-Eleven short-haul routes in the north-eastern states where turnrounds are often as brief as six minutes. In July 1965 Mohawk was the first US regional carrier to introduce jets and has now placed seven separate orders to a current total of 17 aircraft.

Highlights of American Airlines' One-Eleven operation—it has a fleet of 30—is its New York-Boston and New York-Washington "Jet Express" services. Departures "every hour on the half-hour" call for a high degree of aircraft reliability and the outstanding record of the One-Eleven led American Airlines to describe it as "the most dependable jet in service today." Newest engineering development by American with its "400 Astrojet" is the completion of the 150 approach demonstrations required by the FAA to qualify the fleet for future Category 2 weather minima operation.

In Hawaii, Aloha Airlines' One-Elevens operate on the inter-island routes with an average sector length of only 130 miles. Aloha's One-Eleven N11181 completed its 10,000th landing in service only 803 days from delivery, representing a sustained operating rate of over 11 flights per day. Throughout the period the average technical delay rate was below one per cent.

One-Elevens are now flying with nine airlines in the UK and Europe—Aer Lingus, Autair, Bavaria, BEA, British Eagle, BUA, Channel Airways, Laker Airways and Tarom—with operations spanning domestic and international scheduled services and to the holiday destinations of Europe, the Mediterranean and North Africa. BUA also operates scheduled One-Eleven services to West Africa.

The One-Eleven is firmly established on UK domestic routes and on wide-ranging inclusive tour holiday work in Europe and to North Africa in conjunction with leading tour organising companies.

By next summer BUA will have received the first of the 98,000lb gross weight One-Eleven 500s (it has eight on order). Between three and five of the airline's earlier 200 series are due to be sold at the end of that holiday season and three more 500s are to be delivered from March 1970. Caledonian will also begin One-Eleven 500 operations on holiday routes next year.

Since last June the Roumanian airline Tarom has operated a single One-Eleven (the first of six for delivery before the end of 1969) on a network of international scheduled services linking Bucharest with Western European capitals.

In the Far East, Philippine Airlines' One-Elevens fly key domestic routes and internationally to Hong Kong and Taiwan. In the heart of Africa the One-Elevens of Zambia Airways have been pioneering new regional jet routes since January.

Six Latin American countries are operating One-Elevens. BAC has made major inroads to booming Central America which has chosen the One-Eleven as the primary communications tool within the area and to US gateway cities. One-Elevens are now in service with TACA International (El Salvador), LACSA (Costa Rica), and LANICA (Nicaragua) in association with TAN (Honduras), all of whom have enthusiastically welcomed and praised the new jet. In South America, Austral, the leading domestic airline of Argentina, together with its partner ALA, is providing One-Eleven service throughout Argentina and the southern part of the continent on routes radiating from Buenos Aires, and VASP of Brazil.

Matched to the global needs of big business and proved in both corporate and scheduled airline service worldwide, the BAC One-Eleven is providing the benefits of jet mobility and airliner size to four corporate business organisations in Europe and America and to the Australian and Brazilian governments. Nine One-Eleven corporate jet transports have so far been ordered.

Helmut Horten of West Germany, Tenneco of Houston, Texas, Victor Comptometer of Chicago, and Engelhard Industries of New York, have all established efficient One-Eleven operations. In two-and-a-half years of corporate service the One-Eleven has demonstrated a cost/range ability to carry seven passengers on a round trip from Boston to London for a total cost less than seven first-class air fares.

The two One-Eleven VIP transports of the Royal Australian Air Force have made wide-ranging tours in south-east Asia with the Australian Prime Minister. The Brazilian government is about to introduce two executive One-Elevens with the Forca Aerea Brasiliera after ten years of successful Viscount operation.

Reported operating costs filed with the US Civil Aeronautics Board show that the One-Eleven is exceptionally cheap to operate and that it has consistently returned bigger profits than the propeller types that it has superseded. These reports are made at quarterly intervals and include the total costs incurred during the previous 12 months. The average costs of the four One-Eleven operators in the US (Aloha, American, Braniff and Mohawk) currently show over 11 per cent advantage to the One-Eleven in cost per block hour over its nearest competitor.

The One-Eleven has also consistently met its maintenance and reliability targets. During 1967 the worldwide fleet average utilisation was 6.4 hours per day, while during the month of August, this rose to 7.4 hours a day. European Inclusive Tour operators often achieve 16-18hr per day peak utilisation at weekends in the holiday season. Many operators are experiencing 98 to 99 per cent dispatch reliability rates, and during 1968 the worldwide average reliability rate has been 98 per cent.

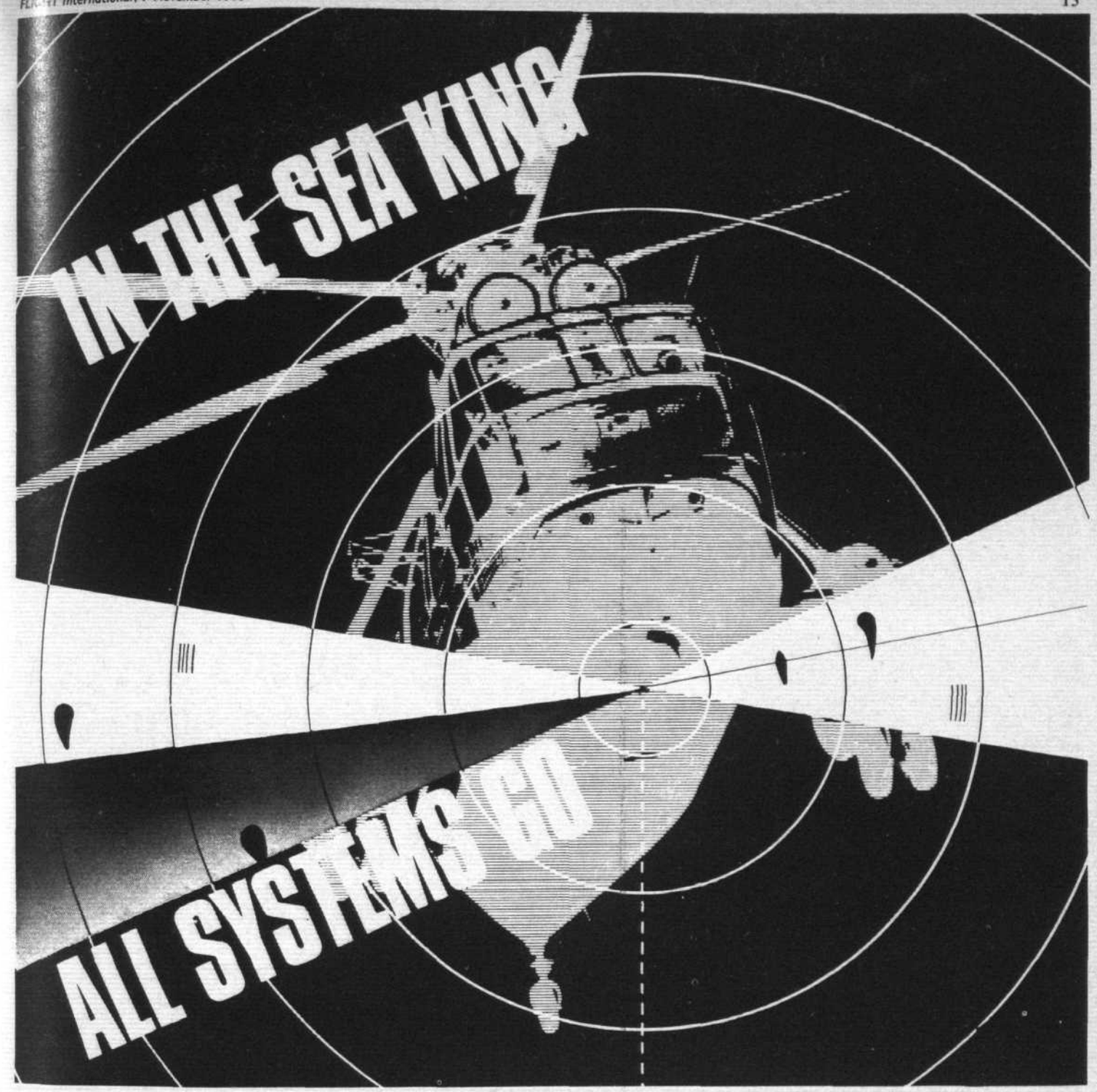
The maintenance philosophy of the equipment is based on the "On Condition" principle with the aim of maximum utilisation from all components, within economic limits, and avoiding the imposition of arbitrary life restrictions. Approval for this has been achieved on over 80 per cent of all major rotable components. The target for the remaining components was a minimum time between overhaul of 3,000hr. This has now been well exceeded and in fact only 2.25 per cent of components have an overhaul life of less than 5,000hr.

The Rolls-Royce Spey has achieved a spectacular rate of growth in approved engine overhaul life. When Braniff began service in April 1965 with the Spey 2, the initial sampling life was 800hr. Now, three-and-a-half years yater, Braniff's Spey engines are approved for 6,600hr (with a scheduled shop visit for hot end check at 3,200hr) and are being taken on trial to 7,000hr.

American Airline's Spey 25s are now following a programme of progressive maintenance at 4,000hr intervals whereby turbines and combustion are checked every 4,000hr, compressors every 8,000hr and the remainder of the engine at 1,200hr intervals.

BAC and Rolls-Royce have, in fact, more experience in developing and engineering short- and medium-haul, turbine-powered airliners than any other manufacturer in the world. The One-Eleven programme is firmly established and under continuing development for a long and rewarding future, well into the 1970s.

ARTHUR NORMAN



to the plotting board

The complete operational, navigation and search pattern laid out on the large radar plotting board, coupled with automatic flight control precision, provides the nerve centre of the Westland Sea King, the World's most advanced anti-submarine helicopter weapons system. The Sea King also provides greater endurance and time on station, increased striking power, day and night all-weather capability, and its Rolls-Royce Gnome gas turbines ensure twin engine safety and performance.

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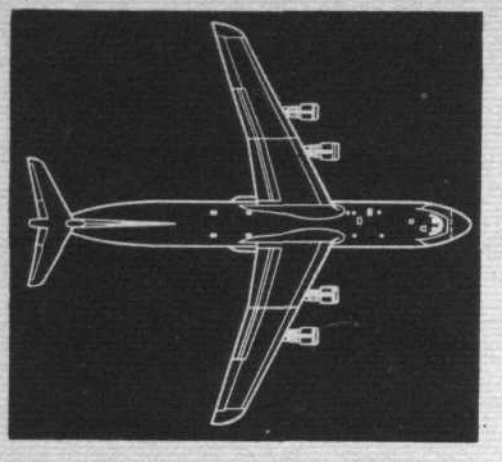

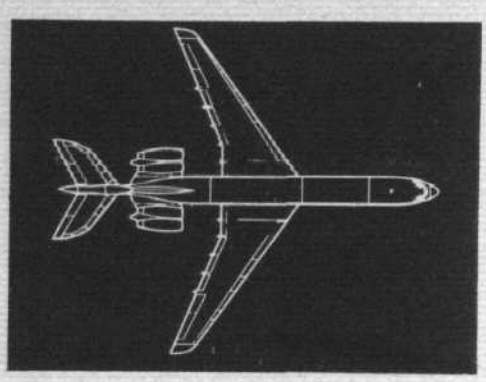

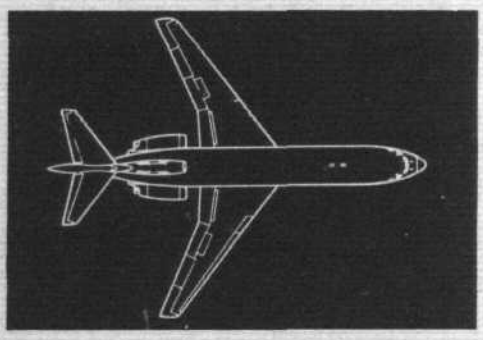

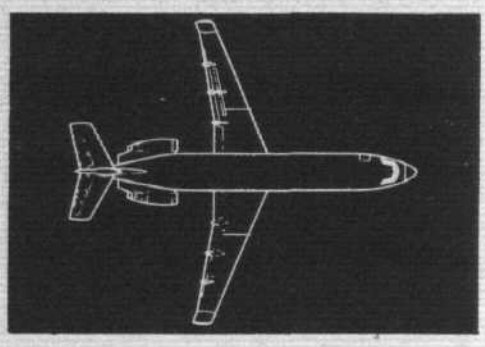

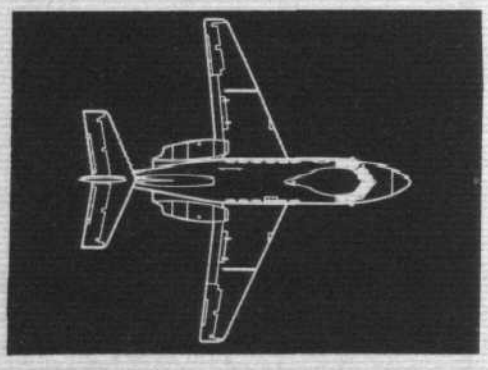

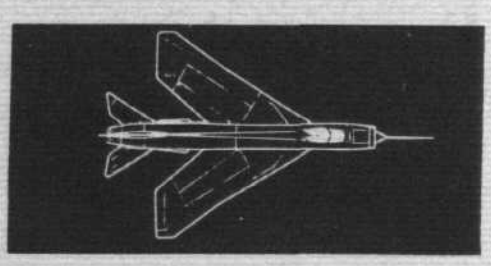

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AGAINST THE ICE MENACE

A "Flight" equipment review

Ice protection of aircraft can take the form both of prevention and of cure. De-icing (the removal of ice accretion after it has built up) can be by mechanical, fluid, or thermal means. Anti-icing (the prevention of ice formation before it can start) is in many cases a better philosophy. A selection from the range of products offered by British manufacturers under both headings are described in the following pages.

