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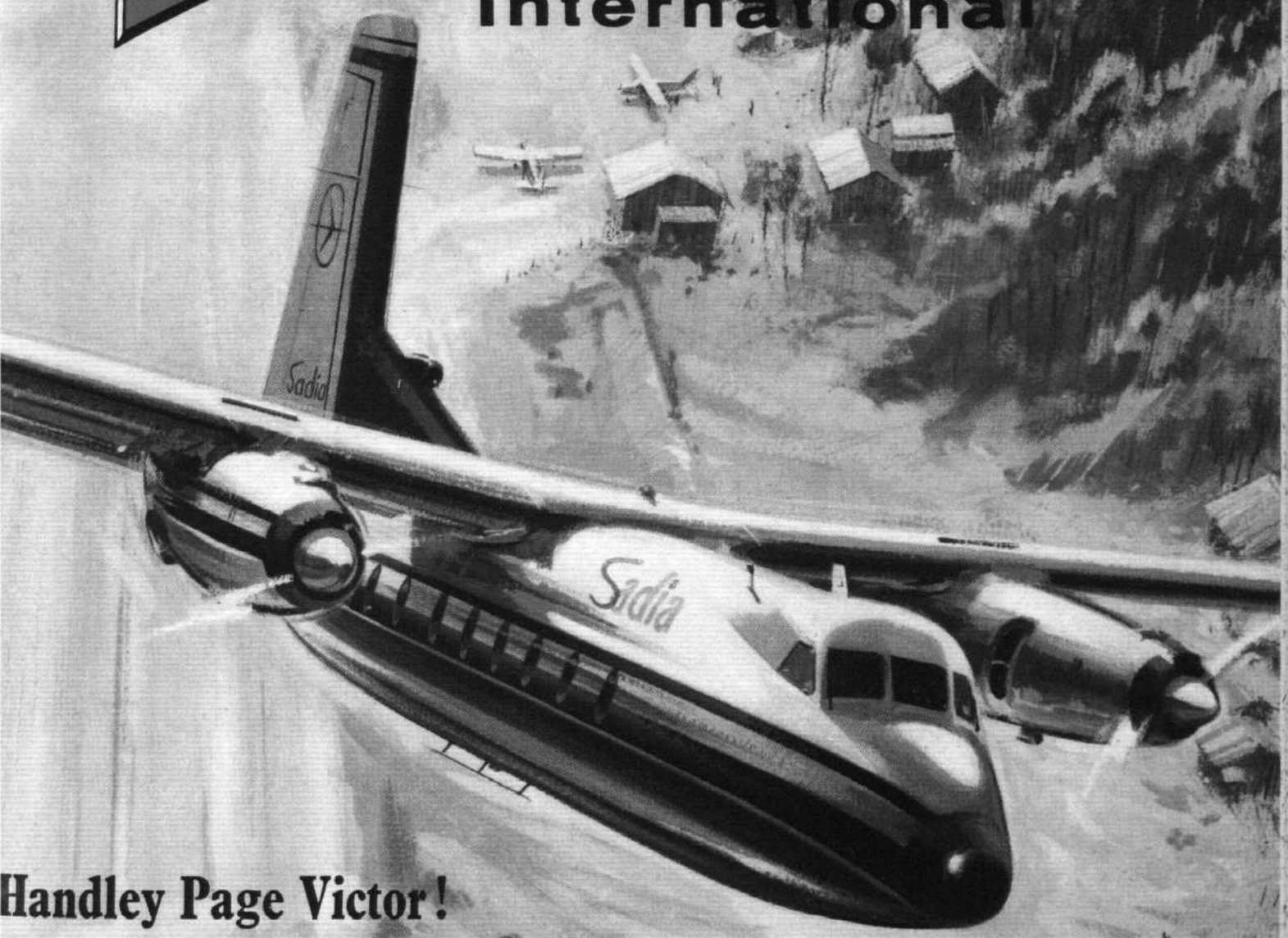

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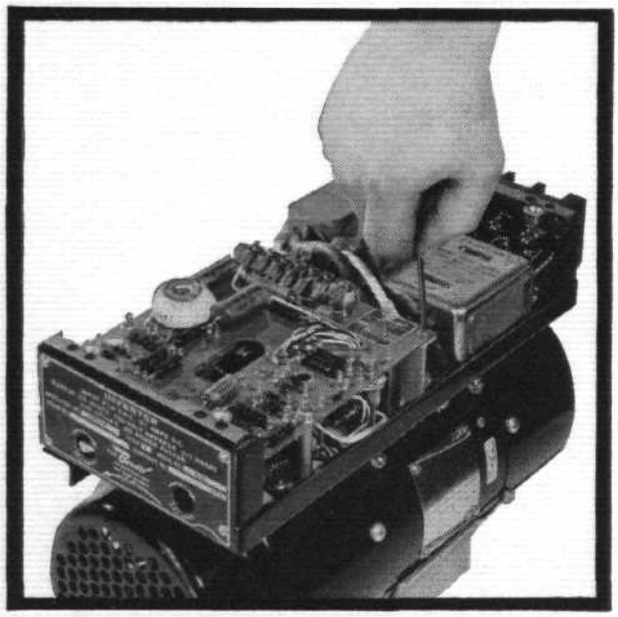

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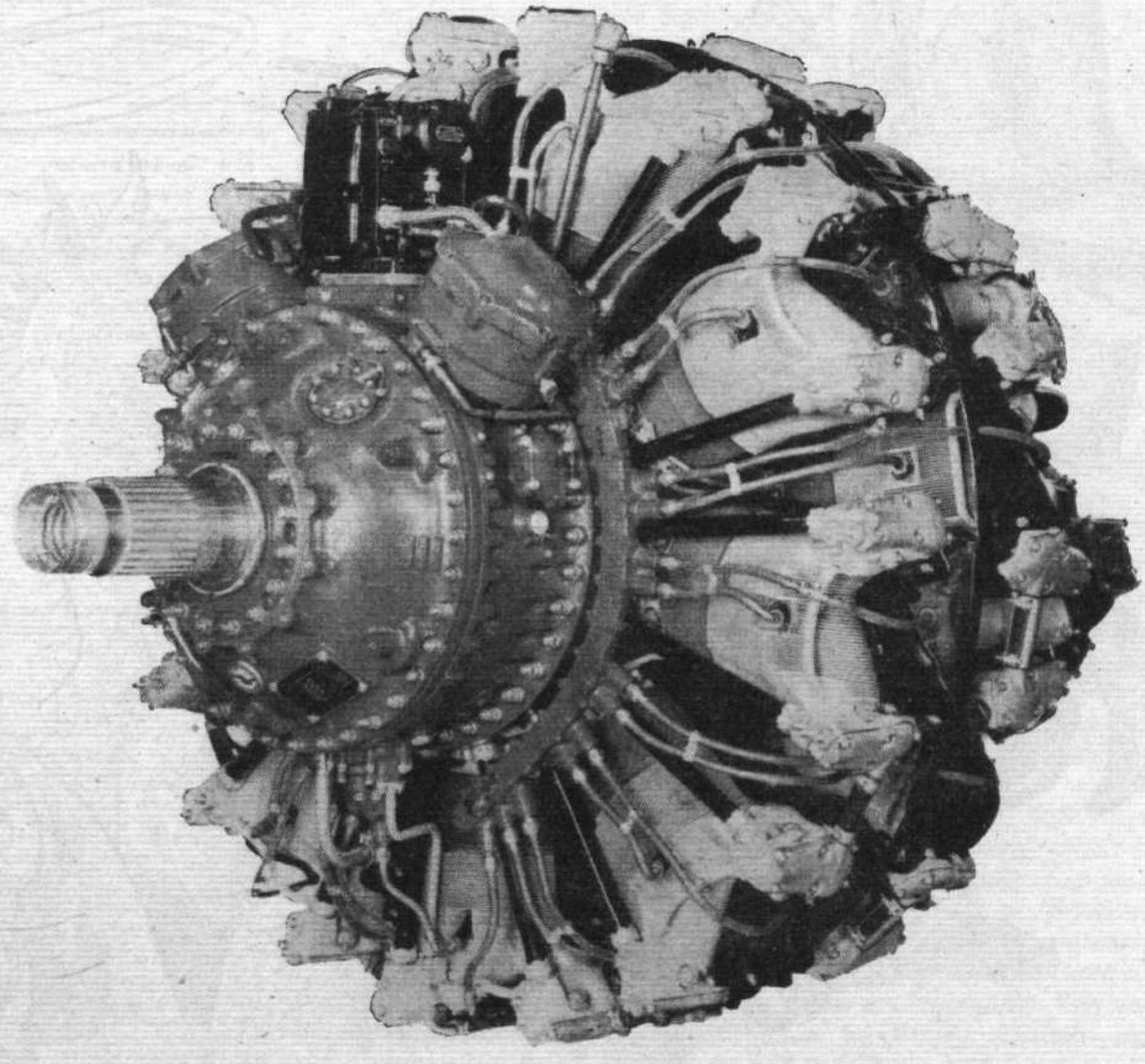

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After TSR.2

CANCELLATION of TSR.2 seems certain as these words are written. Nearly half the British aircraft industry will feel the blow.

The danger is that not only the industry's customers, but also its potential partners, will get the idea that Britain's aircraft industry is now doomed to extinction.

The industry is on the stall; but the Prime Minister said in a television interview in Paris "We certainly intend to see that our aircraft industry shall thrive and be prosperous." Swift recovery action is now essential. There is no point in waiting for Lord Plowden's report, which is not expected until the autumn. Even when it is completed it will not deal with the real problem, which is what the aircraft industry should be designing.

In the new framework of international co-operation and engineering development, Britain is bound to be regarded as a high risk in a high-risk market. It is most significant that the important VFW/Fokker/Nord conference this week on the launching of the VFW 614 short-range jet does not include British representation. Earlier reports state that Britain is prepared to pay half the development costs and buy 40 aircraft of the initial Ecat programme, for which there is no RAF requirement, in order to partake in the later variable-sweep project. VTOL looks like a sell-out—to the Americans. The Kestrel is hopeful, but Germany has projects in every worthwhile VTOL field and will achieve European dominance in two years' time. HS P.1154 and HS.681, which should be succeeding Phantom and C-130E, are cancelled. The Maritime Comet is hardly advanced aircraft technology. Britain has already admitted her inability to provide the Army with a light helicopter, and other projects still on paper will have to improve considerably on US and French prototypes actually in the air.

The New Deal

But the political decision, perhaps the most portentous in the history of Britain's aircraft industry, has been made. Henceforth the policy which will determine the industry's destiny is to be international co-operation.

Now the markets must be examined. This is not a job for politicians, but for the civil and military operators in partnership with designers and engineers. Correct judgement of market demand is the only guarantee of a successful aircraft industry. This may sound elementary, but as the Plowden brief illustrates it is often overlooked. It is no good trying to fit the market to the industry.

Partnership will ease many difficulties, such as the perennial inability of European aircraft builders to match US markets and resources. But it will compound others—for example the determination of market demand and the control of costs and schedules, which are difficult enough when just one cook is preparing the broth.