(1) Ambersil Ltd, *James Estate, Western Road, Mitcham, Surrey (Tel 01-648 9324)* Although Ambersil MS4 and Electrospray silicone fluids are primarily intended to protect electrical equipment such as plugs, sockets and harnesses from the corrosive effects of condensation, their low freezing and water-repellent qualities are stated to lubricate down to minus 50°F and prevent the accumulation of moisture and the subsequent sticking of frozen mechanical components.

Aeroshell Fluid Three low-temperature aviation oil is also available in aerosol form with suitable extension nozzles for the lubrication and protection of flying-control linkages. It is also suitable for the low-temperature lubrication of aircraft parts requiring a light oil, e.g., hinges, pivot joints, shaft joints, link pins, pulleys, cables, cameras, radio and radar gear and instruments. Further protection is afforded by the inclusion of corrosion and oxidation inhibitors.

(2) Atlas Copco (Great Britain) Ltd, *Maylands Avenue, Hemel Hempstead, Herts (Hemel Hempstead 3181)* Mobile ground air starters, such as Atlas Copco's Air Partners, are also useful sources of hot air for defrosting parked aircraft. The Air Partner's delivery, at approximately 200°C, can either be directed from the ground starting connection into the aircraft built-in hot air anti-icing system, or, with a special nozzle attached to the hose, can be sprayed by hand on to the wing, tail and fuselage surfaces from the outside. Projects in hand include equipment for use with large-capacity aircraft, such as the 747.

(3) Auto Diesels Ltd, *Cowley Mill Road, Uxbridge, Middlesex (Uxbridge 38262)* Ground defrosting, in the same manner as already described for Atlas Copco's units, is equally applicable to Auto Diesels' range of diesel and gas-turbine powered air starter vehicles.

(4) Avica Equipment Ltd, *Mark Road, Hemel Hempstead, Herts (Hemel Hempstead 4711)* At numerous points in anti-icing hot air ducting systems provision has to be made for thermal expansion and contraction, structural flexing and other axial and angular movements. Avicaflex bellows, seals, gimbal joints and composite duct assemblies in stainless steel and titanium, designed for this purpose, are incorporated throughout the hot air systems in many British and European aircraft. Restrained-bellows devices are usually employed, as these high-temperature duct systems are invariably of the tension type. Construction is of stainless steel, with internal or external bellows seals, and an encircling can-structure for further protection if required. Bellows are attached to flange joints by argon arc, and to tubular ends by seam welding.

Avica also produce a range of lightweight V-flange duct couplings in stainless steel, with quick-release fasteners incorporating fail-safe protection. Flange joints can be either seam- or butt-welded to duct tubing, or attached by Avica's mechanical method.

(5) Avimo Ltd, *Taunton, Som (Taunton 81071)* Avimo's well-known Mk 8 series of electrically heated pitot heads are still widely used 29 years after their introduction. Current versions are fitted to several smaller aircraft, such as the Islander and Skyvan.

Following the later types of F, G, H and J heads, examples of which are fitted in many British turbine aircraft, a range of pencil pitot-heads of advanced design has been introduced, for which orders have already been received for the One-Eleven, Fokker F.28 and HFB 320 Hansa, among other types. A new method of construction is used for the sprayed mineral insulating substance, providing a high heat resistance, thus allowing accurate positioning of heat in the right concentration, with an added safeguard against overheating if the heater is inadvertently left switched on. The result is a smaller, lighter and cheaper unit, with a more accurate profile and better performance.

A useful source of hot air for defrosting aircraft parked in the open is a vehicle such as Atlas Copco's Air Partner ground air starter

QUICK CROSS-REFERENCE

Used in conjunction with the review in these columns, the index below provides a "who makes what" quick-reference guide. The numbers identify the paragraphs in the review.

Chemical compounds: 1, 25, 28, 31, 43, 46.

Control, detection and warning devices: 11, 14, 17, 18, 32, 33, 35, 38, 41, 45, 48, 50.

Electro-thermal systems and equipment: 6, 14, 18, 22, 26, 38, 40, 50.

Fluid systems and equipment: 27, 46.

Ground defrosting equipment: 2, 3, 7, 9, 13, 15, 20, 44, 52.

Hot-air systems and equipment: 4, 7, 10, 12, 16, 20, 21, 24, 25, 29, 35, 39, 42, 47, 48, 50, 52.

Pilot heads: 5, 38.

Pneumatic de-icers: 34.

Propeller de-icing: 8, 14, 18, 22, 26.

Windscreen de-icing and rain repellents: 14, 18, 19, 30, 49, 51.

(6) Baxter Woodhouse & Taylor Ltd, *Woodside, Poynton, Cheshire (Poynton 2261)* Electro-thermal anti-icers for intake duct splitters, examples of which are installed in the Victor, consist of a nickel mat embedded in epoxy resin or silicone rubber, laminated to a metal shroud.

Other electro-thermal anti-icing products include interchangeable lengths of independently heated, insulated pipe for water and waste-water lines in the Trident; heater muffs for the HS.125 rudder-bias balancer valve, and fuel valves.

(7) Bell's Asbestos & Engineering Ltd, *Farnham Road, Slough, Bucks (Slough 23921)* Bell's aviation products include a wide variety of parts used in hot-air ducting, such as flexible silicone rubber and glass connecting sleeves and bellows: flexible hoses suitable for temperatures up to 300°C and pressures up to 200lb/sq in; lightweight hoses for demisting air; ground supply hoses for air starters and heater vehicles; permanent lightweight insulation, or removable jackets, for stainless steel ducting; and coupling seals and jointing. Metallic clamps and couplings include the Janitrol range of lightweight stainless-steel couplings and flanges with metal-to-metal sealing.

(8) Bostik Ltd, *Ulverscroft Road, Leicester (Leicester 50015)* The extensive range of Bostik adhesives includes Boscoprene cements 2402 and 2413, both of which are approved for attaching rubber de-icer shoes to propeller blades.

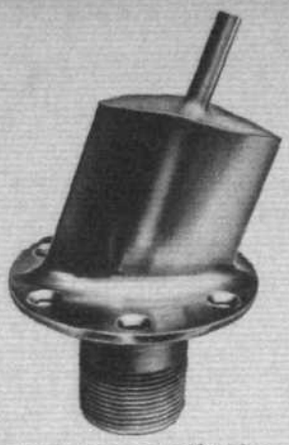
(9) Craven & Co Ltd, W. J., *Evesham, Worcs (Evesham 2631)* Craven Hydralux two-ram, twin-plunger pumps, driven by a 1½ h.p. Villiers four-stroke petrol engine, are supplied trolley-mounted to airlines and other operators for ground defrosting. Fluid delivery is 4gal/min, at a pressure adjustable up to 400lb/sq in. Accessories include suction and delivery hoses, spray guns, lances and extensions, and double nozzles.

(10) Darchem Aero Ltd, *Stillington, Stockton-on-Tees, Co Durham (Stillington 461)* Stainless-steel ducting and Refrasil insulation blankets are manufactured by Darchem Aero for hot air anti-icing systems.

(11) Davall & Sons Ltd, S., *Wadsworth Road, Greenford, Middx (01-998 1011)* Davall's electrically operated cyclic timers, designed for Rolls-Royce Dart and Tyne engine and propeller de-icing systems, are installed in Vanguards, Belfasts, HS.748s and Andovers, Viscounts, Argosies, YS-11s, and Dart/Convair 600s in service with 30 different airlines and air forces, including BEA, Air Canada, Aer Lingus and the RAF.

The function of the timer is to control the remote contactors which switch power supplies to the de-icing heater mats in specified cycles of timed periods. Exceptional reliability is claimed for these 400 c.p.s. units, owing to the use of a brushless motor, constant-speed camshaft, and the absence of worm or bevel gearing. Vanguard timers are being operated to 12,000 hours without attention, and bench-test figures have exceeded 36,000 hours. Current developments include solid-state timers and ice detectors.

(12) Delaney Gallay Ltd, *Vulcan Works, Edgware Road, London NW2 (Tel 01-452 6491)* Engine fuel heaters are made for the Concorde's Olympus 593B engines and for the BS Nimbus turbine. Anti-icing heat exchangers are fitted in the Viscount, Vanguard, Brittannia, Argosy and Herald.



Protruding only 2¾in from the surface on which it is mounted, the Rosemount ice detector head depends on change of resonant frequency caused by ice build-up

AGAINST THE ICE MENACE . . .

The company's Biggleswade, Beds, works manufactures high-temperature thermal insulating blankets either removable from, or integral with, ducting for hot-air systems.

(13) Dragonair Ltd, *Fitzherbert Road, Farlington, Portsmouth, Hants (Cosham 76451)* Although primarily intended for warming passenger cabins, Dragonair's mobile oil-fired air heaters can be fitted with multiple hoses which also render them suitable for ground defrosting — a process which can be carried out simultaneously with the main function.

(14) Dunlop Company Ltd, The, Aviation Division, *Holbrook Lane, Foleshill, Coventry, Warwickshire (Coventry 88733)* As far back as 1935 Dunlop were co-operating in the development of fluid de-icing systems. More recently the company has concentrated on producing pre-formed electrically heated mats, with the heating elements encapsulated in layers of synthetic rubber or high-temperature resin laminates and glasscloth, which are bonded to the metal surfaces of engine intakes, propeller blades and spinners, and wing and tail leading-edges.

More than 20 British and foreign aircraft are equipped with Dunlop electro-thermal de-icing, which is standard on Rolls-Royce Dart and Tyne nose cowlings. The company's de-icing equipment has also been applied to Bastan and Astazou turboprops, as well as to the main and tail rotor blades of the SA.321 Super Frelon and SA.330 helicopters.

The Transall C-160 is exclusively de-iced by Dunlop for, in addition to the Tyne intakes and the propeller blades, the outer wing, tailplane and fin leading-edges are covered entirely by the company's heater mats. The contract covers 23 leading-edge sections for each aircraft, and production is being implemented jointly with Dunlop's French licensees, Usines Paulstra SA. Each leading-edge incorporates a continuous/cyclic heating arrangement and a proportion of the continuous power element is used as a temperature sensor for the overheat control system.

Dunlop will undertake responsibility for entire aircraft de-icing systems, including leading-edge heaters and associated electrical control equipment. These would embody the latest techniques in solid-state devices.

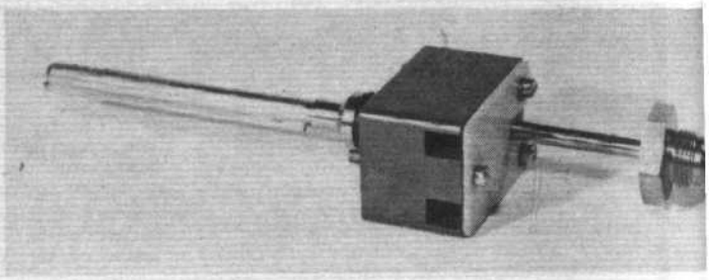
(15) Edghill Equipment Ltd, H. W., *Hook, near Basingstoke, Hants. (Hook 2121)* Edghill Equipment's diverse range of ground equipment includes 50gal and 100gal fluid bowsers, which are produced to suit a variety of liquids, among them de-icing fluid.

(16) Electro-Hydraulics Ltd. *Liverpool Road, Sankey, Warrington, Lancs (Warrington 35922)* The high-pressure bleed air control valves in the Trident's anti-icing system incorporate a solenoid valve consisting of a simple air valve operated by a high-temperature d.c. solenoid supplied by Electro-Hydraulics.