We urge a radical revision of budgeting methods, both in costing and scheduling, right from the start of this new partnership. There must be an end to the unhealthy secrecy which has sown the seeds of so many crises in the past. Runaway spending and timetables will be prevented by the publication—rather in the fashion of France's Lois Programme, but even more fully—of all contractors' budgets and programmes. There is no stricter or wiser system of control than public accountability. This could be the Government's greatest contribution to British aviation—international partnership based on the trust and confidence of full public information.

GERMANY'S NORTHERN INDUSTRY GROUP...

project and VFW are this week holding a three-day intensive conference near Bremen with Fokker and Nord Aviation to determine the framework of co-operative design and production. A British company might join the consortium. The decision to go ahead rests with VFW, but it must be taken by mid-summer if the first aircraft is to be ready to fly during 1967 and production launched in time for a first delivery in 1969. Development cost is estimated at DM47m (about £8.22m) and purchase price DM3.2m each from a batch of 150. Stretching of the Mystère 30 has finally removed all direct competition and VFW estimate that there might be a total demand for 1,100 aircraft in this class, of which they might achieve 25 to 30 per cent. VFW are deliberately avoiding any temptation to stretch passenger capacity beyond 36. The opening nose offers straight-in cargo loading with a capacity for 8,800lb on a 185-mile route. Field performance would be better than that of a DC-3. Gross weight will be 27,700lb and powerplant is to be the Lycoming PLF1C-2 high-bypass turbofan. The PLF1A is already running on the bench with the C-type fan and not much money would be required to complete development. The US Navy development programme for the T55 gas generator is already progressing fast. VFW 614 markets are, in order of importance, South America, Africa, South-east Asia, Australia and Europe. Basic design is complete and wind-tunnel tests have been carried out.

VAK.191B Fiat is actively committed and co-operating in development of the VAK.191B, which will be produced in single- and side-by-side two-seat versions. The combined deflected-thrust and lift engine powerplant, definitely being supplied by Rolls-Royce and MAN, is held to be the right one and there is no surprise at cancellation of the HS P.1154—but on technical rather than political/economic grounds. Advanced simulator studies already made, including those of blind transition and touchdown in poor weather, are now to be supported by flight tests beginning very soon of the bedstead powered by three RB.108s simulating the RB.193 deflected-thrust engine and two more RB.108s simulating the RB.162 lift engines. Hovering control is by puffer jets bleeding 220lb thrust from each engine, leaving 1,980lb pure thrust. All puffers blow downwards to assist lift and are operated by electrically signalled duplicated hydraulic jacks. The electronic hover autopilot is triplexed with a single electrical output signal, but the whole complex can be overridden by a mechanical control-rod system clutched-in by the pilot. Otherwise pilot's input is sensed by electrical stick-force pick-offs. The bedstead has two BMW 6012 a.p.u.s driving independent utility systems. A Martin-Baker Mk 4 seat is fitted.

Space Projects Discontent at the very small national space programme and ridiculously small funding of national space work is now compounded by confusion over the French introduction of a high-energy second stage for ELDO A, which changes the height and diameter of the overall vehicle and nullifies German work on the third stage. Much new technology in explosive forming and automatic welding of titanium structure may now produce useless hardware, but there is still some hope that the *status quo* will be preserved. ERNO has at least seven space projects ranging from ground installations to nuclear-powered space power systems and recoverable space vehicles.

VC-400 Heinkel patents from 1957 describe a tilting rotor VTOL system judged by the company to be the best system for combining helicopter and fixed-wing characteristics at speeds up to highish subsonic. Supersonic extension is thought feasible. These ideas have been merged with former Focke-Wulf work on tilting wings in a contracted study for the ten-passenger VC-400. Dual tandem large propellers, shaft-connected, are driven by four turbines, the propeller size being optimized for low slipstream velocity at hover and reasonable r.p.m. in cruise, among other factors. Civil inter-city applications are foreseen if the design goes ahead.

Transall The first three prototypes have now flown 818 flights and 1,343hr and the last of the six pre-production aircraft is coming off the line. Production of 110 for Germany and 50 for France is beginning with complete aircraft coming from each of the three sources (VFW, HFB and Nord). Further development lies in the direction of automatic landing, flap-blowing and turbojet boosters. Civil outlets are hoped for.

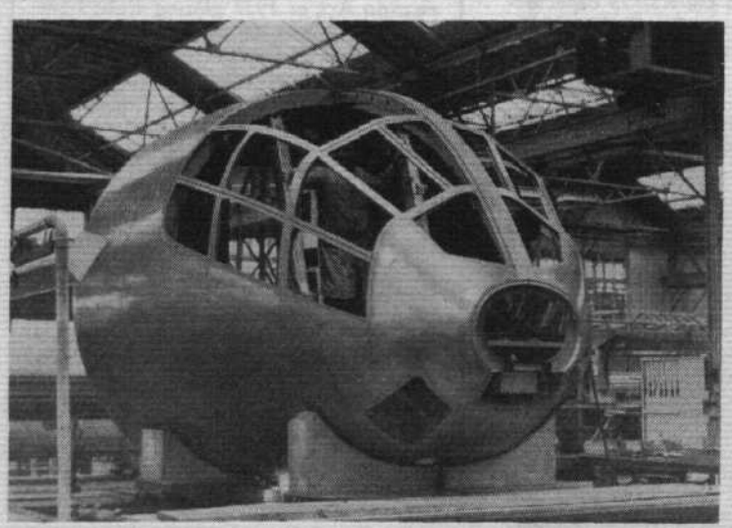
WFS-64 Crane Helicopter The two German-built prototypes are now in Government testing at Oberpfaffenhofen, but have been several times used to excellent effect in civil crane operations in Germany, Norway and Switzerland. The civil potential of a small crane fleet appears to be very great.

WFG-H2 Development Helicopter VFW have for two years been developing an autogyro with sustained hovering capability conferred by compressor-fed tip-burning jets. There are numerous quite new ideas involved and the test-bed, looking not unlike a Bensen, is about to fly. Ultimate production outlet would be a three-seater with three-blade rotor, two 140 h.p. piston engines, single propulsion propeller and a choice of endurance of 30min at hover or 2½hr in cruise with VTOL. Cyclic-pitch variation controls attitude, but power alone would control rotor lift, without collective-pitch change. Blades are given drag, flap and pitch-change freedom by a single Teflon bearing.

DFS.285 This high-altitude glider, now powered by a P & W JT12, is still in the VFW factory after numerous design changes demanded by the customer. Glued honeycomb structure has made design changes hard to introduce. Stated application is high-altitude research.

The third nose and first tail for the Dornier Do31 light tactical VTOL transport in the VFW factory near Bremen. First flight is due in the summer

"Flight" photographs



parliament

KENNETH OWEN

The concern of Conservative MPs that the Government's decision on TSR.2 would be "wrapped up" in Mr Callaghan's budget statement on April 6 was hardly relieved by the replies of the Lord President of the Council, Mr Herbert Bowden, in the Commons on Thursday, April 1. Could the Leader of the House say, Sir Alec Douglas-Home asked, that the TSR.2 announcement would be made as a separate statement and not hidden away in some other, longer announcement? "No, I cannot," replied Mr Bowden, who went on to add, "I do not know why the House should imagine that this statement is likely to be wrapped up in the budget . . ."

Reason for believing that the TSR.2 statement was almost ready for wrapping up, in whatever form (a special gift-wrap addressed to General Dynamics, perhaps?) came later that night when the Prime Minister postponed his departure for Paris to hold the day's second Cabinet meeting. Among those present was Mr Roy Jenkins, Minister of Aviation, who had withdrawn from BOAC's inaugural Super VC10 flight to New York. Assuming that an announcement was imminent, opposition members in their exchange with Mr Bowden had made it clear that they would strive for a full debate as soon as possible.

This session's arguments on TSR.2 and Concorde have dramatically emphasized a basic fact of life at Westminster today —the immense segment of scientific research and technological development for which Parliament is directly responsible. How well informed are those who discuss and decide these matters, in both Commons and Lords? How articulate are scientists and technologists in conveying fact, opinion and advice to MPs and Peers?

An important link is provided by a relatively obscure group, the Parliamentary and Scientific Committee. This is in no way an official committee of Parliament; it is an unofficial body whose membership is open to members of both Houses of Parliament and to the representatives of learned societies, scientific and technical organizations. At the end of last year its members included 70 Peers, 129 MPs and representatives of 131 scientific and technical organizations.

The committee aims to inform Members of Parliament on scientific and technological affairs, and to publish regular summaries of relevant Parliamentary debates and questions. It organizes regular talks and discussions by experts in particular subjects, and visits to scientific and technical establishments. In last year's programme, for example, members heard the assistant chief engineer of British Aircraft Corporation and the chief technical officer of the Air Registration Board on the subject of the Concorde and supersonic transports in general. The relationship of technological research and development to economic growth was discussed, and Northampton College of Advanced Technology was one of the places visited.

Among the non-Parliament members of the Committee are the main engineering institutions and the Royal Aeronautical Society. The Society's two representatives are Sir William Farren, a member of Council, and the head of the Society's technical department, Dr A. J. Barrett.

How effective is the Committee? It does a good job as far as it goes, but it does not go far enough. One snag was quickly spotted by the Duke of Edinburgh, an honorary member. Speaking at the group's annual dinner last year, he said, "It appears to be a forum of the converted . . . There are occasions when I have wished profoundly that the Committee had more members."

But a larger membership of this particular body is not the complete answer. Monthly meetings and cuttings from *Hansard*, even if attended and received by many more people, are not enough. In the professional business of arranging the country's affairs, Parliament has a need for a continuously available source of scientific and technological information and professional advice. Those who doubt this have only to read this session's aviation and defence debates, as recorded in *Hansard*. Sound, undistorted technical arguments are rare indeed.

press

ROBERT BLACKBURN

London, April 5

According to Friday's *Guardian*, "British European Airways hopes to start taking delivery of 15 new Trident jet airliners worth more than £20 million by 1969 . . . The order now nearing fulfilment has been dangled before the manufacturer, Hawker Siddeley, for more than a year . . . The outstanding arguments concern guarantees of delivery dates and final details of cost."

The adjoining column quoted Mr Kenneth Wilkinson, chief engineer of BEA, on the question of spare parts costs for another aircraft, the Vanguard: "You can always make a lavatory door bolt that costs £17. I could do it myself. If we want cheap air travel in the second half of the 20th century we shall have to be clever enough to design door bolts that cost less."

The time has come for someone to whisper gently in Mr Wilkinson's ear that while BEA has made profits with British aircraft the British manufacturers have not profited from their dealings with BEA. The Vanguard, in fact, made a thumping loss, and by my rough calculations Vickers' shareholders subsidized Vanguard operators to the tune of about £30 per flying hour. That may be water under the bridge, but to sell aircraft abroad in the face of increasingly tough competition the British airframe builders could do with a testimonial that its products can actually make profits. Last week they needed such a testimonial more urgently than at any other moment in their history.

Of course, Mr Wilkinson was lecturing to the Royal Aeronautical Society and hardly expected his remarks to escalate to the *Mail's* all-fools'-day headline "Plane Bills Exposed." But such is the way of the Press that the same thing can happen to anyone who opens his mouth in a public place. The same front page, incidentally, gave four lines to the £10.5 million East African Airways order for Super VC10s.

The Times was one of the few papers to quote Sir George Edwards's blunt statement that "uncertainty about the future has caused airlines all over the world to be reluctant to order British—a situation which has been not surprisingly turned to good account by the competition." Sir George added that the Government had given BAC excellent support in its fight to win the order. However, the general feeling in industry must be that the Government's handling of the industry, and particularly its handling of *information*, has been a major factor towards that uncertainty.

This column is not the place to discuss the rights or wrongs of cancelling TSR.2, but it is concerned with the interaction between the Press, the aviation business, the Government, and the citizens. It is a fact of life that most people form their impressions from Press, radio and TV, and not from Parliament. Those impressions matter overseas as much as they do in Britain. What is the impression among her allies and potential customers of a country which suffers self-denigration and uncertainty to the extent that Britain does?

Whatever the Government decides it will be impossible to assess the consequences properly because Security prevents commentators from having enough inside knowledge of the project, its real cost, and its real benefits to technology. The Plowden Committee will do well to concern itself with the true purpose of Security, and whether Governments and Ministries use it to protect the interests of the public or to protect themselves from blame or responsibility.

Headline from the *Daily Express* :—
BONANZA FOR BOAC.

AIR TRANSPORT

EAST AFRICAN BUYS SUPER VC10s . . .

AN order for three Super VC10s has been placed by East African Airways with the British Aircraft Corporation. The value of the order, with spares, is £10-£11m and deliveries will be from August 1966. A large freight door and seating for up to 172 passengers are features of East African's specification. The airline stated some time ago its intention to order replacements for the three Comet 4s which are at present used for medium-long-haul services and studies have been in progress for about 12 months. A comment from Sir George Edwards, managing director of BAC, is quoted in World News.

Other prospective buyers of the Super VC10 are Aerolineas Argentinas and Middle East Airlines, both of which at present operate Comets. Aerolineas was reported some weeks ago to have decided on Boeing 707s, but the Argentine Government did not apparently give its approval and there is still the possibility that the airline will, after all, buy Super VC10s to replace its Comet 4/4Cs, rather than 707s or DC-8s. At the time of writing MEA has still not decided which of the three long-haul jets it will buy. Much depends on the terms which can be offered—and, in particular, on the part-exchange deal which can be arranged for the Comets.

. . . AND TAA BUYS DC-9s

SIX Douglas DC-9s have been ordered by Trans-Australia Airlines. In these pages a year ago (April 30, 1964), Mr Ansett told *Flight*: "I'll take a gamble with you that TAA buy the DC-9." Within a year, as announced last week, TAA decided to order the DC-9 in preference to the BAC One-Eleven.

Once again TAA have followed the pace-setting Mr Ansett, and once again Australia has rejected a British product. When TAA decided to order Boeing 727s instead of Tridents, following Mr Ansett's order for 727s, it could have been argued that the two aircraft were not comparable in terms of delivery date. As it turned out, the two airlines put 727s in service in November 1964, whilst they would still have been waiting for delivery of their Trident 1Es.

According to reports from Australia, TAA can get delivery of the DC-9 from October 1966, while delivery of a comparable One-Eleven could not be made until March 1967.

What seems to have happened is that Ansett, whose preference for the DC-9 has been clear from the start, decided in the last few weeks to buy the DC-9B. This is the enlarged up-to-95-seat version (*Flight*, March 18, page 394) ordered by Eastern and it is a new development. Because the two Australian domestic airlines are required by law to have parity of equipment, obviously the bigger Series 500 One-Eleven would have been required to match the Ansett DC-9B. This stretched version of the One-Eleven, not yet announced, is still relatively elastic. It is believed that it would have fuselage "plug" of up to 10ft to accommodate three more seat rows to bring maximum seating capacity up to about 95 at 34in pitch, and the Spey engines would be Series 512 of about 12,000lb thrust. Gross weight would be of the 95,000lb order.

SUD/DASSAULT MERCURY

AN agreement is reported to have been reached between Sud-Aviation and Dassault for joint development of the Mystère 30 baby jet feederliner and also for joint development of the Galion "aerobus."

The Mystère 30, first revealed a year ago at Hanover, is to be called the Mercury (Mercure).

Having started life in project form as a 30-40-seater powered by Rolls-Royce RB.172-51 engines of about 6,000lb thrust (*Flight*, April 30, 1964, page 708) the Mercury now appears to be considerably bigger. According to sources close to Germany's VFW 614, the aircraft is now a 48/56-seater, and is to be powered by two Rolls-Royce Spey Juniors of 8,740lb. This would seem to put it squarely in the class of the Fokker F.28, which is finding itself in competition with the BAC One-Eleven, the Douglas DC-9 and the Boeing 737.

These new developments are of special interest to the British aircraft industry, and to Hawker Siddeley in particular. There is one big market left for a new type of jet airliner with the right engine—an aircraft in the class of the Hawker Siddeley 136. Although Mr Jenkins has not specifically mentioned collaboration on a baby jet feederliner, it is obviously improbable that Britain would go ahead with such a programme without the French. Indeed, because the engine of the proposed Anglo-French supersonic combat trainer (RB.172 or M.45) would make a suitable powerplant (with a higher by-pass ratio) for civil transport in the HS.136 class, it has seemed sensible to explore the idea of a joint programme with Dassault, who have the Mystère 30.

Although the new Sud/Dassault deal does not preclude Anglo-French collaboration, the increased size of the aircraft—if it is correct—would appear to be a sad mistake. The biggest market—perhaps as many as 2,000 aircraft over the next 30 years—will be for a much smaller, highly efficient jet (with an engine which "reads across" from a military programme) having aircraft-mile costs low enough to make its seat-mile costs competitive with Friendships and Convairs.

Footnote The French Government is reported to be supporting the Mercury to the extent of £365,000. It is expected to be flying before the 1967 Paris Show.

On March 27 the first of four BAC One-Elevens (EI-ANE) for Aer Lingus was rolled out at the Hurn factory

BOAC's £7m NET PROFIT

OUR predictions last week that BOAC made a 1964-65 profit of £15m and earned £113m revenue were confirmed by the provisional results announced on April 1 by the chairman, Sir Giles Guthrie. His statement follows:—

"Any figures I give you are provisional because it takes us some time to get in all the bills and revenue returns, settle up with our partners and so on. So I am not pretending to give you exact final figures.

"However, subject to that qualification, I am very glad to be able to tell you that in the past 12 months BOAC has made an operating surplus of at least £15m.

"After providing for the interest on both active and dead capital, for tax and for all other outgoings, we expect to show a net profit of over £7m—that is absolutely clear profit.

"This is the largest operating surplus and the largest clear profit BOAC has ever had. It is also the *first* clear profit for eight years. It has been achieved not only by raising our revenue to a record £114m, but by holding down our expenditure. In fact the steps we have taken to streamline BOAC's organization and operations have already begun to pay off and resulted in a saving of about £2m this year; it will take a year or two for their full effect to be felt.

"So you can see why we shall be going off on the Super VC10 tomorrow morning [April 1] in very good heart. Tomorrow is BOAC's 25th birthday and it is going to be the happiest birthday we have had for a very long time. I am naturally very glad for the sake of our staff who have put so much hard work into producing this result. We are in the black and we are going to stay that way."

Asked if BOAC would not in any case have made large profits in 1964-5 under the former management, Sir Giles replied:—

"They certainly ought to have done this year. The point is that this good traffic year gave us the chance to solve some of our problems a little faster than we had planned. While we were enjoying good revenue results we were also negotiating the capital reconstruction, settling our aircraft requirements, bringing down staff numbers—in fact working on the many things that will ensure we are in the right shape if the boom slackens off. Whatever kind of traffic we had had in 1964-5, we could still have told you a pretty encouraging story of lower costs, smaller staff and improved earning ability.

"The day I am looking forward to is the one when I can tell you that we have made the same kind of progress in a lean year as we have just done in a good one, because it is the lean years, not the good ones, that will really demonstrate our new ability to stay in the black. You can quote me on all that."

INDEPENDENT CONTENTMENT

LAST week in London Mr Eric Rylands, managing director of Skyways Coach Air and a confessed Conservative, expressed an optimistic view of the Labour Government's policy towards civil aviation. His Lympne-based company has successfully built up a unique low-cost London - Paris service, and on May 1 begins a new stage of development with the introduction of a service from the new East Midlands Airport to Paris via Beauvais and thence by motor coach. This is the first important private-enterprise route to be licensed under the Labour Government and Mr Rylands said that it "proves the point that the Government's policy is at least clear and has opened the way ahead for the development of independent airline operations alongside the two national corporations."

Speaking of the "grand Conservative Party promises to the private airline industry," Mr Rylands said that, in retrospect, these could be seen to have been largely impracticable. "No Government, whatever promises may be made in Opposition, can sensibly alter the basic structure of our national air transport industry." He attacked the Conservatives for holding out hopes "which they could not fulfil" and he quoted the experiences of Mr Harold Bamberg, chairman of British Eagle, and his company's disappointments on Atlantic and domestic routes.

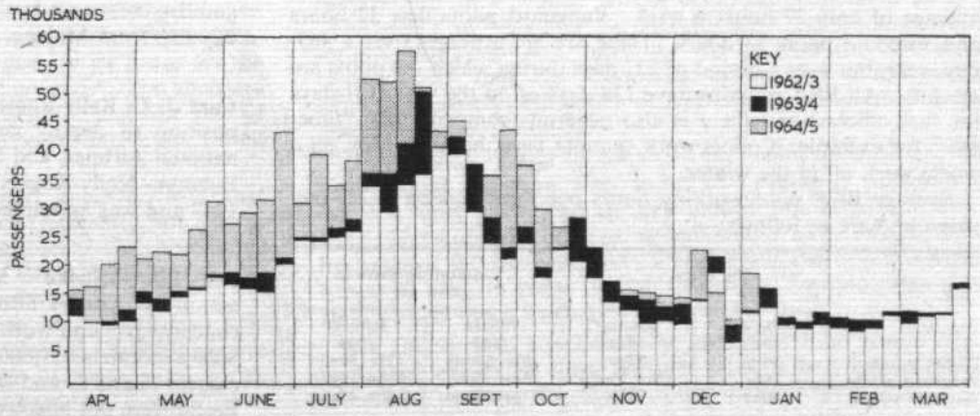
The new service from the East Midlands Airport is an interesting prospect for Skyways; not only does the operation fit in remarkably well with the existing service, but the company feels that it is pioneering a new and prosperous market. There has been no objection from BEA to the licence. From an operational aspect the new scheduled service fits in perfectly with the Lympne - Beauvais flights. The East Midlands, Lympne and Beauvais airports lie in a straight line and are almost equally spaced, while the 48-seat HS.748 and one motor coach carry identical numbers of passengers. Asked whether Skyways had plans for buying any more 748s to add to their present fleet of three, Mr Rylands said there was quite a possibility, but that the model now offered by Hawker Siddeley was, if anything, more advanced than the airline really needed; he thought that secondhand 748 Series 1s were more likely to be sought.