(17) Engel & Gibbs Ltd. *Elstree Way, Boreham Wood, Herts (01-953-2291)* Engel & Gibbs electrical contact thermometers have for many years been associated with hot air and electro-thermal anti-icing systems, both in the ice warning and in the temperature overheat and heater cycling control circuits.

Matchstick-sized, sub-miniature contact thermometers have also been developed, for lamination into electrically heated windscreen transparencies. Examples of these tiny glass thermostats are incorporated in English Electric Sierracote panels for the primary or secondary control of the built-in heater elements.

(18) English Electric Co Ltd, The, *Engineering and Heating Systems Division, PO Box 26, The Airport, Luton, Beds (Luton 31441)* Of English Electric's ice protection equipment installed in various applications in more than 45 different types of civil and military aircraft, one of the most important is the Spraymat electro-thermal system which has a service background of more than 60 million flying hours. Type 2 Spraymat has demonstrated its performance and reliability in operational service on complex airframe de-icing systems and on engine air intakes, spinners, propellers and auxiliary equipment.



Smiths Industries ice detector probe for the Concorde senses ice formation on its leading edge, then automatically de-ices itself to begin another cycle

Spraymat Type 3 is being supplied for the Concorde, and is installed on specific sections of the upper and lower wing surfaces and on the main engine and auxiliary air intakes. The installation has involved development of new materials and manufacturing methods which enable it to be used for sustained supersonic flight under conditions producing skin temperatures of 150°C. The system has been designed for long life to be able to withstand erosion and damage from cloud droplets, ice crystals, rain and hailstones. Heater mats are now manufactured in prefabricated form to very close thickness, weight and contour tolerances for bonding under pressure to give a surface that satisfies the stringent aerodynamic requirements.

Among current applications in production are intake ice-protection systems for supersonic military aircraft such as the NATO F-104s.

Aircraft fitted with Sierracote electrically heated plastic windows are listed in the table below. An important feature of Sierracote windows is that heated transparencies, manufactured from laminated plastic, can be formed to include compound curvatures, and yet remain cabin pressure-sustaining, abrasion-resistant and bird-proof. The resistance of the transparent metallic film can be graded in local areas to give a uniform heat dissipation over an irregular area. A recent development, now in production, is an electrically heated glass-faced plastic windscreen which provides abrasion resistance in cases where this is an extreme problem.

Electro-mechanical rotary ice-detectors, built under licence from Teledyne Systems, are fitted in—among six British turbine aircraft—the Buccaneer and BAC One-Eleven. Increased torque loading, caused by shavings of ice accretion on a protruding serrated rotor, operates a microswitch to light the warning lamps and initiate de-icing.

Other anti-icing system products include transistorised thermal controllers for windows and surface heaters, and sealed amplifier/relays for use with low-current temperature-sensitive switches.

(19) Field Aircraft Services Ltd, *London (Heathrow) Airport, Hounslow, Middlesex (01-759 2141)* Field design, manufacture and install rain-repellent systems under licence to the Boeing Company. A wide variety of civil and military aircraft have now been equipped with Field's system using Boeing repellent Type 3, named RainBoe. While no de-icing or anti-icing effects are claimed for the system, pilots have reported freedom from ice build-up on unheated repellent windscreens during freezing-rain encounters.

(20) Flexible Ducting Ltd, *Aviation & Electronics Division Sales Office, 55 Lattimore Road, St Albans, Herts (St Albans 50403)* Flexflyte lightweight flexible ducting is suitable for the distribution of warm air for demisting and de-icing purposes, especially in light aircraft and helicopters.

Spiratube flexible ducting, produced in diameters from 6in to 30in, with optional thermal insulation or abrasion-resistant scuff strip, is supplied for ground defrosting delivery from air heater vehicles.

(21) Flight Refuelling Ltd, *Wimborne, Dorset (Wimborne 2121)* Saunders spherical-plug valves, although designed primarily for fuel systems, are equally suitable for fluid and air systems operating at higher temperatures and pressures. Valves supplied for warm air systems, such as windscreen demisting are usually from the ½in and ⅝in s.p. size range.

(22) Godden Ltd, M. H., *Prestbury, Cheltenham, Glos (Cheltenham 7202)* This company's electro-thermal de-icing elements, fitted to Dowty Rotol's and Hawker Siddeley Dynamics' propeller blades and spinners, are in service on the majority of Dart- and Tyne-powered aircraft, including Viscounts and Vanguards.

Godden's latest de-icer elements, consisting of p.t.f.e.-insulated stranded wire, woven in glass yarn, may be applied to external or internal surfaces, in synthetic rubber or epoxy resin as required, and are equally suitable for air intakes or for aerofoil sections; these particular applications Godden are actively developing, in addition to their established propeller de-icers.

Exceptional reliability is claimed for these elements on the score of their electrical insulation and high-temperature and mechanical properties. Some 500,000hr of service has already been achieved by Godden-de-iced Dart and Tyne spinners, and individual spinners have exceeded 6,500hr without electrical failure.

(23) Hampson Industries Ltd, *Aircraft Ground Power Division, Greets Green, West Bromwich, Staffs (West Bromwich 2071)* Hampson's Airmaster is another type of diesel compressor jet starter vehicle that is also a suitable source of hot air for ground defrosting, either through the built-in system of the aircraft, or by external application.

(24) Hawker Siddeley Dynamics Ltd, *Manor Road, Hatfield, Herts (Hatfield 62300)* Hawker Siddeley Dynamics is currently producing anti-icing equipment for all versions of the Trident, the complete system for which was developed in the company's extensive air conditioning test facilities at Hatfield. A similar system, using slightly modified Trident somponents, is now being supplied for the HS.801 Nimrod.

The Trident's hot air anti-icing installation consists of two main systems. First, each engine and its intake has an individual sub-system that is selected and controlled independently of the second main system—that of the airframe—although each draws high-pressure bleed air from the final compressor stages of the three engines. Engine low-pressure bleed air, also, is fed into the airframe system, each of the three supply circuits of which comprises pneumatically operated high- and low-pressure bleed air control valves—both HSD components—manual shut-off valves, and a mixing chamber incorporating temperature sensors and cut-out switches. Mixing chamber output passes, at the correct flow and temperature, through non-return valves into the main distribution gallery leading to the wings and tail unit.

(25) Imperial Chemical Industries Ltd, *Millbank, London SW1 (01-834 4444)* ICI silicone rubber, produced in Scotland by the Nobel Division Silicones Group, is used for flexible connectors—such as those supplied by Bell's Asbestos & Engineering—in hot air ducting. Silicone rubber can be fabricated to any shape, remains flexible from −40°C to 230°C, and is unaffected by hydraulic fluid or condensation.

Isopropanol, another ICI product (from the Heavy Organic Chemicals Division) is used alone, or as a component, in aircraft de-icing fluids.

(26) Isopad Ltd, *Barnet By-pass, Boreham Wood, Herts (01-953 2817)* Isopad electric surface heaters, described in detail in *Flight* as long ago as March 1, 1957, are still widely used on Dowty Rotol propeller blades and spinners in Dart-powered aircraft. The spinner elements comprise practically alkali-free glass yarn, interwoven with special resistance wire.

Isotapes, manufactured to suit any type of voltage, are applied with thermal insulation for frost protection of waste water lines in the BAC One-Eleven, among other aircraft. Isotapes use a high-temperature p.v.c. extrusion over the heating elements, and are suitable for temperatures up to 60°C.

Isopad products are also used for frost protection on valves, cameras and missile components.

(27) Kigass Ltd, *Kigass House, Chapel Street, Leamington Spa, Warwicks (Leamington Spa 22241)* Kigass produce a range of hand-operated pumps—with capacities of 5, 10, 20 and 40 c.c. per stroke, and spray nozzle jet units—which are suitable for windscreen fluid de-icing systems in helicopters and light aircraft.

(28) Kilfrost Ltd, *162-164, Uxbridge Road, Hanwell, London W7 (01-567 7274)* Pioneers of chemical de-icing and de-frosting under wartime conditions. Kilfrost have been supplying defrosting fluids to the Services and to airlines for some 25 years. More recently this company has developed, in conjunction with BEA, the hot defrosting technique for removing frozen deposits from parked aircraft.

The original hot defrosting concentrate DC2, and the later DC2A, have now been superseded in Service and airline use by a still more advanced product—the Kilfrost Anti-icing Barrier Compound (ABC). This can either be applied to aircraft during turn-round as a hot defrosting fluid or, by application as a cold concentrate, can give protection to parked aircraft for up to 12hrs. Kilfrost ABC is now used by three air forces, 13 airlines and two airport authorities.

Other Kilfrost compounds include de-icing fluids for T.K.S. airborne airframe de-icing systems, hoar-frost remover and Arctic de-icing fluid for parked aircraft, and a wing de-icing paste designed for manual pre-flight application.

Latest product for de-icing and cleaning pilots windshields is Windscreen Washing Fluid Mod. 2.

(29) Lucas Gas Turbine Equipment Ltd, *Shaftmoor Lane, Birmingham 28 (Springfield 3232)* Lucas combustion heaters represent the alternative to compressor bleed, or exhaust gas heat exchangers, as the heat source for built-in hot air anti-icing systems. Temperature controlled, the air combustion heaters take their fuel from the aircraft main supply. The full system comprises, in addition to the heater, fuel and electrical control units, ram air pressure switch, and control panel.

On the ground the output from Lucas mobile air heaters, employing similar combustion heaters to the airborne units, can be used for external defrosting of parked aircraft.

(30) Miraflores, *The Friary, Old Windsor, Berks (Windsor 63742)* Kleerscreen rain repellent, supplied by Miraflores in kit form for external, pre-flight application by hand in a matter of seconds, is in world-wide use by airlines and light aircraft operators. One kit is sufficient to treat 50 airliner windscreens, and each application should, properly applied, last about 200 flying hours. Kleerscreen is not a de-icing compound, but its properties can deter the onset of icing.

(31) Mobil Oil Co Ltd, *Caxton House, Tothill Street, London SW1 (01-839 6645)* Mobil aero de-icing fluid No. 1 is a special isopropyl alcohol, supplied for use in propeller, windscreen, carburetter and other airborne fluid de-icing systems.

(32) Negretti & Zambra Ltd, *Aviation Division, Stocklake, Aylesbury, Bucks (Aylesbury 5931)* Differential pressure switches are supplied by Negretti & Zambra for engine mounting, to detect changes in pressure drop caused by ice accretion across the engine fuel filter when there is no provision for fuel heating other than through the oil cooler. The type of switch fitted to the Rolls-Royce Spey is designed to signal when a differential of 5lb/sq in exists in the system. This operates a panel light to give warning for reduction of the fuel flow rates, thus permitting increased heat pick-up through the oil cooler.

Negretti & Zambra also manufacture a range of thermal units—temperature-sensing devices designed for servo control of actuators or for electrical switching.

(33) Page Engineering Co (Sunbury-on-Thames) Ltd, *Page Works, Forge Lane, Green Street, Sunbury-on-Thames, Middx (01-768 4242)* A two-minute delay device is incorporated in the Trident's anti-icing system to cater for intermittent icing conditions while under automatic control. This ice detector delay unit, manufactured by Page Engineering, provides two controlled outputs, one to the anti-icing control system operated by the ice detector contacts; its purpose is to maintain the anti-icing system in operation after the detector contacts have opened.

(34) Palmer Aero Products Ltd, *Penfold Street, Edgware Road, London NW8 (01-723 8822)* Palmer aerofoil de-icer equipment, Goodrich-licence manufactured at the Leyland works of BTR Industries, is produced in a range of systems to suit small piston-engined aircraft such as the Islander and Beagle B.206 series, and turboprops such as the HS.748, Skyvan and Jetstream.

These externally mounted, lightweight rubber de-icers are attached with an air-cure cement, and are manufactured to tolerances approaching those of metal leading-edge skin profiles. In the HS.748 installation, engine bleed air is used to inflate the mainly chordwise tubes, through solenoid-operated distributor valves; alternate tubes are cyclically pulsated under the control of an electronic timer. Tubes are deflated under suction from ejectors, which also derive their forcing pressure from compressor bleed air.

In the light aircraft system, the spanwise tubes are simultaneously inflated by air at 15lb/sq in from the exhaust side of the standard engine-driven vacuum pumps. A transistorised electronic timer operates the control valve solenoids and, when the systems is de-energised, pump suction keeps the deflated tubes flat against the skin.

(35) Plessey Co Ltd, *Dynamics Group, Ilford, Essex (Tel 01-478 3040)* A miniature temperature controller for electrically heated windscreens or de-icer elements is now produced by Plessey. The operation-point of this 28V d.c. controller is adjustable over a wide range of settings, and its construction lends itself to stacking. It may be used as an ON/OFF control for any function which can be sensed as a change of resistance.

Other Plessey products used in anti-icing systems include hot-air stop-valve actuators and ducting components.