AER LINGUS TO SELL F-27s

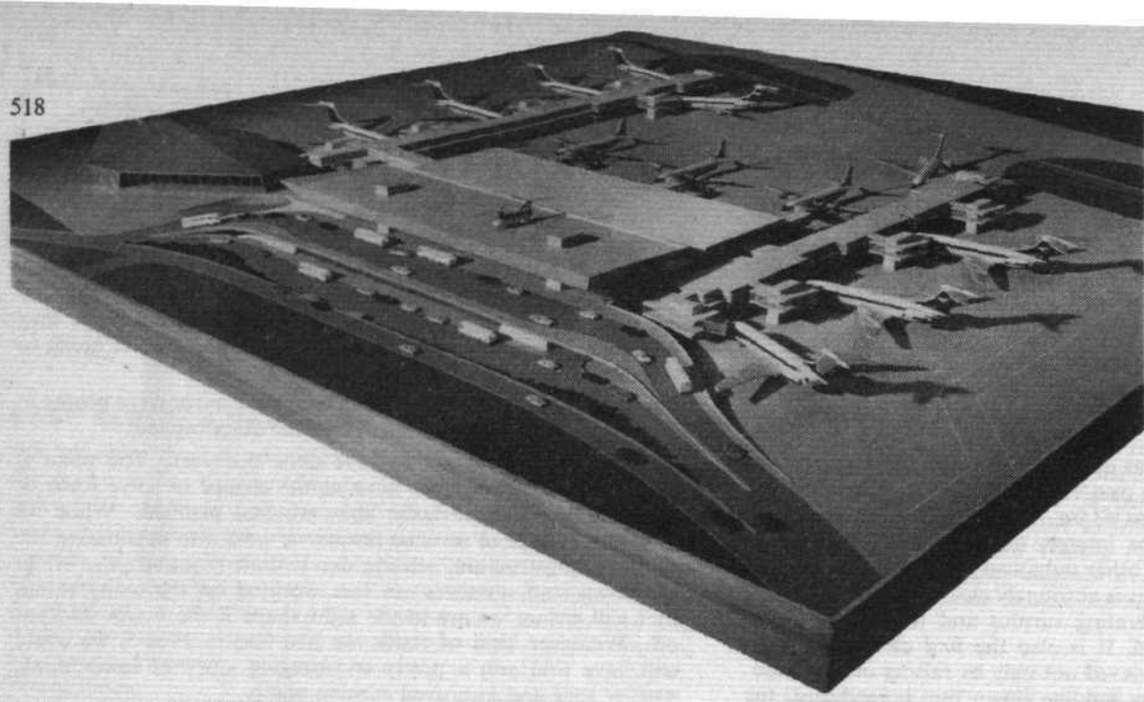
WHEN KLM confirmed their purchase of six DC-9s the decision was also made to dispose of their nine Viscount 803s. These are to be bought by Aer Lingus for delivery on a progressive basis. In turn, Aer Lingus will sell the seven Fokker F-27s which have been in service on the airline's short-medium-haul routes since 1959.

The first two of KLM's Viscounts will be handed over to Aer Lingus in advance of delivery of the first DC-9 (expected in January 1966). Aer Lingus will receive two this year—one in October and one in November. The remainder will be delivered during next year, with the ninth aircraft due for handing over in November, 1966.

Among the reasons given by Aer Lingus for these moves is first, the need for a gradual but considerable increase in capacity, and, second, a wish to standardize, so far as is practicable, their fleet.



Those troublesome North Atlantic traffic "shoulders" are responding to treatment. The seasonal fare structure introduced just a year ago to get people moving in the off-peak, i.e., "shoulder," months seems to be working. This illustration, based on IATA traffic figures, shows the new-style padded shoulders. Another new North Atlantic trend is the merging of the eastbound and westbound peaks



BOAC is to build its own passenger terminal at Kennedy International Airport, New York. Work will start next January and the terminal will be opened early in 1968. Special features will be a rooftop heliport and a special shelter (far left) to allow aircraft to be serviced in bad weather

AIR TRANSPORT . . .

BEA v THE PILOTS

AFTER deadlock had been reached between BEA's management and BALPA over the pilots' claim for higher pay and improved conditions, it was agreed on March 30 to go to arbitration.

Unless an arbitrator in a dispute of this kind actually lives the life of a BEA pilot, his recommendations might not gain the respect that arbitration should command. But this was what Dr H. P. Ruffell Smith of the Air Ministry (as it then was) actually did three years ago. He flew with BEA pilots on the routes and witnessed at first hand their difficulties and problems. He produced a report which proposed a points system for measuring flight-time limitations. It took the place of the traditional hours system. Clearly, an hour's flying on short-haul routes is a very different sixty minutes' worth of pilot-fatigue *vis-à-vis* long hauls.

Unfortunately, the Ruffell Smith report has never been published, though there cannot have been anything secret about it.

It is known, however, that BEA's pilots are not expected to fly more than 18 points a day (points being awarded for a specific operation, e.g., tuning into a beacon, a landing, a take-off, and so on). Not more than 36 points shall be marked up over a three-day period, and not more than 50 points (or alternatively, as it happens, 50 hours) in a week of seven consecutive days.

Although the Ruffell Smith system appears to be working in principle, and indeed has improved management-pilot relations, its interpretation still appears to be disputed. For example, a pilot can fly 36 points in three days, having had the whole of the middle day off, and yet he cannot fly 18 points the next day without exceeding his weekly quota of 50. It is for such reasons that BEA feel the pilots could concede a little, so as to improve productivity.

Do the pilots, in fact, deserve the higher pay and shorter hours they are demanding? Facts and figures are hard to come by, since for obvious reasons BEA do not want to comment. It can, however, be calculated from evidence given by BEA to the ATLB that even in the peak summer month of August BEA's captains fly only 55 hours. This remarkable fact has already been the subject of comment in these pages; further investigation reveals that, even in the busy summer of last year, BEA's Comet pilots worked an average of only 27 hours a week. Vanguard pilots flew 32 hours and Viscount pilots 33 hours. These are *not* averages over a 365-day year, but over a period of 227 days during which the pilots are on duty. All BEA captains have 138 days off in the year (131 days for first officers) and there is also generous compensatory "time-off"; for example, if pilots work summer bank holidays they get a whole week off in the winter.

Average BEA pilot working hours per week (taking a 227-day year only) are as follows:—

	On duty . . .		. . . including time in the air	
	Winter 1963	*Summer 1964*	*Winter 1963*	*Summer 1964*
Comet pilots	24hr	27hr	8hr 50min	12hr 30min
Vanguard pilots	26hr	32hr 30min	8hr 6min	13hr 54min
Viscount pilots	30hr	33hr	11hr 42min	13hr 24min

Yet BEA have offered their 850 pilots an 18 per cent increase in salary over three years—8 per cent back-dated to October 1, 1964, with the rest in two instalments over the next two years. Existing salaries vary from £1,300 a year for a Viscount First Officer to £4,700 a year for a Senior Captain First Class flying Tridents or Comets.

Perhaps the main trouble, which BEA have brought upon themselves, is the airline's image of a profit-making employer with plenty of money to spare. Whenever it has been suggested that BEA costs are too high or that their efficiency is too low, BEA's management have taken exception, and have gone out of their way to claim high efficiency. BEA made a £3 million profit in 1963-64, and though their 1964-65 profit may be of the order of £1 million net, it is only natural that the employees should demand a share. Perhaps the time has come for BEA's management to tell all staff, not only pilots, quite plainly that unless costs are not only held but very substantially reduced, the corporation is going to be flying into very rough financial weather.

Malaysia/Borneo Merger On April 1 Borneo Airways, formed in 1957 by the now Malaysian States of Sarawak, Sabah and the Sultanate of Brunei, was merged with Malaysian Airways.

727s For Iran National The contract for the purchase of two Boeing 727s has been signed by the Iran National Airlines Corporation. So that jet operations can be started in July this year Iran National is also leasing a 727. The two other aircraft will be delivered in mid-1966.

The Tangiers Accident An Iberia Convair 440 crashed into the sea about ten miles from Tangiers on March 31. Three passengers survived and were picked up; the remainder of the 48 passengers and five crew were lost. The Convair had been chartered for a one-day trip from Malaga, Spain, to Tangiers.

Capt J. C. Kelly-Rogers has, at his own request, retired from the position of deputy general manager of Aer Lingus-Irish International Airlines, and has been appointed to the board of Aerlinte Eireann. Kelly-Rogers joined Aer Lingus as technical manager in 1947 and was appointed deputy general manager in 1952.

PAA Pilots' Strike Most of Pan American's pilots took strike action on April 1 after mediation efforts had failed. The strike concerns pay and work hours. Average pay for a jet captain flying 80hr a month is $31,800 and for a jet co-pilot $21,600. Government-charter flights to and from South Vietnam and flights to and from Berlin were not affected by the strike.

The RAeS Debates Supersonics

UNLIKE the depressingly low attendances at Royal Aeronautical Society lectures over the past year or two, the theatre at 4 Hamilton Place was packed on March 31. The attraction was a discussion between Mr Beverley Shenstone of BOAC and Dr A. E. Russell of BAC on "The Difficulties and Advantages of the Supersonic Civil Transport."

MR SHENSTONE'S opening address followed the lines of the preview in the RAeS *Journal* (as published in *Flight* for March 25). He suggested that the RAF and the French Air Force should each operate two Concordes before the type went into public service. Although further improvements were "in the offing," said Mr Shenstone, "we have not yet been persuaded that it will be viable." The airlines' attitude, he said, was that of the man from Missouri—"you show me." No sensible airline would buy an aircraft that would not pay for itself, and it was not until there were "more facts than there are assumptions" that any sensible airline would buy it.

Perhaps, like Hamlet, he protested too much? He thought that perhaps BOAC had not protested enough in the past. But the airline was co-operating closely with the manufacturers, and "if the combined efforts of BAC and Sud produce a sow's earf, it will not be the fault of BOAC."

DR RUSSELL said that all civil projects without military feedback had to fight for existence. The question was whether to fight at all. Mr Shenstone had said that the Concorde was instigated and financed by Governments for airlines and not by airlines. Weren't the Friendship and the Caravelle? It might be said that Governments had been more successful sponsors than airlines.

Concorde Simplicity

Although flight crews would probably demand more money to fly the Concorde, said Dr Russell, "they won't deserve it." The simplicity of the Concorde systems and airframe would contribute to its economy, and five Concordes would do the work of eight Boeing 707s. Because of their higher speed they would offer 50 per cent more frequency and only half as many pilots would be required.

The empirical use of formulæ to compare the operating cost of one aircraft with another "can be very misleading," Dr Russell said, noting that one 707 operator declared a cost of $700 per hour, while another quoted $1,100. Likewise one Concorde customer reckoned he could carry 100 passengers on the same route while another reckoned he could carry 128.

As for the boom, its extent could be very considerable, but the validity of the claims made as the result of the Oklahoma tests were very exaggerated. Dr Russell said he had been told by two Americans that a series of tests daily over Chicago, introduced without prior publicity, had led to no comment whatsoever.