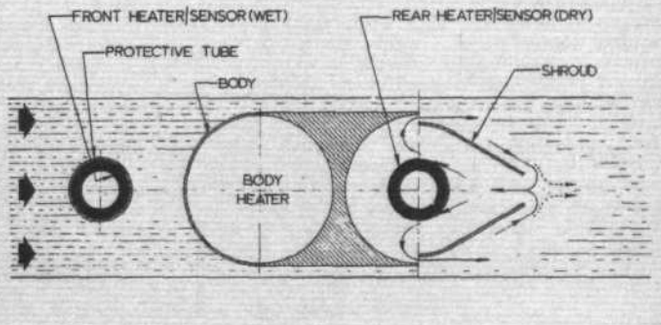
(36) Porter Co (Great Britain) Ltd, H. K., *Cameron Street, Hillington, Glasgow SW2 (Moss Heights 8771)* Porter V-band clamps, incorporating fail-safe protection, provide a positively sealed, compact lightweight joint suitable for use in hot air ducting systems. Porter also supply heavy duty Thermoid ground air starter delivery hose.

(37) Rollason Engineering Ltd, *Croydon Airport, Surrey (01-688 7238)* Rollason's Thawspray trolleys are supplied to airlines and other operators, for ground application of hot defrosting concentrates such as Kilfrost's anti-icing barrier compound. This mobile spraying plant is equipped with a 50gal insulated tank, petrol-engine-driven pump, thermostatically controlled mains powered immersion heaters, delivery hose and two 9ft spray lances.

(38) Rosemount Engineering Co Ltd, *Durban Road, Bognor Regis, Sussex (Bognor Regis 4101)* Currently manufacturing a new type of miniature ice detector suitable for both ground and airborne use. It is capable of sensing very low thresholds of ice accretion, is proof against dirt and insects and has no moving parts. The detector head can be mounted on the forward fuselage or, alternatively, directly in the engine intake. The output of the detector can be processed further to give a measure of icing intensity.

Rosemount manufacture two types of miniature electrical heating cable capable of producing a high power output per unit length, and these cables are being used for de-icing the intake leading-edges, variable-geometry ramps and the extreme wing leading-edges of the Concorde.

The Trident 1C, 1E and Nimrod carry Rosemount temperature-control equipment which measures and controls the wing-skin temperatures. For the Trident 2E this equipment provides automatic control of the hot air de-icing valves and controls wing and tail skin temperatures automatically.



Teddington's icing-rate system. The leading heater/sensor is exposed to the airstream and the rear heater/sensor is shielded by an inertial droplet separator. With both maintained at constant temperature, difference in power requirement is a function of cooling effect

A Triplex gold-film electrically heated windscreen panel mounted in a scanning unit in which it is checked for optical deviation

AGAINST THE ICE MENACE . . .

(39) Rotax Ltd, *Willesden Junction, London NW10 (01-965 7777)* Solenoid-operated ON/OFF and pressure regulating valves, capable of operating at inlet pressures and temperatures of 360lb/sq in and 550°C respectively, are produced by Rotax for hot-air anti-icing systems in the VC10, One-Eleven, Trident and some Caravelles. Nominal regulated output pressure is 50lb/sq in.

In the One-Eleven's and Trident's engine intake anti-icing systems, two of these valves are mounted in parallel in a bifurcated section of the h-p compressor bleed ducting on the top of each Spey. Electrically initiated by the ice detectors or manual switches, and pneumatically self-regulating, either valve can maintain air flow and temperature at the correct level without the aid of other thermal controls.

Rotax distributor valves are fitted in the Palmer pneumatic de-icer system.

(40) Royal Worcester Industrial Ceramics Ltd, *Gilfach Road, Tonyrefail, Glam (Tonyrefail 435)* To satisfy a requirement from Dunlop for the electro-thermal equipment for the Transall C-160, a sealed terminal has been specially designed by Royal Worcester which, sized within fine dimensional limits, is capable of withstanding not only air pressure when in use, but also the high temperatures attained during the curing stage of heater element manufacture. Difficulty had been experienced with thermoplastic sealed terminals because of the temperature and moisture absorption during the curing process.

The insulating material of the terminals which provide the pressure-tight connections to the elements through the multiple layers of construction, is manufactured from Regalox, a high-alumina ceramic developed by Royal Worcester; it possesses exceptional thermal, mechanical and electrical properties.

(41) Sangamo Weston Ltd, *Great Cambridge Road, Enfield, Middx (Tel 01-366 1100)* A sensitive electrical ice-warning system, comprising a detector head, a resistance thermometer, and either a manual or an automatic reset control unit, is produced by Sangamo Weston for use in several high-performance military aircraft.

Any part of an aircraft where a pressure-drop occurs, such as an axial-flow engine intake, is liable to icing even though the ambient temperature is above freezing. The system is designed to operate at the onset of two conditions conducive to icing—the presence of free water in the atmosphere, and a local temperature below freezing. Signals of such conditions from the water sensitive detector head, and from the resistance thermometer, are fed to the control unit to initiate either a warning device or the de-icing equipment, or both together. A ram-air pressure switch is incorporated, to cut the system out below 90kt.

(42) Serck Radiators Ltd, *Warwick Road, Greet, Birmingham 11 (Victoria 4353)* A thermostatically controlled compressor-bleed heat exchanger, designed to come into operation below 5°C, is being produced by Serck for fuel anti-icing in the Concorde.

(43) Shell-Mex & B.P. Ltd, *Industrial Markets Division, Shell-Mex House, Strand, London WC2 (Tel 01-836 1234)* Stressing the importance of following manufacturers' instructions on the correct application of de-icing fluids to the aircraft, Shell-Mex & BP list a varied range of fluids and compounds which British Petroleum and Shell International Petroleum have available on a worldwide basis for anti-icing and de-frosting aircraft.

Details of these products, their specifications, applications, and various civil and military designations, can be obtained from the respective publications issued by the two companies —*The Air-B.P. Handbook of Products, The AeroShell Book*, and *The Shell Aviation Specifications Guide*.

(44) Simon Engineering Dudley Ltd, *Queen's Cross, Dudley, Worcs (Dudley 54661)* Simon hydraulic elevating platforms, available in six sizes for extensions between 25ft and 85ft, with trolley, trailer or truck mounting, are particularly suitable for ground application of de-frosting compounds to otherwise inaccessible surfaces, and are widely used by operators of large aircraft. Swissair, as an example, operate a 35ft Simon platform at Heathrow; mounted on a five-ton Bedford chassis, it is equipped, complete with pressure pump, spray gear and 440 gal fluid tank, as a mobile self-contained defrosting unit.

(45) Smiths Industries Ltd, *Aviation Division, Kelvin House, Wembley Park Drive, Wembley, Middlesex (Tel 01-452 3333)* Smiths ice detector equipment which has been selected for the Concorde is based on designs already proved in airline and military service. The system has been designed to warn the pilot immediately ice starts to form on the aircraft structure during flight, and it can also be arranged to provide simultaneous and automatic operation of the de-icing equipment.

The ice detector consists of a probe mounted in the airstream, perforated on both leading- and trailing-edges, and having a miniaturised electronic relay unit. The system responds immediately to the formation of ice on the probe and is not energised until ice is actually present, thus extending the effective life of both the detector head and relay.

The detector head is installed in a prominent position on the aircraft with the stainless steel tubular probe pointing downwards. Under normal flight conditions a positive air pressure is built up in the probe. When ice forms on the leading-edges, a pressure-sensitive switch in the relay unit senses the pressure change and initiates a cycle which includes providing a warning signal, electrically de-icing the head, and preparing for another sampling cycle.

Smiths ice detector systems are fitted to the Britannia, Comet, Caravelle and a number of other aircraft in commercial airline and military service.

(46) T.K.S. (Aircraft De-icing) Ltd, *162-164, Uxbridge Road, Hanwell, London W7 (01-567 7274)* The T.K.S. de-icing system is a simple, lightweight installation which is designed to destroy the ice-to-aerofoil bond by fluid diffused through porous panels formed to the leading-edge profile of wing and tail surfaces. Well-proved during 25 years' service in British aircraft, the principle is now earning further appreciation (particularly in the United States) in its latest application in the HS.125, which incorporates the current panel-type distributors.

The T.K.S. system has been chosen for the world's largest aircraft, the Lockheed C-5A, is fitted to the Short Skyvan and is stated to be under consideration for a number of projects in four countries.

The installation—which in the HS.125 weighs little more than 70lb complete with 2gal of fluid—consists of a fluid tank, small electric pump, filters, small diameter nylon piping, proportioning units, and porous stainless-steel distributors. Control may be manual by a simple ON/OFF switch, or automatic from an ice detector.

There has never been a reported instance of the self-cleaning distributors being fouled by extraneous particles. In fact, reliability and long operating life are as much attributes that are claimed for this system, as are its simplicity and low weight. The approved fluids are T.K.S. R.328 and DTD 406B; the latter is marketed by the oil companies under their brand names such as AeroShell Compound 7, and is available immediately in some 40 countries throughout the world.

(47) Taylor (Metal Workers) Ltd, C. F., *Molly Millars Lane, Wokingham, Berks (Wokingham 2500)* Stainless, titanium and light-alloy duct assemblies are fabricated by C. F. Taylor for the hot air anti-icing systems in the BAC One-Eleven and VC10, and the HS Trident.

(48) Teddington Aircraft Controls Ltd, *Merthyr Tydfil, Glam (Merthyr Tydfil 3261)* Teddington's prolific contribution to aircraft anti-icing and de-icing covers detection and warning, and control and distribution, in both hot air and electrothermal systems. Among the company's most widely-used products is the type P.B.E. "hot-rod" illuminated ice detector probe, which protrudes beneath the captain's window in the majority of British transports to give immediate visual warning of icing.

In the VC10 (a typical example of an extensive hot air anti-icing system) Teddington products (in addition to the "hot-rod") include duct temperature control and pressure regulator valves, associated servo packs, and over-pressure relief valves; high-pressure stop valves and main non-return valves; overheat sensing elements to give audible or visual warning of excessive temperature; pressure switches; tail stop valves; and independently operated, double butterfly stop valves, to allow the wing system to operate with 50 per cent through area, in the event of electrical supply failure to either port or starboard equipment. An associated company, Teddington Bellows, supplies internally hinged and gimballed bellows units as expansion joints in the VC10's wing ducting.

Teddington systems for sequencing supplies to electro-thermal de-icing equipment on engines, propellers and wing and tail surfaces, are fitted to many turboprop aircraft. An important unit is the a.c. motor-driven cyclic switch, one particular version of which is associated with the Spraymat system.

Further products in this field include automatic ice warning and icing intensity indicator systems, and solid-state temperature controllers designed to maintain skin temperatures at the minimum level for anti-icing.

Teddington is also marketing a newly designed ice warning system which not only warns of ice but also indicates its severity. Information is given to the pilot either by an indicator dial or by means of a warning light which is illuminated at a pre-determined level of ice formation. It is undergoing trials, basically for light aircraft, in the United States, where it is attracting considerable attention

(49) Teleflex Products Ltd, *Christopher Martin Road, Basildon, Essex (Basildon 22861)* Alco Valve Company's electric windscreen wiper systems are manufactured under licence by Teleflex Products.

(50) Tiltman Langley Ltd, *Redhill Aerodrome, Surrey (Nutfield Ridge 2232)* Electrically heated waste-water outlets with automatic temperature control and suitable fairings, are produced by Tiltman Langley for the galley and toilet drain systems in the Britannia, VC10, One-Eleven and Trident 2E.

Also produced are single pole, two-way, snap-action thermal switches, and thermo-pneumatic switches which may be used to control pressure-sensitive switches, or directly, pneumatically operated modulating valves or actuators. Both are operated by the effect of temperature change on a co-axial bi-metal sensor. These units have found application in military and civil aircraft for overheat protection and de-icing circuit control.

This company also manufactures a range of manually operated control valves, pneumatically controlled gate valves, and pressure reducing valves suitable for use in warm-air demisting and defrosting applications.

Continued on page 755

This Piper Navajo cruises 398 kph (247 mph), can fly higher on one engine than any mountain in Europe, and doesn't cost a fortune.

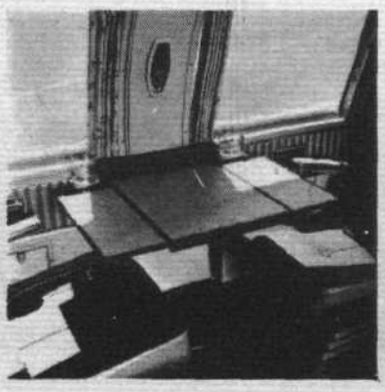
A swift, long-range Piper Navajo at your command changes your entire concept of where you can be when you want to be. With its fast cruising speed—363 km/h (225 mph) at 12,000 feet; 398 km/h (247 mph) at 23,500 feet—this turbocharged executive transport will take you over 2,000 kilometers (1300 miles) non-stop on *your* schedule.