MR PIERRE YOUNG of Bristol Siddeley thought that Mr Shenstone had overlooked the extent of Mach 2 experience with Mirages and Lightnings attained to date by the two countries. Because of the joint committee of officials the manufacturers could not hide behind their brochures for more than two months—checks were constantly being made.

As for take-off noise, the Concorde was very overpowered, so that before the aircraft got to the monitoring point the pilot could "throttle back heavily and the observer will record that he had made no noise!" Mr Young showed photographs of new jetpipe silencer hardware developed by SNECMA. "The forecast is that we will match subsonic jet noise on the ground and will be much better off the ground." The silencers would achieve a 5PNdb reduction in noise for a thrust loss of 1.5 per cent; and because the silencers were moveable, thrust losses would not occur in the cruise.

MR BOB MORGAN, BEA's chief project engineer, said that because supersonic airliners landed more frequently, the operators would in effect have all the problems of short-range airlines. The more often an aircraft landed, obviously, the more often potentially it went out of service.

Mr Shenstone did not know whether Mr Young had said that his engine silencers actually silenced anything, but they certainly looked most impressive. It was amazing the impression that a pile of ironmongery made on people. Airlines had to be sceptical, he said, "because they were dealing with great gangs of enormous optimists." He asked again, "How much will the Concorde cost? When will it be available?"

MR HANDEL DAVIES, Deputy Controller of Aircraft, Ministry of Aviation, noted that 99 per cent of Oklahoma's population had not complained. The FAA had tried to break special test buildings but had failed. The over-pressures required were four to five times greater than the Concorde was likely to produce. Mr Shenstone had said "show me how to make it pay," but would Mr Shenstone say how he would make his airline pay when he was trying to compete with subsonic jets against supersonic jets? As for aerodynamic noise, he had flown at Mach 2 and it was very quiet. There was "just one thing that could wreck the whole thing—the question of whether we can do it for the price we have to do it at."

AIR CDRE F. R. BANKS of Hawker Siddeley said that Mr Handel Davies had asked whether they could keep to the cost? "Of course they can't. This is the thing that has killed aviation in this country." But the supersonic airliner was going to come, so one accepted it. A little more design co-operation with the airlines would help. He did not think that the public would get used to the sonic boom.

DR RUSSELL replied that so great were the efforts being made to avoid increasing costs that the complex machinery involved might itself lead to an increase! But for the moment targets were being held—"though this does not mean that they will continue to be held indefinitely." Of the American SST, said Dr Russell, "its size begins to look terrifying. One has 240 passengers."

MR MORIEN MORGAN, Controller of Aircraft, Ministry of Aviation, said he was surprised at the lack of heat in the discussion. He found this very cheering. He had long felt the need for dispassionate discussion of this subject. "A lot of the decisions on this are very finely balanced indeed." Cost was "one of the most worrying things in the aeronautical scene"—and not just the cost of the Concorde. "It is up to us as engineers, all of us, to have a go at costs in the same way that we have always had a go at weight." He had, he said, always thought that SST direct operating cost could be got into the right ball park. "Without actually defining the ball park I mean that costs would not be ten times higher or anything daft like that."

"Front End of Progress"

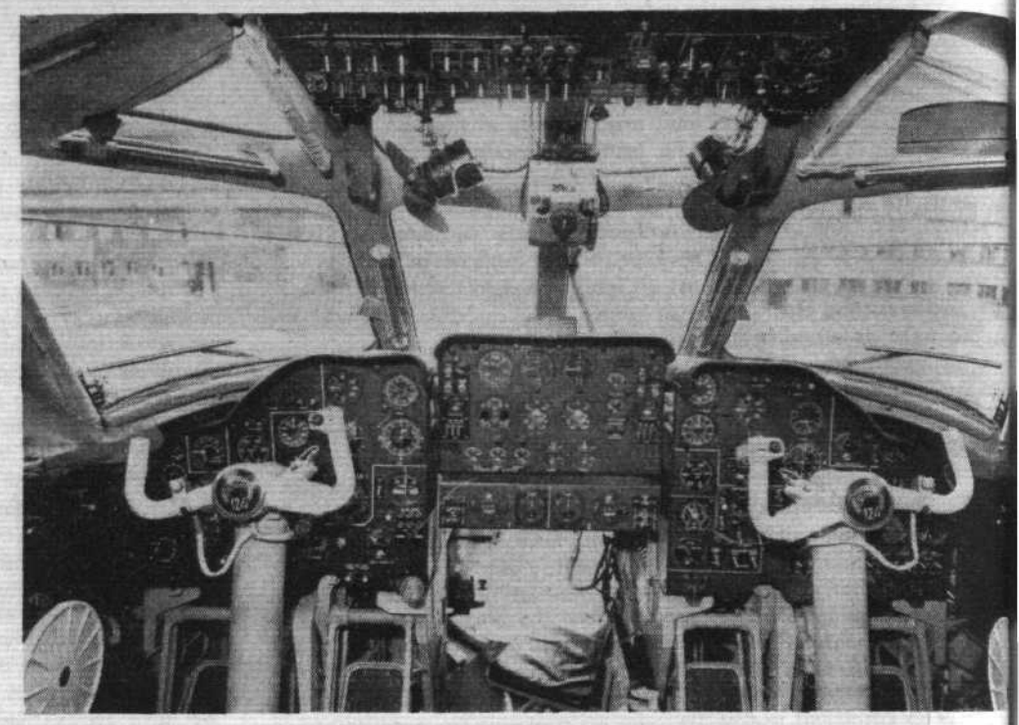
It was, Mr Morien Morgan thought, imperative that we should do a number of things in this country "at the front end of progress." This was why he had been keen, "as part of our national endeavour, to have a whack at the supersonic airliner." He had, he said, been impressed by the workings of the 50-50 partnership with France. "We all feel that we are better than the other lot and they feel the same about us, but this arrangement means that neither side feels that it is the junior partner." Mr Morgan concluded: "The Concorde is quite firmly nailed, it is going ahead with vigour, the money is coming in, and I am myself quite confident that something good will come out of the pipe at the end of this decade."

Quotes from other speakers "We have got one block of credit in the bank—time. The Concorde is going to be no earthly use if it comes along after the American SST" ... "The effect of delaying the development programme will be serious—someone will have to pay a bill for £300m." ... "Every year that the Concorde drags is a £30m penalty. Aircraft industry standards of accounting mean that nobody takes this very seriously."

DR RUSSELL, asked to comment on how Concorde operating costs would compare with those of developed subsonic jets, said, "I find very few airlines indeed interested in 700-seat jets." Development of existing jets would have DOCs reduced by perhaps 20 per cent, but "I am afraid there is no prospect for some time to come of [the Concorde] beating present subsonics by as much as that."

MR SHENSTONE concluded by saying that he would like to know the names of those airlines who, it had been said, had calculated that the Concorde would make them a profit.

AIR TRANSPORT...



Czechoslovak Airlines have now had twin-jet Tu-124s in service on short-medium-haul trunk routes for more than three months. The flight deck is, as might be expected, reminiscent of the Tu-104—from which it was evolved—with the "bomb-aimer/navigator" entry into the nose section and the consequent absence of the familiar central control console

MR CONNELLAN'S "SUPER HERON"

IN the March issue of *American Aviation* Mr E. J. Connellan of Connellan Airways, Alice Springs, suggests the development of the Heron into a Super Heron. This was first proposed in the USA, as noted in *Flight* for January 16, 1964.

Mr Connellan says: "We have a project for re-engining the Herons with Lycoming GO-480 engines—the same as on the Twin Bonanza. I have recently been in the United States on this project. You might recall that the third-level operators suggested that a Super Heron could be the answer to their problems.

"I would like to suggest to you that the Super Heron could well be the answer to the problems at one particular level—the type of short-haul service for which 18 passenger seats are sufficient, and for which higher aircraft utilization is impossible. I am anxious to obtain help from other operators to share the cost of developing the Heron along these lines."

A Second DC-7F has been acquired by Shannon Air, the non-scheduled carrier founded by a group of US investors headed by Mr Kermit Roosevelt.

A fourth 707-320C convertible passenger/freighter has been ordered by Sabena for delivery (as OO-SJJ) in the spring of next year. The airline's 707 fleet will then total eight.

Newfoundland Accident An Air Manila (Philippines) DC-3 crashed in Newfoundland on the night of March 18 soon after leaving Gander Airport with two crew on a flight to the Azores. There has been no later news of casualties.

Crash in Colombia An Avianca DC-3, with 26 passengers and a crew of three on board, was reported missing on March 22 while on a flight from Bogota to Bucaramanga, Santander Province. The charred wreckage of the aircraft was sighted the following day in the eastern Andes. No survivors have been reported.

A New Australia-Italy Air Agreement gives Qantas and Alitalia the right to serve Manila and Hong Kong on services between Sydney and London through Rome. A fourth weekly service through Rome for Qantas has been confirmed. Alitalia has rights to fly between Sydney and New Zealand and is authorized to operate a third weekly service between Rome and Sydney from January 1, 1968.

British Midland Changes Capt T. H. Pike has been appointed general manager (flying) of British Midland Airways. He was previously chief pilot, a position now taken by Capt S. D. Fenton, who was previously operations superintendent. Capt B. G. Cramp, formerly commercial manager, has been appointed operations manager and Mr L. W. Hopkins, previously with British Eagle, is now commercial manager.

A Colour Visual Flight System has been bought by TWA from General Precision Systems for use in conjunction with the airline's DC-9 and Boeing 727 flight simulators. The system, using a Marconi colour television camera, will show a moving terrain model of Mid-Continent International Airport, Kansas City, and its surroundings, with colour approach and runway lighting and a strobe flash system for the main runway.

IFALPA's Twentieth Conference

THE annual conference of an organization such as the International Federation of Airline Pilots Associations tends to fall into a pattern of procedural routine, with a review of the work of the previous year and the programme plan for the forthcoming year forming the major tasks. This year, however, Rio de Janeiro was the venue for the 20th conference and nothing is ever permitted to become routine in this dramatically beautiful and lively city—which had just celebrated its own 400th anniversary.

The members of the pilot association of Panair do Brasil were the hosts. They had recently seen their airline declared bankrupt by presidential decree and its routes handed over to competitor airlines —Varig, Cruzeiro do Sul and VASP. That the pilots of this association elected to continue with the demanding tasks which fall to the organizers of an international meeting, provided proof of the traditional optimism and courage of the "Carioca"—the citizens of Rio de Janeiro.

The conference was opened by Brazil's Director General of Civil Aeronautics, Maj Brig Nelson Freire Lavenere-Wanderley, who paid tribute to the work of IFALPA in international aviation and to the importance of aviation to a country such as Brazil with its problem of communications with the interior and especially along the Amazon. Mr Roy Jenkins, Britain's Minister of Aviation, sent a message to the conference which was very well received, for it laid stress upon the importance of international interdependence and the role which organizations such as IFALPA can play in improving international understanding.

Greetings from Russian Pilots

Thirty-six national associations were represented at the conference. The pilot associations of Fiji, Hong Kong and the Argentine joined the Federation during the meeting and the pilots of the USSR and Jugoslavia sent messages of greeting. Total membership would undoubtedly be even larger if all governments conceded the right of association to their pilots. Many other organizations were represented, including ICAO and the National Mediation Board of the USA. Some of these observers were especially interested in the industrial aspects of the conference, while others were more concerned with the technical issues. Six sub-committees conducted the business of the conference with all recommendations processed by plenary sessions. Full consideration of an agenda which was both varied and wide-ranging produced decisions which are likely to be carefully considered in all the sectors of civil aviation.

Among the highlights was the unanimous decision to send a message to the then-continuing ICAO North Atlantic Regional Air Navigation meeting, characterizing the proposed reduced aircraft separation standards as being "unsafe" (see last week's issue, page 477). This action was an unprecedented one for IFALPA, which has previously refrained from "confrontation" with either ICAO or its member states. This past year has seen a gradual hardening of IFALPA policy, with the pilots of the world proving their willingness to act when words have appeared unlikely to produce results. A partial ban on operations into the Naples and Acapulco (Mexico) airports has already produced some improvements in the airport technical facilities and similar pressures now seem likely to be applied at the ICAO level.

The results achieved by the strongly worded message to ICAO were not known at the close of the meeting, but there is no doubt that the conference recognized the implications of its action. It is believed that any revised North Atlantic procedures based on reduced separation standards cannot be introduced before late 1966 at the earliest, but an earlier test of IFALPA's determination will be made if the US Federal Aviation Agency goes ahead with its plan to reduce vertical separation to 1,000ft above flight level 290 over the continental USA later this year. As the USA's ALPA is a member of IFALPA, it might perhaps instruct its members to refuse ATC clearances based on the reduced vertical separation. IFALPA's mutual support policies (technical) will make it incumbent upon the other pilot associations to take similar action. What steps any regulatory authority will take in such circumstances remains to be seen.

No doubt the pilots will be criticized in some quarters if they take such action, but the reaction of the air-travelling public might well be sympathetic on an issue so obviously concerned only with air safety. There appears to be a genuine disagreement between the pilots and the states and other organizations represented at the ICAO NAT meeting. This may well require a further meeting before a solution is found. Perhaps ICAO's Air Navigation Commission will intervene in the disagreement.

Another agenda item which attracted a good deal of attention arose from two separate incidents involving the arrest, temporary imprisonment and ill-treatment of airline pilots in Liberia. There was some support for a proposal which would have had the effect of depriving Liberia of international air transport for a specified period of time as a gesture of disapproval of the actions of some agencies of that Government. However, it was finally agreed that subsequent events, including the payment of $4,000 compensation to one of the pilots, had lessened the need for action relating to those specific cases. The eventual outcome was a resolution which calls upon all pilot associations with members operating into Liberia to make representations to their own governments aimed at securing a guarantee of safe conduct and protection from the Liberian Government. The possibility of ceasing operations into Liberia in the event of any further incidents was foreseen and stated. The widest international publicity is to be given to these decisions by the Federation.

It should not be assumed from these decisions that all the attention of the conference was directed towards destructive criticism of the actions of other organizations. Many constructive decisions were taken which are likely to prove of great value to civil air operations.

Before the end of the conference there were some encouraging signs that steps will be taken toward solving the problems created in Brazilian aviation by the cessation of operations by Panair do Brasil. The pilots of Varig, Cruzeiro do Sul and VASP are now convinced of the need for international representation of airline pilots and the name of the original Panair pilot association is to be changed to "Associacao de Pilotos de Brasil" with the strong possibility that it will become the association representing all Brazil's pilots. Such a move would greatly assist in absorbing Panair's pilots into the other airlines.

During the course of the meeting the delegates were flown to

At the opening session of the IFALPA conference are, left to right, Maj Brig N. F. Lavenere-Wanderley, Brazil's Director General of Civil Aeronautics, Capt Bunener (Brazil), Capt J. Foy (Canada), president, Capt J. Bartelski (Netherlands), deputy president, Capt Alcaraz (Mexico), vice-president

AIR TRANSPORT . . .

the new capital city of Brasilia. This trip demonstrated to all the enormous and vital importance of air transport to Brazil. In the early days of construction of the new city even bricks and cement were being flown in. A good highway now connects Rio de Janeiro and Brasilia, but commuting by government officials and others is done mostly in the various aircraft operating the "Punte Aerea Brasilia"—the air bridge to Brasilia. Some 1,700kg of newspapers are flown to the new city each day and in the first two and a half years of operation 634,000 passengers used the services.

Some 40 pilots were on board one of the special flights to Brasilia and a sweepstake run to guess the total flight hours of those pilots produced the startling fact that they had some 528,400hr between them with the top man nearing 30,000hr. Not very valuable information perhaps—but indicative of the vast amount of experience which is eventually reflected in IFALPA's policy decisions.

A very pleasant ceremony during the last day of the conference was the presentation of the Clarence N. Sayen Award to Capt W. M. Masland (USA) for his outstanding services to IFALPA. The trophy has been donated by the Mexican pilots association to commemorate Mr Sayen's invaluable work for IFALPA during its formative years. Capt Masland started his aviation career in the US Navy and has since spent 30 years in the service of Pan American, during which time he has done a good deal of pioneer flying and has amassed 28,000 flying hours. One of the best speakers in aviation, Capt Masland is well known internationally for his representations on behalf of the pilot fraternity.

The Clarence N. Sayen Award is presented to Capt W. M. Masland at the IFALPA conference. Left to right are Capt Fabre (Mexico), Capt J. Foy (Canada), president, Capt Masland, Capt C. C. Jackson, executive secretary of the Federation, Mr C. N. Sayen, and, partly hidden, Capt Forsberg (Finland)

One of the last items of business was the election of the principal officers of the Federation. No changes were made, so Capt Jim Foy of Canada remains president with Capt Jan Bartelski of the Netherlands as deputy president. The three continuing vice-presidents are Capts Alcaraz (Mexico), Arthur (UK) and Forsberg of Finland.

During the year attempts will be made to implement the decisions taken at Rio before the Federation meets again in the spring of 1966 in New Zealand. **Note:** The various working papers at the conference will be appraised in a later article.

THE DEEP STALL THAT WASN'T

A SEQUEL to the fatal One-Eleven deep-stall accident—the report of the investigation on which was summarized in last week's issue, pages 479-480—was the incident in which a modified One-Eleven was belly-landed on Salisbury Plain without serious damage on August 20, 1964. This incident has also been investigated by the Ministry of Aviation and the report was issued on March 26. As with the accident to the prototype, flight-recorder and, in this case, normal flight-test-recording data provided most of the answers for the MoA accident investigation branch.

The aircraft, G-ASJD, had been about to carry out stalling tests at forward-limit c.g. During recovery from an abortive first run the pilot gained the impression that the elevator response was abnormal and that the aircraft might be in a stable stall condition. The tail parachute was streamed—though the indicated airspeed had by then increased to 225kt and the incidence was only 6°. The pilot's conviction, however, remained that a stable-stall condition existed and he did not jettison the parachute. With full flaps and full power to check the descent, a wheels-up landing was made with little damage to the aircraft and no injuries to the crew.

This One-Eleven had the modified leading edge to improve the pitch-down characteristics at the stall and the power-operated elevators which were introduced following the fatal accident to the prototype, G-ASHG, in October 1963. A tail parachute was fitted to give a powerful nose-down pitching moment if high angles of incidence were reached in stalling tests. A special modification to the engine reverse-thrust cascades had also been incorporated to give an upward thrust component of 44 per cent of the obtainable gross thrust and thus to provide another powerful means of getting the nose down. The pilot had used this thrust as well as normal forward thrust several times during the descent with the parachute streamed, but the apparent lack of effect "served only to increase [his] conviction that a stable-stall condition existed."

In his comments the chief inspector of accidents explains that, because the angle of incidence was already small, the nose-down pitch caused by the use of the tail parachute and of the upward thrust component would have been small. This was interpreted by the pilot as proof of the ineffectiveness of the devices in reducing the incidence. If the parachute had been jettisoned the aircraft could, the report says, have been flown away normally, but the pilot's conviction of a deep stall "ruled out any logical thought process."

The pilot had flown G-ASJD during most of the tests since its first flight (which he also made) on July 6, 1964, and had flown it on six previous series of stalling tests—which were the first such trials to be conducted on the One-Eleven since the accident to G-ASHG.

The investigation report discusses the possible reasons for the pilot's misinterpretation of the behaviour of the aircraft. The RAF Institute of Aviation Medicine, whose assistance was sought, considered "that a 'set' towards the occurrence of a stable stall" was apparent from the evidence of the pilot's previous experience when, while testing a Victor bomber, an anti-spin parachute had to be used to recover from a spin following a sudden uncontrollable pitch-up.

BETTER YEAR FOR KLM

FURTHER strong signs of financial recovery for KLM are seen in the unaudited interim report for the 1964 calendar year which the airline has recently issued. Operating results were, with a loss of only Dfl2m (about £200,000), almost at break-even point by comparison with the operating loss of Dfl49m (£5m) in 1963. Reorganization and staff reductions, however, will continue to involve substantial expenses and the final result for 1964 is likely to be an overall loss of about Dfl55m (£5.5m). Accumulated losses now total Dfl130m (£13m).

During 1964 capacity ton-miles was increased by only 6 per cent on scheduled services while revenue ton-miles increased by about 17 per cent to 297.4m. This year the biggest increase in capacity will be on the North Atlantic where service frequencies are being stepped up to 28 a week at the peak period—representing a 22 per cent capacity increase. On freight services the capacity increase, overall, will be nearly 30 per cent. Introduction of the DC-8F on the Amsterdam - Montreal - New York service, operated five times a week, resulted in an increase of freight tonnage last year of about 23 per cent.

KLM will pay for its six DC-9s over a period of 12 months from its cash resources.

NEW FREIGHT SYSTEM FOR TAA

TRANS-AUSTRALIA AIRLINES is planning to introduce a new-type "roller pallet" cargo-handling system. This will come into use with a fourth DC-4 freighter which the airline will shortly buy from overseas and modify for its own requirements.

TAA's general manager, Mr John Ryland, said that the new system comprised a lightweight pre-stressed metal pallet and a roller system in the floors of all the airline's cargo aircraft. The system would enable these aircraft to be turned round in 45min instead of the usual 2hr.

IN THE AIR *By Neil Harrison: Number 192 of the series*

VICTA AIRTOURER 100

(One Rolls-Royce Continental O-200-A 100 h.p.; McCauley fixed pitch metal propeller 69in diameter)

Span, 26ft; length, 20ft 9in; height, 7ft; wing area, 120 sq ft; empty weight of basic aircraft, 1,050lb; empty weight as tested, 1,075lb; gross weight, 1,650lb; gross weight for aerobatics, 1,550lb; fuel capacity, 28.7 Imp gal; wing loading, 13.75lb/sq ft; power loading, 16.5lb/h.p.

Performance (claimed) Max speed at sea level, 138 m.p.h.; max cruise at 4,000ft, 128 m.p.h. (TAS) fuel consumption 5 Imp gal/hr, and dry tanks range 735 miles; economy cruise at 4,000ft, 109 m.p.h. (TAS), fuel consumption 4 Imp gal/hr, dry tanks range 780 miles; normal take-off distance, 1,770ft; normal landing distance, 1,505ft; max sea level rate of climb, 675ft/min.