The scope, range, and utility of the Navajo are as limitless as the horizon in the picture above. Its 26,000-foot cruise capability tops most of the weather, and optional radar adds further to round-the-clock schedule reliability with little regard for the weather. You fly with peace of mind thanks to "dual everything", from two engines to double alternators. *On just one engine* this new Piper will fly higher than any mountain in the Continental U.S. or Europe.

What this picture does not portray is the economic significance of the new Piper Navajo—an economical turbocharged executive airplane with conference room seating in the main cabin, separate pilot compartment, buffet and toilet. For anything faster in the 6-8 place class you'd have to pay at least fifty percent more.

If you are not yet taking advantage of the high-speed, personal type of transportation which only a company airplane can provide, the Navajo could let you make this inevitable move most prudently and satisfactorily. If your company, like so many, operates larger aircraft perhaps a Navajo could be a logical supplement. Because the Navajo can use thousands of airports too small for larger aircraft, it could greatly expand the usefulness of any corporate fleet.

There are many exceptional points, both economic and aerodynamic, about the Navajo. It's an airplane well worth your consideration. Your Piper dealer will be most happy to introduce you to the Navajo, or you may write for full particulars to:



EXECUTIVE NAVAJO features include luxurious seats with fold-away tables, separate crew compartment, buffet and toilet in rear. Quickly convertible to 8-place seating.

PIPER
AIRCRAFT CORPORATION

LOCK HAVEN, Pa., U.S.A.
Distributed in the United Kingdom and Ireland by:
C·S·E Aviation Ltd., Oxford Airport, Kidlington, Oxford, England.


tellair

Switzerland's new airline

Tellair is the name of a new airline that will appear among the airlines of Europe in the Spring of 1969. Taking its name from the most popular of Swiss heroes, this new airline will operate into Berne and Sion with incoming visitors and will utilize Zurich, Geneva and Basle for Swiss Traffic to holiday destinations abroad. In the initial stages from March onwards, Tellair will be mainly concerned with contract operations for tourism. A full jet fleet will be operated in the early 70's. Tellair was formed by Swiss local government, financial and tourist interests and a major international airline.

Exciting and progressive careers with Tellair are now open to suitable applicants in all departments including:

FLIGHT OPERATIONS

Superintendent FOS

Will have management experience in major air transport concern. He will hold a valid airline transport licence with not less than 5000 hours command time in reputable air-transport service.

Captains FOC

Will hold a valid airline transport licence with not less than 5000 hours command time in reputable airtransport service.

First Officers FOFO

Will hold at least a commercial pilot's licence with 2000 hours flight time, the majority of which shall be in multi-engine aircraft.

CABIN STAFF

Supervisor CSS

Will have a minimum of 5 years experience as an airline stewardess and have fluent command of English, German and French languages.

Stewardesses CSSF

Height 5' 2"–5' 7". Weight not exceeding 135 lbs. Good appearance and capable of passing appropriate medical examination. Age limits: 21–35. Fluency in English, French and German. Suitable candidates will receive 4–8 weeks' training in England, commencing 1st January 1969.

FLEET MAINTENANCE

Superintendent FMS

10 years experience in airtransport service with full licence cover in both piston engined and turbine powered aircraft. Previous supervisory experience essential.

Supplies Supervisor FMSS

At least 5 years experience in reputable airline service in supervision of technical supplies.

Quality Controls Supervisor FMGC

7 years experience in airtransport service with full licence cover in both piston engined and turbine powered aircraft. Previous supervisory experience essential.

Licensed Technicians FMLT

Shall hold appropriate licences for either airframe engines or avionics.

MARKETING AND SALES

Marketing Superintendent MSS

Must have minimum of 5 years experience in airtransport, marketing and sales with proved ability in contract negotiations and further background in airline traffic is desirable.

Sales Representatives MSR

Minimum 2 years experience in airtransport sales and familiarity with travel agency business. Must be able to speak fluently English and German or French.

HOW TO APPLY: Fill in the coupon alongside, inserting clearly the key letters of the vacancy interested in. Attach coupon to your application, which should give full career details and curriculum vitae. All applicants will be notified by 30th November 1968 as to whether their application is being considered or not. Preference will be afforded to citizens of Switzerland but consideration given to all nationalities. Selected candidates will be called for interview in Berne or London during latter part of November.

TELLAIR, 3001 BERN SWITZERLAND SCHAUPLATZGASSE 21

I am applying for Job Vacancy ..... (fill in key letters)

Name .....

Address .....

.....

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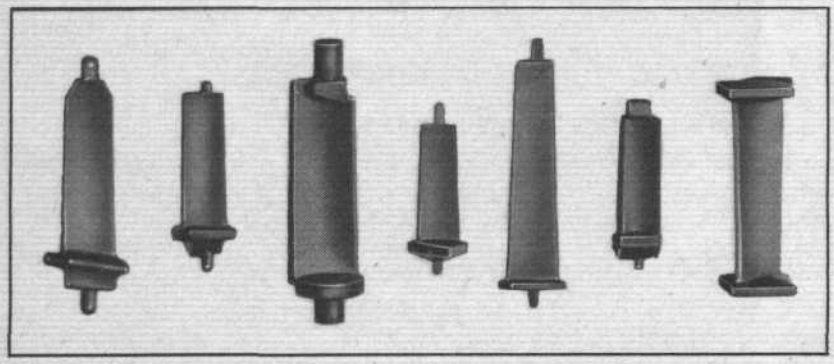
Bern · Switzerland

TELLAIR 3001 BERNE SWITZERLAND SCHAUPLATZGASSE 21

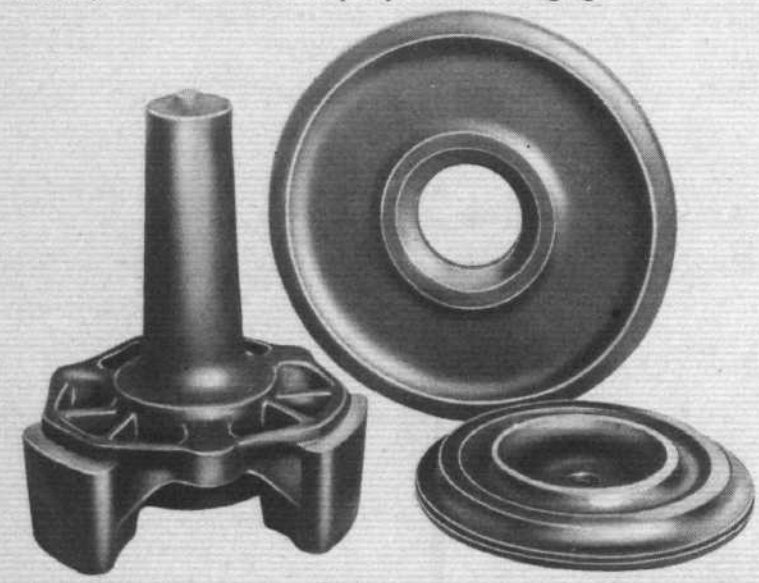
GKN forgings and castings play a vital role in Britain's aircraft industry

GKN
FORGINGS & CASTINGS

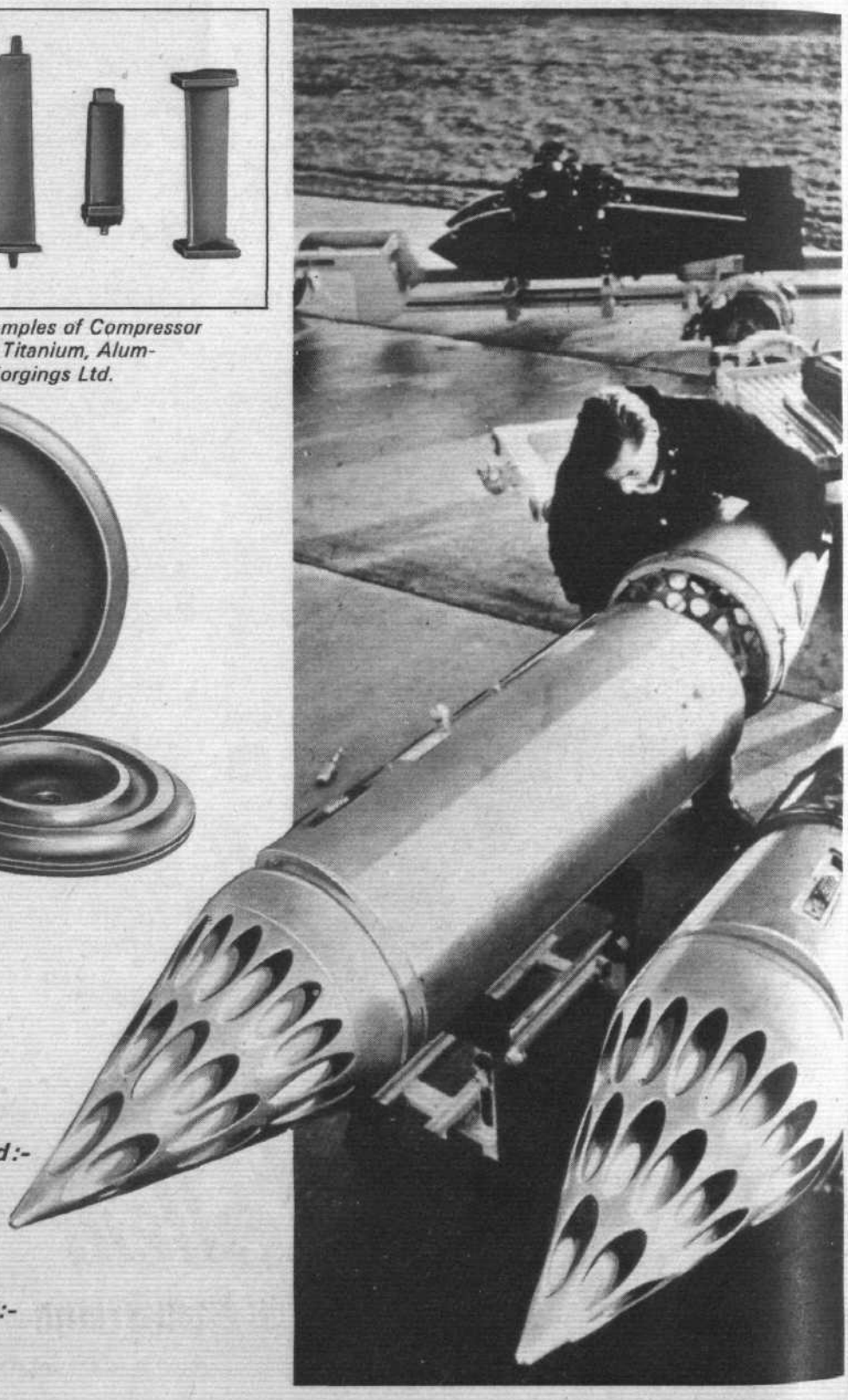
The specialised skills of three GKN member companies (Kent Alloys Limited, Smith-Clayton Forge Limited, Precision Forgings Limited) meet the challenge presented by progress and development in the air — and supply the "high stress" components vital to the reliability and efficiency of Britain's latest aircraft and the new "advanced technology" engines.
On the right, a fine example of GKN precision. The nose cones on the rocket pods shown are cast by Kent Alloys Limited in Aluminium. Each cone houses 32 projectiles.
To the left, illustrating GKN versatility, are examples of forged aircraft engine components.



Operating in famous aircraft engines these examples of Compressor and Turbine Blades are forged to fine limits in Titanium, Alum-Bronze, Steel and Nickel Alloys by Precision Forgings Ltd.



Examples of compressor wheels, and a prop shaft weighing 323 lbs produced by Smith-Clayton Forge Ltd. for Rolls Royce Engines serving aircraft the world over.



Members of GKN Forgings Limited:-
Smith-Clayton Forge Limited,
Tower Works, P.O. Box No. 22,
Lincoln
Precision Forgings Limited,
Clomendy Road, Cwmbran, Mon.

Member of GKN Castings Limited:-
Kent Alloys Limited,
Temple Manor Works,
Rochester, Kent

AGAINST THE ICE MENACE . . .

(51) Triplex Safety Glass Co Ltd, *Triplex Works, Kings Norton, Birmingham (Kings Norton 2031)* The Triplex gold film system of electrical heating has been used for many years for de-icing and demisting aircraft windscreens. Examples of current applications are listed on the table on page 1079, the most recent important civil one being Concorde.

The "cathodic sputtering" technique of depositing gold as a heating medium, developed by Triplex, involves coating the surface of the glass, in an evacuated chamber, with a 0.0000002in layer of pure gold, which can be graded to give uniform power dissipation over any chosen heated area, including curved surfaces. The gold film, which is also a good infra-red reflector, combines a high standard of light transmission with excellent electrical and heating characteristics.

Laminated panels consist of the outer gold film glass, main inner glass, and inside glass splinter shield, with Vinal interlayers and a Thiokol flange. The thick Vinal interlayer behind the gold film glass forms a diaphragm capable of withstanding bird strikes, whilst sustaining pressurisation without rupturing in the event of glass breaking. Temperature is controlled by a resistance thermometer embedded in the plastic interlayer. Typical power ratings are 250-900W per sq ft on a.c. or d.c. supply.

To overcome the problem of kinetic heating, Triplex has developed new materials capable of withstanding temperatures from —70° to 150°C.

(52) Warne & Co Ltd, William, *Aviation Division, Gascoigne Road, Barking, Essex (01-594 3800)* In addition to a range of reinforced silicone air starter hose, which is equally suitable for ground defrosting applications, William Warne's products also include various grades of insulated and non-insulated lightweight flexible ducting for airborne installation in warm-air delivery systems.

Industry International

Dowty Rotol's DC-10 Order

WITH THE SIGNING, announced last week, of the McDonnell Douglas contract with Dowty Rotol for up to 150 nosewheel gears for the DC-10, the full story of how this order—the first of its kind ever given to a British company on an American aircraft—was won can now be told.

It started back in 1963 when, in the words of Alec Watson, Dowty Rotol's sales director, "we decided we ought to look to the United States to expand our business." In that year the company, whose leading spirits throughout this enterprise have been Mr Watson and the general sales manager, John Eldridge, went to visit the US "big three"—Lockheed, Douglas and Boeing. At that time, they found Douglas "polite," and encouraged by this attitude decided to aim at getting some of their equipment on a Douglas aircraft.

It was not until the early spring of this year, however, that the possibility of a Dowty Rotol order on the DC-10 began to loom large, although the spadework which the company had done in the US since 1963 contributed to its realisation. Over the past two years, Eldridge has spent seven months in the United States, and Watson nearly an equivalent amount of time. As the latter puts it, "You've got to single out something you can sell." Apart from its engines, landing gear is the largest single item of equipment on an aircraft; Dowty knew they could do the job, having already produced 165 different types. Moreover, Dowty's timing was right. As Watson also says, "It so happened we timed ourselves nicely in relation to DC-8 production."

Things started to take shape in the spring of this year when on March 9 an eight-man Dowty Rotol team gave a presentation to Douglas at Long Beach. Its members included the sales and production directors, general sales manager, chief engineer, chief metallurgist, chief production controller and quality controller. They didn't, however, talk to Douglas about undercarriages but about Dowty Rotol, putting on a presentation with 35mm slides describing the Dowty Group and Dowty Rotol, its facilities and capacity, every aspect of its productive ability being illustrated and described. Of this presentation, Watson says, "We talked for about an hour, then threw it open for discussion. The main purpose was to let them see things for themselves."

On April 25, Douglas issued an RFP (Request for Proposal) on a 30-day response which meant that replies were due to be received by June 1. Six other companies were in the running for the DC-10 nosewheel contract, five of them American and one Canadian.

Next step in the story was a bidders' conference called by Douglas for May 13 which all the companies concerned attended. Watson comments: "They're very fair: if you have a question to ask, they circulate the question and answer to the other bidders, so that everybody has the same knowledge." Such a conference normally comes between the RFP and the response, in this case due in by June 1, and Dowty's bid was put in at the end of May. The actual document was in two sections, A and B, together about an inch thick. It was proof-read and finalised at the Green Bank Hotel, Falmouth, where Watson was snatching a quick holiday in the midst of his US visits, Eldridge bringing him down the proofs to read. It had been prepared by a Dowty Rotol sales projects team under Eldridge's direction; 24 copies were printed, 11 of them being air-freighted to Douglas.

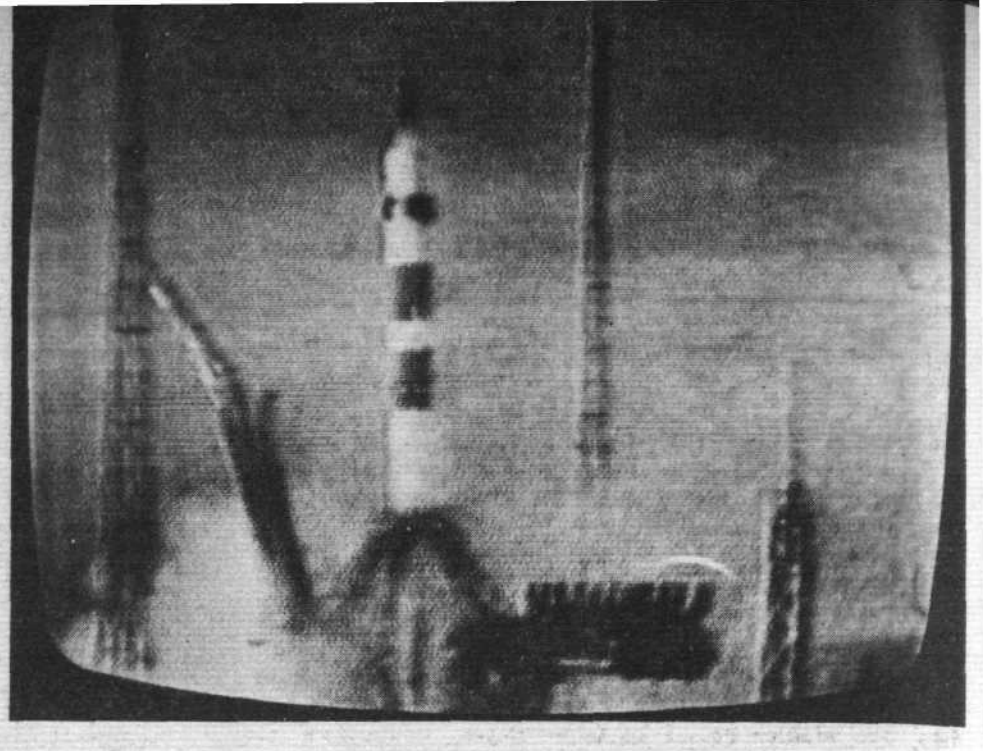
Dowty realised that the wind was blowing favourably for them when Douglas asked to send a survey team, which came to Cheltenham in the third week in June and stayed for about three days. (Douglas had in fact in the meantime short-listed three or four companies and decided to "dig into them.") Noticeably, this visit followed receipt of the Dowty proposal at Long Beach. The Douglas team consisted of engineers, quality control and manufacturing executives, and each member carried a questionnaire to be answered.

Following the Douglas visit to Dowty Rotol, a high-level team from the company went across to California in early July, consisting of R. F. Hunt, deputy chairman, Warwick Squire, financial controller, Watson and Eldridge. This was rather like the introduction of prospective in-laws once a young couple has decided to marry. Actual purpose of the mission was to go over the terms of the contract document, which required the agreement of Dowty's top people.

Once the proposed contract had been mutually discussed, Douglas issued Dowty with an ITP (Instruction to Proceed, under certain limitations) and this was received towards the end of August. It was only on the Friday before the SBAC Display began (September 13) that Dowty were given permission to release this news publicly—hence the "Show surprise" of the DC-10 order (recorded in *Flight's* issue of September 26). As was stated there, a light alloy mock-up of the nosewheel gear was rushed through in time for the Show, and this is now on view at the Dowty Group headquarters.

One difficulty about the wording of the contract was the different terminology employed by the Americans and the British; for example, to the former "solid cylinder" is what a piston is to the latter. But any misunderstandings or difficulties on either side were successfully resolved. (Dowty had the services of a US lawyer who put himself at their disposal day and night.) In itself the contract document is not a lengthy one, but its appendices make it altogether something like two inches thick.

Every employee at Dowty Rotol received a note in his pay packet saying that the order had been won and asking him to play his own part, however large or small, to fulfil it. For Alec Watson and John Eldridge, it represents only a beginning; they know Dowty Rotol can give Douglas what it wants, and expect that other orders from the US will follow successful fulfilment of this one.



The launch of Soyuz 3 was televised by Moscow Radio. Assessment of the size of the vehicle is difficult since the rocket is believed to have lifted from a sunken pad, and the lower section of the first stage was then obscured by smoke. The vehicle must, however, be at least as large as Saturn I. The relatively casual wear favoured by Russian astronauts was again demonstrated by Beregovoi (see picture below), who sported lightweight blue overalls and a soft helmet. This was apparently retained even for launch and landing

Spaceflight

SOYUZ 3: PRELUDE TO THE SPACE STATION

WHILE RUSSIA continued to observe official silence about the exact purpose of the Soyuz 3 flight, all the indications are that the main purpose of the mission (the first Soviet manned flight since that of Soyuz 1 in April last year) was the development of techniques for use, at least initially, with manned space stations.

Soyuz 3 was launched from the space centre at Baykonour at 0834GMT on October 26. Flown by Col Georgy Beregovoi, the spacecraft made 64 Earth orbits before landing near Karaganda, a town about 350 miles ENE of Baykonour, at 0725GMT on October 30. The landing was apparently accurate, for a recovery helicopter was soon at hand to fly the astronaut back to base.

The main objective of the flight, apart from the qualification of the parachute system, was an approach and rendezvous (and possibly docking) with an unmanned target vehicle, the Soyuz 2 spacecraft, which had been launched on October 25. The initial orbit for this satellite was 115/139.2 miles at an inclination of 51.7°, while that of Soyuz 3 was 127.4/139.8 miles with an inclination of 51.67°. Soyuz 3 was manœuvred to within 600ft of the target vehicle using both automatic and manual tracking. There are no indications that the two spacecraft actually docked, although Soyuz 2 is believed to have had a docking collar, but Soviet reports claim that all the scheduled manœuvres were successfully completed. Two rendezvous exercises were completed, after which the orbit characteristics were given as:— Soyuz 2, 112.4/143.5 miles, and 51.7° inclination; Soyuz 3, 111/156.5 miles, 51.7° inclination.

Following the rendezvous, Soyuz 2 was returned to Earth at 0751GMT on October 28. A parachute system, together with retro-rockets, was used to lessen the landing shock.

Several TV sessions were held by Col Beregovoi using a small hand-held camera. These showed fairly clearly the layout of the instrument compartment, also used for rest periods. This was one of two habitable units of Soyuz 3, the other being the command module. The instrument compartment appeared to consist of a cylinder, large enough for the astronaut to stand upright, and equipped with switching and control panels. Among the displays was a map or globe of the world, upon which the position of the spacecraft was represented by a moving point of light. This was sychronised with computing and tracking equipment at the launch centre, and allowed instant identification of the area visible at any given time through any of the four windows.

At one end of the compartment was an airlock, presumably communicating with the command module. The internal pressure of the compartment was stated to be 780mm mercury, much greater than might have been expected from structural and biological considerations.

Preparations for landing were begun over Africa, apparently on the 61st orbit, when retro-thrust was applied for 145sec (by comparison, the main engine on Apollo 7 fired for 11sec). The main engine was then jettisoned (together with, possibly, the instrument compartment). The spacecraft was lowered to Earth by parachute and, as with Soyuz 2, retro-rockets were fired to lessen the landing impact.

Soviet Press and radio have been at pains to promote the impression that the immediate application of Soyuz 3 data will be for space stations in Earth orbit, rather than for manned missions to the Moon (though the possibility of lunar flights at a later date was not discounted). For example, Leonid Sedov, who was director of Russia's space programme at the time of the Sputnik 1 launch in 1957, stated that Soyuz 3 was "part of a programme to develop operations around the Earth." He added that the spacecraft was large enough to carry three or four astronauts, although only one had been needed on the Soyuz 3 flight (a further indication of the experimental nature of the flight). He added that "In the immediate future the programme does not include the landing of men on the Moon's surface."

Col Beregovoi is, at 47, the oldest active astronaut (Russian or American) and Soyuz 3 was his first space mission. He flew as a fighter pilot during World War 2, and was awarded the title of Hero of the Soviet Union.

McDONNELL DOUGLAS MINI-SATURN

The interim civil space budget for the fiscal year 1969 is running at only $3,850 million, the lowest figure since 1963. Despite this a provisional programme of new projects has been approved by NASA, although it is yet to be endorsed. Among the new projects is a new launch vehicle, intermediate in size between the Saturn S-1B and the Saturn V, of a type for which NASA has sponsored design studies over a period of several years.

The new vehicle, a proposal for which was discussed by McDonnell Douglas at the XIX International Astronautics Federation conference in New York, will be developed for use with post-Apollo Earth-orbital space stations, and for launching unmanned interplanetary probes.

The USAF also requires an inexpensive booster to reduce the cost of orbiting military payloads and it is possible that the civil and military requirements may be combined.