VICTA AIRTOURER 100

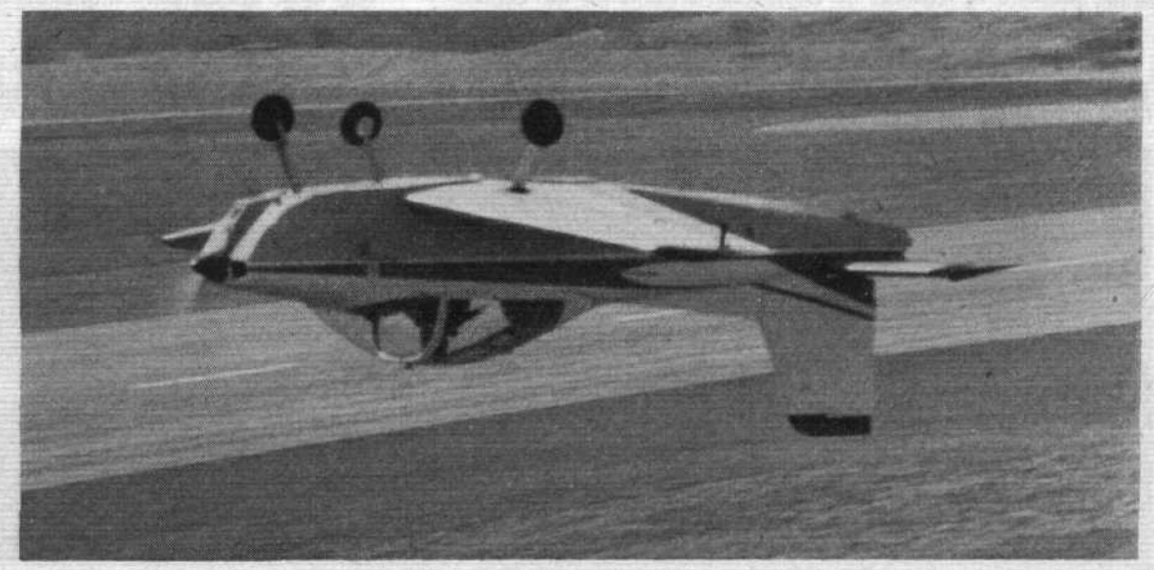
NOT for six years—since import restrictions on foreign-built light aircraft were lifted—has the British light-aviation movement shown enthusiasm for a new aircraft to compare with that with which it has greeted the Australian-built Victa Airtourer. Within days of the launching of the sales campaign last month the planned import quota was sold out; and, despite a longish waiting-list, the number of eagerly interested customers continues to grow. In 2½ years of production over 100 Airtourers have been built, and the delivery rate is being increased as fast as possible. But perhaps the most telling testimony to the worth of this quite ordinary looking little aeroplane is that two leading American rival builders have each sought to buy one for its own research department to evaluate.

To what can be attributed the Airtourer's instant success? One simple answer is that it was conceived with a clear understanding of the needs, taste and pocket of the British Commonwealth market. The design springs from Mr Henry Millicer's winning entry in the British Royal Aero Club's 1952 competition for a low-cost two-seat trainer/tourer. Picking the right specification was obviously a significant factor; yet, remarkably, there is no other aircraft at the price which combines fully aerobatic capability with the light, powerful and precise flying controls beloved of European pilots plus all the up-to-date convenience and reliability exemplified in American aircraft.

A great deal of the current malaise in British private flying can probably be traced to the characteristics of the aircraft commonly used. Most American machines are nothing more than efficient A-to-B vehicles, and once the very simple task of learning to fly them from A to B has been accomplished there is virtually no more scope for more advanced pure flying. This obviously does not worry pilots who merely learn to fly in order to travel; but the proportion of people who regularly fly in this way must be very small compared with those who start flying, would like to do more, find they can't afford it, and ultimately give up altogether through lack of challenge or purpose. British flying clubs and groups clearly need a safe and cheap general-purpose aircraft, suitable for aerobatics yet comfortable and efficient for touring, and with parachuting and glider-towing capabilities. This is just what the Victa Airtourer 100 offers.

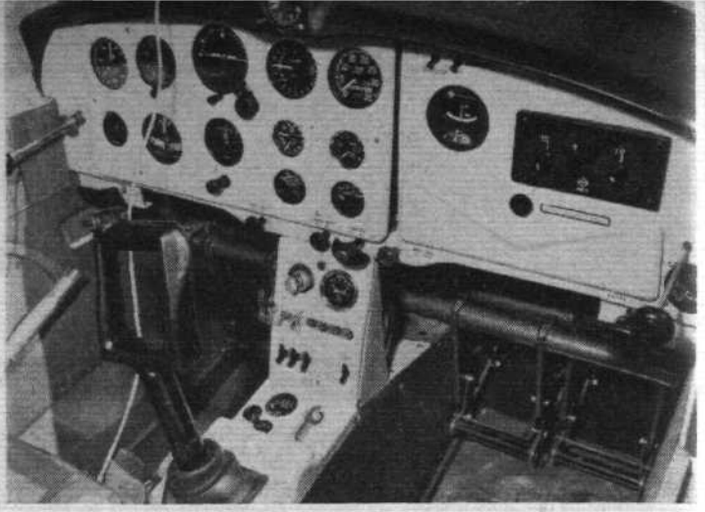
General-purpose devices of any kind are usually criticized for not performing any single function particularly well. The all-metal Airtourer is the heaviest 100 h.p. aircraft on the market, because it is stressed for the fully aerobatic manœuvring load of +6g (factored by 1.5 for design) and a design diving speed of 220kt. Nevertheless, by the application of clever aerodynamics, the airfield and cruising performance penalties have been kept to a minimum in comparison with those of other aircraft. The gross-weight wing loading and power loading are higher than average, yet a low-drag shape has saved the day. The single-slotted flaps and drooping ailerons confer a remarkably high maximum lift co-efficient—hence the small wing area. Powered by a 100 h.p. Rolls-Royce Continental O-200-A flat-four piston engine driving a 69in diam fixed-pitch McCauley metal propeller, the Airtourer 100 is offered at £3,950 delivered and tax-paid in Britain. The more powerful Airtourer 115, fitted with a 115 h.p. Lycoming O-235, costs some £500 more than the Airtourer 100. Included in the basic specification of both aircraft, which have identical airframes, are an overall paint scheme and complete internal corrosion proofing, a cabin heater and night lighting. Optional equipment includes a full blind-flying panel (£124 extra installed), radio, anti-collision beacons, and landing lights.

Australians are notoriously tough customers in the matter of field support, and from home experience Victa are determined to provide faultless backing for their product on world markets.



Demonstration pilot Peter Philips' aerobatic routine in the Victa is not much less spectacular than his similar display in the Cosmic Wind. The length of inverted gliding is limited by engine lubrication considerations in the absence of "inverted systems"

An upward roll, split-S turns and six-point hesitation rolls are all within the aerobatic Airtourer's ability; the full-span "flaperons" and tiny wing give precise control and low rolling inertia



The Airtourer cockpit shows careful detailed planning. A full blind-flying panel of instruments is available as an extra, and there is also space for a moderate amount of radio equipment. The demonstrator has an accelerometer mounted on the coaming; plunger throttles and brake handles are duplicated, and the flap lever is on the port side only

VICTA AIRTOURER 100...

The United Kingdom division of the company—Victa (UK) Ltd, 134 St Albans Road, Watford, Herts—is handling sales and distribution, while Glos Air at Staverton Aerodrome have contracted to handle assembly, maintenance, overhaul and spares supply. Within the next month or so a complete spares price list will be available. One of Victa's aims is that not a single one of their aircraft should be grounded for more than a week through any failure to supply parts; if necessary, spares will be airfreighted from the factory in Sydney. So far as the engine is concerned, Rolls-Royce can be relied upon for service.

Photographs tend to make the Victa look bigger than it really is; in fact it is quite small. The British demonstration aircraft is attractively painted in two shades of green with glowing red tips to the flying surfaces. Many of the external items to be attended to on the pre-flight external check are clearly marked. The external finish is nicely smooth and there are very few excrescences to disturb the airflow.

Entry to the cockpit has been well planned by the provision of steps and hand-holds, and a small flap unfolds from beneath the squab to protect it from muddy boots. The seats are comfortable and softly upholstered. The full shoulder harness, with a twist-to-release central clasp, may be worn just as a lap-strap. Behind the seats a useful well for suitcases is stressed for a load of up to 100lb. Some people may consider the elbow width marginal but the central position of the control column leaves one's lap clear for maps and so forth.

The alert seating angle, excellent visibility and conveniently situated armrests and spade-handle control stick combine to inspire confidence. Because of the stick location the throttles are duplicated, and the only awkward feature of the otherwise simple and effective layout is that one must twist slightly to reach the Tiger-Moth-type elevator trim lever mounted centrally aft of the stick. Parking brake pressure is released by depressing a knob on the central pedestal, while a duplicate handle beneath each throttle operates the brakes when the aircraft is moving. Directional control is achieved through a steerable nosewheel directly connected to the pedals—an arrangement which occasionally transmits sharp feedbacks and is a little heavy to operate.

The pre-take-off checks consist of adjusting the friction nut to the plunger throttle; setting the trim around mid-travel; switching on the fuel boost pump (the tank is under the seats and the Australian DCA has decided the fuel tap should be wire-locked "on" for safety); lowering half flap, if necessary, to shorten the run; and checking harness and the single canopy-lock secure. Still-air take-off distance to 50ft from a smooth surface is around 600yd at gross weight, and although this is longer than average the performance is adequate for the usual private airfield. Handling during the take-off run is straightforward, with directional control becoming sensitive towards unstick—which occurs almost without control movement at around 60kt. Speed builds up quite quickly on retraction of the flaps, and the clean climb is made at an indicated 70kt with the aircraft in a fairly nose-high attitude and with a rate of climb of over 650ft/min. A persistently oiling plug on the engine of the demonstrator was the cause of an initially unfavourable impression of noise level and vibration in and around the cockpit, but a dive to 125kt soon cleared the offending plug and everything then became much smoother.

On seeing the central control column for the first time I rather expected an impression of feeling "off centre," especially when doing aerobatics. But nothing of the kind happened: in fact, the control could well be the most simple, well planned and convenient ever devised for an aeroplane of this kind. The spade handle may be gripped at the same time by both pilots and there is a choice of holds to suit the particular manœuvre; angular movement is quite small, and the stick is always well clear of the occupants.

The most immediately impressive feature of the Airtourer is

The Airtourer may be flown at up to 70kt with the canopy open and can be used for parachuting; glider towing is possible, though a tow hook is not a listed extra at the moment

Marconi AD70 DME

The Marconi AD70 airborne distance interrogator is the only airline DME being manufactured in Europe. The AD70 is a second generation high performance equipment incorporating many new features designed to simplify pilot operation and speed up the acquisition of distance information.