The McDonnell Douglas proposal employs a cluster of four solid-propellant motors as the first stage, with the existing lox/H_2 S-IVB as second stage. This booster could place 108,300lb into a 105 n.m. circular orbit and 76,000lb into polar orbit. For interplanetary flights, the vehicle could inject 22,000lb into a lunar transfer orbit, or (depending on velocity requirements) carry between 6,400lb and 15,000lb on a Mars flyby. The addition of various upper stages, for example the Apollo service module, or a Centaur, are possible. For example, a Centaur third stage could increase the payload in lunar transfer orbit to 36,700lb; the Mars flyby payloads could be increased to 23,600lb-30,600lb.

Further performance increments could be obtained by increasing the number of first-stage segments, increasing the fuel capacity of the S-IVB stage, or by employing a more powerful S-IVB motor. Alternatively, the launch vehicle could be downgraded for simpler flights by reducing the number of first-stage motors. According to McDonnell Douglas, testing already done on the 156in motors had shown that no major technology problems were likely to be encountered in the development of the proposed first-stage motors.

The total thrust at lift-off, with the four-rocket cluster, would be 7,280,000lb (by comparison, that of the present Saturn V is 7,500,000lb). Each motor would have a moveable nozzle to provide pitch, roll and yaw control. Only minor modifications to the S-IVB stage (which delivers 205,000lb thrust in vacuo) would be required.

SATURN 1Bs IN MOTHBALLS

The last of 12 Saturn 1Bs (uprated Saturn 1s) built in support of the Apollo programme has now been put in storage, along with six others, pending the indefinite start to the Apollo Applications Programme. The first stages are stored at Chrysler's New Orleans plant, while the upper stages are kept at the McDonnell Douglas factory at Sacramento, California. Indefinite storage is acceptable, although lifed items such as seals will need to be replaced before the rockets are used.

The Saturn 1Bs were designed as stop-gap launchers to fly elements of Apollo in Earth orbit while the larger Saturn 5s were developed. In the event, recurring problems with the spacecraft pushed the schedule back so that only four rockets were actually used. The first flight took place on February 26, 1966, when the first Apollo command and service modules were flown sub-orbitally. Subsequent Saturn 1Bs were flown on July 5, 1966 (a study of the hydrogen-fuelled S-IVB stage); August 25, 1966 (verification of Apollo systems for manned, Earth-orbit missions); and January 22 (test flight for the lunar excursion module, using the launch vehicle modified following the disastrous fire at Cape Kennedy on January 27, 1967).

The fifth flight was that in which the vehicle was used to orbit the Apollo 7 in its 11-day flight last month. This will be the only Apollo flight to use the uprated Saturn 1, but the seven vehicles now surplus to the programme will be used for the Apollo Applications Programme. The recent NASA economies have forced a postponement in this project and it appears unlikely that the first launch will occur before 1971.

Meanwhile an evaluation of the Apollo 7 flight has shown that the vehicle performed almost flawlessly. Launched during steady surface winds of 20kt (twice that recorded in previous Saturn 1B launchings), the trajectory was close to nominal and the orbit-insertion conditions were met satisfactorily.

JAPAN'S SPACE BUDGET GROWS

Japan plans to spend $39.5 million (£16.5 million) on its space programme during the fiscal year 1969, more than twice the current expenditure. The national space programme is directed towards developing an ionosphere research satellite, for launch in 1971-1972, and a synchronous communications satellite, to be orbited in 1972-1973.

It is reported that two satellites will be launched next year, using MU-4 launchers, while work will begin shortly on two further scientific satellite (all in addition to the ionosphere probe).

RUSSIA TO LAUNCH FRANCE'S ROSEAU

A conference of French and Russian scientists at Paris to discuss collaborative space research ventures ended on October 11, after the decision had been taken to launch the French Roseau satellite by means of a Russian rocket.

Roseau is an IMP (interplanetary monitoring platform) type of spacecraft which, according to *Space Daily*, will be launched into an orbit having an apogee of between 62,000 miles and 124,000 miles. It will make measurements of fields and particles in regions of space which are unaffected by the magnetosphere, as well as measurements of solar plasma in the transition zone at the magnetosphere.

Experimental transmissions of both monochrome and colour TV between France and Russia, using Molniya satellites, have been successfully concluded and telephonic trials using the same satellites are nearing completion.

TITOV FOR MOON LANDING

The Russian astronaut Gherman Titov is to be one of the crew members of the first Soviet lunar landing mission. Reporting this news in its issue of October 23, the Mexican newspaper *Ultimas Noticias* quoted the astronaut (who was in Mexico as part of the Russian contribution to the "Man in Peace" programme) as saying that he did not know when the launch would occur or who the other crew members would be.

Maj Titov was the commander of the one-man Vostok 2 spacecraft which made 17 Earth orbits after being launched on August 6, 1961.

RECENT COSMOS LAUNCHES

Cosmos 244 was launched on October 2 into a 50° orbit. The apogee and perigee were 132 miles and 87 miles respectively.

Cosmos 245 was launched on the following day on a 71° orbit. The apogee and perigee were 315 miles and 172 miles respectively.

Cosmos 246, possibly a new reconnaissance satellite, was placed in a 65.4° orbit on October 17. The apogee and perigee were 216 miles and 91 miles.

Cosmos 247 was launched into orbit on October 11. The orbital elements were: apogee, 225 miles; perigee, 127 miles; and inclination, 65.4°.

Cosmos 248, launched on October 19, is believed to be the first of a new series of flights with spacecraft having, possibly, orbit-manœuvre abilities. The initial parameters were: apogee, 343 miles; perigee 305 miles; and inclination, 62.3°. This is the first occasion on which this orbit has been used since the launch of Cosmos 217 on April 24 this year. On this occasion the satellite failed to attain the predicted orbit.

Cosmos 249 was launched the following day into a very elliptical orbit, with an apogee of 1,350 miles and perigee of 319 miles. The inclination was 62.4°. It is possible that Cosmos 248 and 249 are part of the Soviet programme to develop docking techniques, since a later orbit of this satellite was found to have an apogee of 1,017 miles. Such performance would be essential to the docking manœuvres during space-station operations, a sector of research in which Russia is known to be actively interested.

Results from Yantar The Soviet satellite Yantar 1, launched in October 1966 to study the operation of electric propulsion, was described by Russian scientists at the recent IAF conference in New York. The engine on board the satellite has provided a velocity increment of 25 miles/sec.

DEFENCE

PHANTOMS FOR JAPAN?

JAPAN'S NEXT MAINSTAY FIGHTER to succeed the F-104J Starfighter may be the F-4E Phantom 2. This is the "majority view" following visits by an F-X mission to the United States and France where they have been looking at possible contenders.

Japan's Air Self-Defence Force currently operates 200 F-104J Eikos and a decision as to which type is to succeed this aircraft was being made at the end of October. This was announced by the Defence Agency Director-General, Mr Kaneshichi Masuda, after he had received a recommendation from Lt Gen Tsutomo Omuro, chief of the Air Staff Office, who based it on a report prepared by the F-X mission. This body had looked at the F-4E and CL-1010-2 in the United States and Mirage F1C in France and the majority view (say informed sources) favoured the McDonnell Douglas contender.

The CL-1010, a Lockheed private venture, was described in *Flight's* report last week of the Tokyo Aerospace Exhibition (pages 699-707). It is a development of the F-104 with more power, greater speed, longer range and a triple weapon system: M-61 Vulcan cannon, radar-homing Sparrow III and infra-red-homing Sidewinder missiles, all controlled by the Autonetic F-221 micro-miniature three-weapon firing system. The Mirage F1 was described in the same issue (Defence, page 720) in a report of M Marcel Dassault's recent press conference in Paris. Mr Motoo Shishido, director of the Defence Bureau of the Defence Agency, referring to the F-4E evaluation when answering questions in the Japanese Diet, said that members of the mission had flown the aircraft about 30 times. He said he had "no idea" about an "aggressive sales promotion for its aircraft in Japan" being launched by Lockheed Aircraft International.

As has been the case with the F-104Js, the F-X would be built in Japan and funds available for its production under the next five years' defence plan (1967-1971) total Y78,000 million (about US$217 million). If F-4Es are decided on, about 36 aircraft will be secured under the current programme. The US had shared part of the cost of Japan's domestic production of F-104Js. Prime contractor for the F-X has yet to be named; in the case of the F-104J it was Mitsubishi, which produced a total of 230 F-104Js and -DJs in co-operation with Kawasaki.

Italy's Atlantics

AVIONS LOUIS BREGUET issued on October 29 details of the Italian order for Atlantics, subject of a news-item in *Flight* for October 31. The contract is for 18 aircraft (not 40, as had been assumed) and it is being placed by Breguet with the European SECBAT consortium—Société Européenne de Construction de l'Avion Breguet Atlantic. Under Breguet's design leadership, airframe companies in this are Dornier and Siebel (West Germany), Fokker (Netherlands), Sud-Aviation (France) and the SABCA-Fairey-FN group (Belgium). Engine and propeller manufacture brings together Rolls-Royce and HSA (UK), Hispano-Suiza and Ratier (France), FN and SABCA (Belgium) and MAN (West Germany). The bringing of Italy into the committee which directs the programme and of the Italian industry, headed by Finmeccanica, into the industrial consortium "enlarges and consolidates European aeronautical co-operation," Breguet state.

The Atlantic went into service at the end of 1965. So far, in addition to the Italian Navy, the following other navies have ordered it: French (40), West German (20) and Netherlands (nine).

The MRCA Situation

AN EVEN MORE complicated situation seems now to have arisen over the MRCA (multi-role combat aircraft). The British are still insisting on design leadership, but the German aircraft industry is prepared to go it alone if it does not get design leadership. Now the French Government is reported to be seeking West German collaboration on a Franco-German swing-wing type based on the Dassault Mirage G. Britain's position is that it wants to build an MRCA (for which the European market would be something like 1,000 aircraft) in co-operation with West Germany, the Netherlands, Belgium and Italy (Canada has now withdrawn). The project would take the place in the British aircraft industry's agenda of the cancelled AFVG.

If the other nations in the proposed consortium fail to agree on the project, the West German industry claims that it is capable of undertaking such an aircraft itself. Reflecting possible preparations for such a move is the recently announced decision by the Bavarian Ministerial Council to take a 25 per cent stake in Bölkow as part of a capital increase in this company of from DM3.2 million to DM9.6 million ($0.8 million to $2.4 million).

Since June this year Bölkow has been merged with Messerschmitt to form Messerschmitt-Bölkow, in which the Boeing Company, Nord Aviation and the Bavarian Reconstruction Finance Board each had originally a 16⅔ per cent holding. This is the largest single aerospace company in West Germany, employing more than 12,000 people!

A French Government move to seek West German collaboration in development of a joint swing-wing strike aircraft—presumably the twin-Atar Mirage G4, two prototypes of which have been ordered—was reported from Paris last week. The French argue that this aircraft would not only be cheaper than the MRCA, but that the German aircraft industry could hope for a large share in its design and development. The pro-

Modified by the addition of stub wings in which fuel is carried, this US Navy UH-2C Seasprite recently began flight testing at the Kaman Aircraft Corp Flight Test Centre, Bloomfield, Conn. Fuel in the wings and in two 60 gal drop tanks gives the modified version an endurance of over 4½hr, about 27 per cent greater than that of the standard UH-2C

jected type would come into service from 1975, when the German Air Force would need a replacement for its Starfighters and the French Air Force a new high-performance combat aircraft.

Reports last week from Bonn that Mr Anthony Wedgwood Benn, Minister of Technology, had told Germany that Britain would have to reconsider the A-300 if it did not get design leadership of the MRCA have been denied by Mintech.

Canadair's CF-5 Production

FIRST OF 189 centre fuselages for CF-5s and NF-5s was received by Canadair at Cartierville, Montreal, from Fokker in the Netherlands at the end of October. The Canadian company is manufacturing 115 CF-5s for the Canadian Air Force and 105 similar aircraft, but designated NF-5s, for the Royal Netherlands Air Force. This Fokker sub-contract, worth about $5.5 million £(2.3 million), forms part of a production sharing agreement between the Canadian and Netherlands Governments.

Canadair built the first 31 centre fuselages at Montreal and Fokker are to deliver up to ten a month to Canadair up to September 1970.

The production-sharing agreement was referred to in *Flight* for September 26. It represents the largest sub-contract Canadair has placed in the CF-5/NF-5 programme.

HS.748s for RAAF

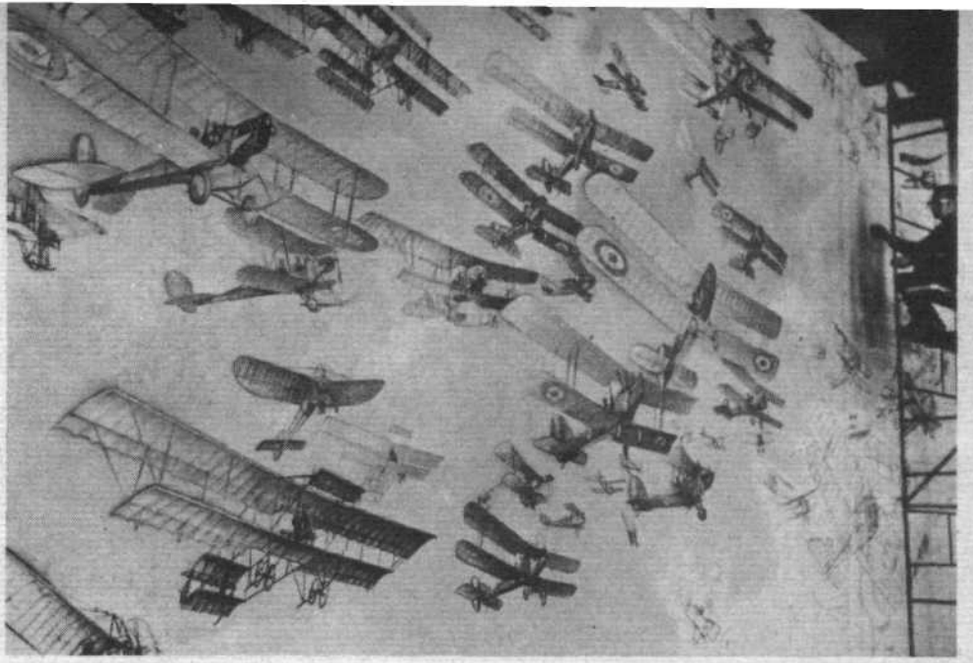
FIRST OF EIGHT HS.748 Series 2s bought by the Royal Australian Air Force as navigation and electronics trainers was handed over recently at Hawker Siddeley's Woodford airfield to the Acting High Commissioner for Australia, Mr J. H. Knott. The 748s are replacing Dakotas, which have served the RAAF in this role since the early 1950s.

Battle of Berlin?

IN ORDER TO PREVENT Soviet "buzzing" of Berlin during a Christian Democratic Party rally, the RAF, USAF and French Air Force were flying aircraft into the city last week. The purpose of having these allied aircraft in the city is to prevent a recurrence of what happened in April 1965 when Russian aircraft interrupted a session of the Bundestag being held in Berlin. In order to "keep the air filled" during the rally the allied aircraft were to take off and land continually, making circuits over the city. The RAF contribution was two C-130s, three Pembrokes and two helicopters.

Norway's C-130 Order

AN ORDER WORTH $16 million (£6.6 million) has been placed by the Royal Norwegian Air Force with the USAF for production of six C-130Hs. This was announced on October 30 by Mr. E. T. Crockett, vice-president of the Lockheed Gorgia Co, who said that the aicraft would be delivered in July and August of 1969. The C-130H is an advanced version of the -130E with more powerful engines, rated at 4,910 e.s.h.p. for take-off as against 4,050 e.s.h.p. in the earlier aircraft.



Being painted by Mr Harold Freedman (seen in the top right of this photograph) for the Australian War Memorial in Canberra, this is the first panel of a mural depicting all aircraft flown by Australians in a military sense from 1912 to the present day. Commissioned by the AWM trustees, the finished work—in oils—will be about 150ft long and 15ft deep, round the walls of the museum's "aeroplane hall," which will contain examples of the SE.5A, Spitfire, Lancaster and other famous aircraft. Space is being left on the walls to depict future types after the F-111

NATO's Eden Apple

A FIVE-NATION NATO air-sea exercise in the Mediterranean, code-named Eden Apple, began last Tuesday and is continuing for a fortnight. It brings together ships and aircraft of five nations—US, UK, Greece, Italy and France (although the last-named is no longer a member of NATO)—into one of the largest forces ever assembled for such an exercise in the Mediterranean. Its main objectives are to improve maritime co-ordination between the countries participating and also to provide a counter to the Russian show of naval strength in the eastern Mediterranean (*Flight*, October 31, page 721).

Nigerian NF Operations?

A DECISION TO MOUNT fighter operations by night against aircraft flying supplies to Biafra has reportedly been taken by the Nigerian Federal Government in Lagos. The new policy was coming into effect from this week. What has prompted it has been the increasing flow of arms into Biafra by night airlifts from Fernando Poo and Gabon, along the routes shown in the sketch map published in *Flight* for October 31, page 719. The aircraft involved fly in to the landing strip at Uli, a blanked-off section of the Port Harcourt-Kano road, and the supplies delivered have been having a pronounced effect on Biafran resistance to the Federal offensive.

To counter this air-delivered support for Biafra, Lagos has for the first time mounted night intruder operations, by rocket-firing L-29 Delfins of the Nigerian Air Force, against the Uli strip. What the Federal Government is also aiming to do, however, if it can acquire more MiG fighters from the USSR, is to intercept and destroy aircraft flying on supply missions. A complication in this policy is that Lagos has given permission to the International Red Cross to fly in relief supplies by night to Biafra, and some of these flights are made in the same types of aircraft—DC-6Bs and DC-7Cs—as those used to fly in arms, so there is a recognition difficulty for Federal pilots in discriminating between the two types of flights.

AAFCE Exercises

EXERCISES BEING MOUNTED in 1969 by Allied Air Forces Central Europe to test the capabilities of its component air forces in reconnaissance and strike operations have been scheduled as follows: Royal Flush PR competition, Spangdahlen AFB, Germany, May 11-23; Tactical Weapons Meet, RAF Jever, Germany, May 30-June 14.

Self-destroyed Mirage

A MIRAGE 3C of the Royal Australian Air Force was recently destroyed on a strafing exercise as a result, apparently, of a dead round of ammunition ricocheting off the ground and being sucked into the engine. The pilot, Fg Off Brendan Roberts, ejected safely although he suffered bruising when he landed heavily.

Fg Off Roberts was carrying out his exercise over an Air Force firing range when the accident occurred. He had reduced speed to about 200kt for his run over the target area; when this run had been completed he went up to about 3,500ft, then the engine lost power, flames and smoke coming from it. Reason for this is believed to be that a round of ammunition struck the ground, bounced up and was sucked into the engine.

As his aircraft lost speed, Fg Off Roberts ejected. The Mirage came down about 30 miles north of Newcastle, which is some 60 miles north of Sydney.

Straight and Level

WOULD YOU LIKE to know why the Government will have a problem if it concedes design leadership of the proposed new European combat aircraft to Germany?

Because every front-page headline of every newspaper in the kingdom would just have to be:

MESSERSCHMITTS FOR RAF

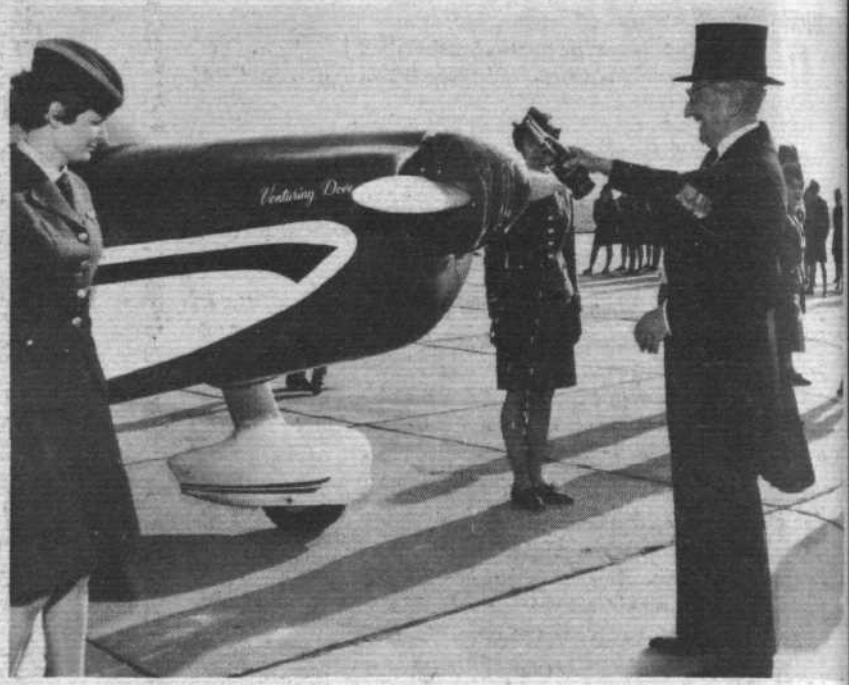
● So heavy has been the demand for car-parking space at Gatwick Airport lately that the British Airports Authority has been forced to raise the charges. Quite right, too. Dash it, can't those idiot passengers recognise a good rail link when they see one? They should be priced out of the car parks altogether—and serve them right. The next thing they'll be suggesting is more car-parking space!

● The pilot of a Cessna 310 which collided with a Piedmont 727 near Asheville, North Carolina, in June 1967 may have misunderstood an ATC instruction. At any rate, the US National Transportation Safety Board report recommends that the FAA should look into the possibility of "mandatory clearance read-backs" by pilots, and the clarification of controller phraseology.

All 79 occupants of the 727, and all three occupants of the 310, died in the collision.

The Cessna pilot was probably much more familiar with controller phraseology than most private pilots, some of whom are scared of asking "say again?"

While listening to all that secret shorthand ATC-Speak they are probably trying to find a railway line that they actually passed miles back and missed because of all the intimidating RT chatter, which makes them feel that at least five Boeings are about to fly through the cabin any moment.



I think she's wondering whether, as a member of the Girls Venture Corps, she might not venture to whip off Air Chief Marshal Sir Francis Fogarty's top hat and catch the bubbly with which he is naming the girls' new Jodel "Venturing Dove" at RAF Manston

● I see that the Edwards Committee inquiring into British civil aviation has, in the course of its inquiries into British civil aviation, visited Australia, Canada, France, Germany, Holland, Sweden, Switzerland and the United States. It has seen the top airline people and civil aviation officials in each country.

I wonder whether Sir Ronald Edwards and his colleagues made all their own travel arrangements? If their peregrinations were smoothed for them then I'm afraid they must do them all again, and see what it's like for people (if there are any) who are not on aviation committees.

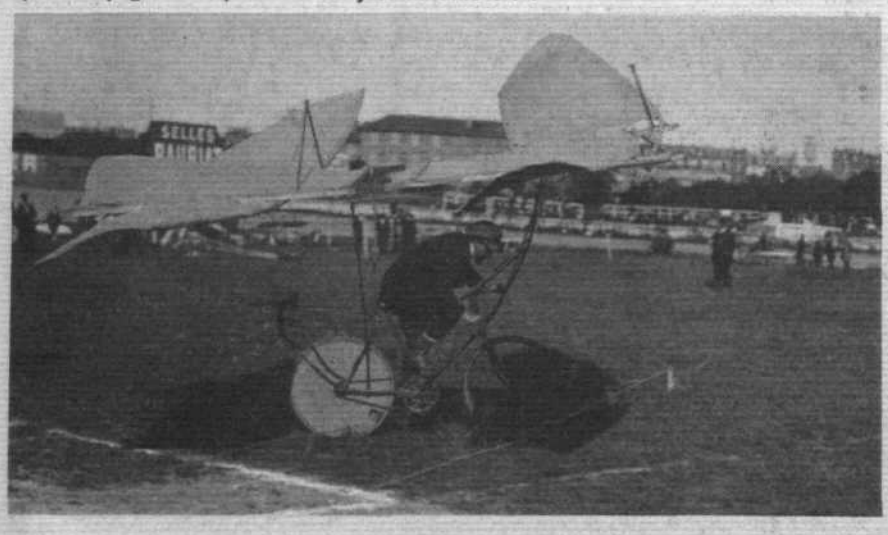
> The Germans have only toyed with advanced military-fighter aircraft. The MRA-75 (multi-role aircraft for 1875) will have to stay in service until 1986.

From the "Sunday Express", October 22, 1968

● Passenger baggage in the 747 is to be loaded into huge containers shaped to fit the belly holds of the aircraft.

So now it's going to be *whole containers*, or 60 people's baggage, sent to Bangkok by mistake.

If I really get a shift on I'll be just in time . . .



. . . to watch the flying

Roger Bacon

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DOUGLAS DC 6B. This is an 80 passenger seat aircraft. Seats are track mounted and are of high density type. Engines are Pratt & Whitney R2800 CB 17's. The fuel system is an 8 tank installation with useable capacity of 5,512 U.S. Gallons. The instrumentation is the standard Douglas DC 6B type. All mandatory modifications are embodied. The aircraft is immediately available price U.S. Dollars **150,000**

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