RAPID SEARCH AND LOCK ON

The automatic search circuits scan distance range from 0—200 miles *in 5 seconds* and 40 miles *in 1 second.*

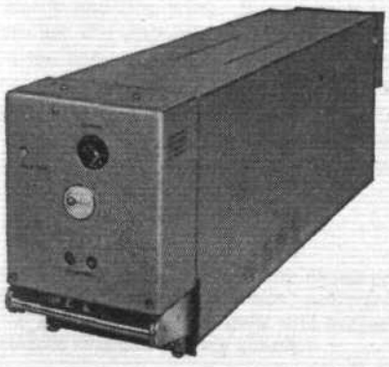
VELOCITY MEMORY

Velocity memory enables the AD70 to continue tracking if the reply signal is temporarily lost.

AUTOMATIC STANDBY

If no signals are received the AD70 will automatically search until a reply signal is received.

CHANNEL EXTENSION



The AD70 provides 126 channels which can easily be increased to 252 channels to cater for future DME system expansion.

SELF TEST

Self Test confirms correct equipment operation.

ARINC SPECIFICATION

The AD70 meets all the requirements of ARINC 521D.

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The Marconi Company Limited, Aeronautical Division, Basildon, Essex, England LTD/A52

B *

What happened when the Bell Iroquois took off with the new (1400 shp) Lycoming T53 aircraft engine?

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This new 1400 shp version is one more step in the continuous development of the intrepid Lycoming T53.

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We're already working on it.

Lycoming

VICTA AIRTOURER 100 in the Air . . .

the effect of its superb full-span "flaperons." The whole of the wing trailing-edge is in effect a slotted flap built in two sections per side; the deeper-chord inner sections move in sympathy with the conventional outboard ailerons but never go above the level position where they would destroy lift. There is also a split flap under the fuselage across the centre section, and all sections move down to act as high-lift flaps.

While I was still feeling-out the aeroplane before trying low-speed handling, Mr Peter Philips—Victa's salesman and well known as a display and competition aerobatic pilot—suggested trying "one of the things I like to demonstrate." Without having any idea what was coming I obeyed the instruction to depress the nose and let the speed build up to 130kt and then to pull the nose up to about 40° above the horizon before smartly moving the stick over to full aileron deflect. The result? A perfect barrel roll. Student pilots with only an hour's previous dual have done the same.

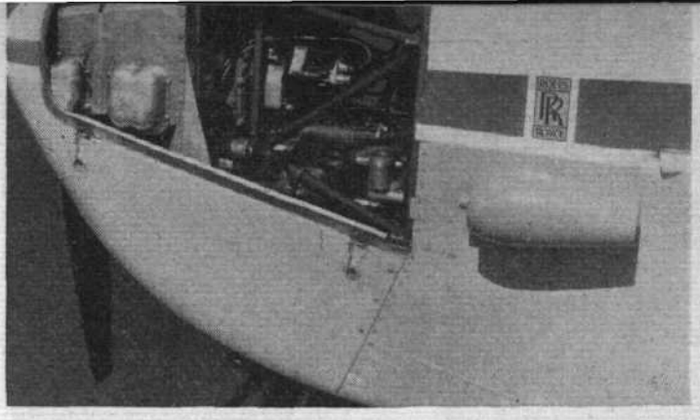
The rate of roll is excellent for such an aeroplane and the lateral control is extremely responsive and precise—a six-point hesitation slow roll is well within the Victa's capabilities.

Resisting the temptation to have fun with the aeroplane, we returned reluctantly to the humdrum task of checking level speeds. While aerobatics are obviously the Victa's secret weapon, a great many people will be interested only in the straight-and-level performance. Compared with those of other 100 h.p. aircraft, the cruising speed, range and payload of the Airtourer 100 are perhaps slightly above average. Though a few other two-seaters fly faster, go further and carry more, many very popular types are not so good in these respects. On part-throttle with the engine turning at the red-line continuous-rated 2,750 r.p.m., speed stabilized around 118kt at 2,000ft, while 2,500 r.p.m. produced 106kt. These observed figures tend to confirm the claimed maximum speed of 138 m.p.h. at sea-level; maximum cruising at 4,000ft of 128 m.p.h. and best range speed of 109 m.p.h. also at 4,000ft.

The single fuel tank contains 28.7 Imp gal, of which all but a drop is useable. Best endurance and dry-tanks range therefore would be around 7hr and 760 miles. Empty weight of the demonstrator G-ASYZ is 1,075lb, and with full fuel this gives a payload of 370lb within the 1,650lb gross weight limit—equivalent to a couple of 13½-stone occupants. Permitted gross weight for aerobatics is 1,550lb. Included in the empty weight of the demonstrator was a Narco Mk 12 Com/Nav VHF radio.

In the course of a fairly brief evaluation flight during which we were rarely straight and level long enough to appreciate the touring aspects of the aircraft to the full, the Airtourer nevertheless felt promising in this respect. As previously remarked, the seating was very comfortable. Noise level is always difficult to assess in little aeroplanes, which are rarely outstanding in this respect; the Victa seemed about average, but did have one or two irritating rattles. Visibility is excellent in all directions, owing to the bubble canopy and tiny wing. Sitting high in the also high-sided cockpit, one has the opposite wing almost out of view. An opaque patch on the back of the canopy usefully shades the back of one's neck from the Sun, yet does not hinder the view rearwards. The Airtourer was also quite stable and held a heading well.

We next tried stalling before eagerly getting back to "tweaking" hose ailerons. Weight for the flight was about 1,450lb (200lb under gross and 100lb under the aerobatic limit). Without flap and with power-off the minimum speed was 55kt indicated; with the stick hard back, and a cacophony from the oilcanning panels at the back, the Airtourer sank, wings level, with only a slight nose-down pitch. Recovery was normal. The performance was much the same with flap, when minimum speed was cut to 40kt IAS; and a stall-warning horn is set to operate when speed falls off with the flaps lowered. Even when stalling off steep turns there is not the slightest hint of a wing drop, while the noise from the back serves as an effective and realistic warning of the ultimate danger of letting speed fall off.



The Rolls-Royce O-200 is adequately accessible for most routine checks though the propeller must be removed to detach the main one-piece glass-fibre cowling

In spite of their power the flaps have very little effect on trim and they can be easily held without adjusting the trimmer. A full-flap simulated overshoot with full aft trim could be held without the slightest difficulty. A minimum full-flap approach-speed of 65kt is recommended, with 70kt suggested for gusty conditions. These speeds are well within the control capabilities and lower speeds could be used, bearing in mind the increased rate of sink and lack of margin for error should power fail at the critical point.

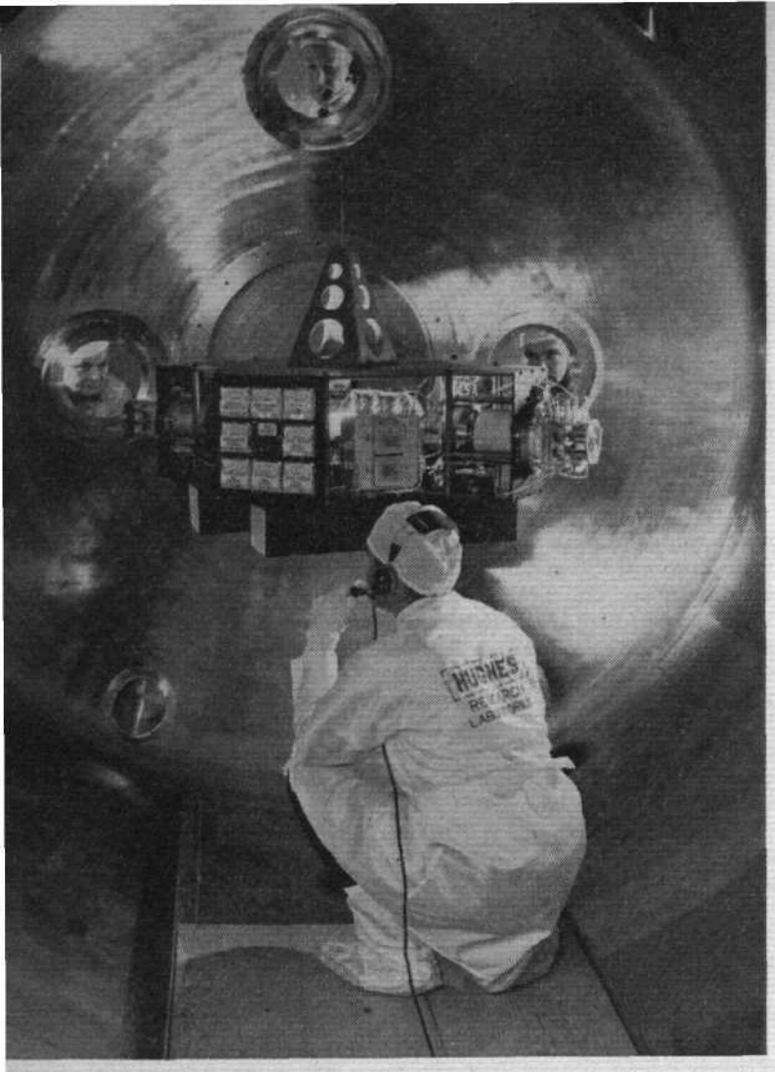
The Victa will spin, but one must be very determined and use ailerons to enter the condition and avoid getting into a spiral dive. The attitude is steeply nose-down and rotation is quite fast, while recovery is quick and conventional.

That the Victa is capable of being put through a very respectable aerobatic routine is being superbly demonstrated by Peter Philips. The upward rolls, split-S turns and inverted performance is not much less spectacular than his similar display in the Tiger Club's Cosmic Wind racer. It is remarkable that the two-seat Victa has only 15 more horsepower than the Cosmic Wind. At our weight the Airtourer had sufficient power for doing all the standard aerobatic manœuvres though some practice and a nice touch is needed for smoothness and best effect.

There is ample airframe strength for aerobatics; the placarded speed of 175kt maximum diving corresponds to the engine r.p.m. limit with the fixed pitch propeller. The airframe is stressed to 220kt, while the manœuvring limit is 122kt.

Flying the circuit, the speed is brought back to 100kt for flap lowering and carburettor hot air selected. The power-off approach at 70kt is quite steep and there is an excellent view of the runway over the sharply drooping nose. There is surprisingly little tendency to float, in view of the full-span flaps which might have been thought to trap a cushion of air, and the aircraft sits down firmly on its wide-track tricycle undercarriage.

Nosewheel steering provides the Airtourer with a 9ft 6in turning radius; powerful dual hand-operated hydraulic disc brakes combine to make taxying simple



Possible system of ion engines for station-keeping and attitude control of a large synchronous satellite is tested in vacuum chamber at Hughes Research Laboratories, Malibu, California, under NASA contract. A single engine can be seen at right of assembly

PROGRESS IN ION PROPULSION

BY DR GEORGE R. BREWER*

THE advent of ion propulsion systems for spacecraft as well as for satellite control makes available to man an entirely new means of propulsion which can pay vast dividends in the field of space exploration. Some day ion engines may propel manned expeditions millions, perhaps even billions, of miles beyond the Sun. Actually the possibility of using electrical propulsion for space travel has been considered for more than 35 years, having been first suggested by the German rocket scientist, Hermann Oberth, in 1929. The first serious proposal and system design which demonstrated the theoretical feasibility of electric propulsion was made in 1954 by Dr Ernst Stuhlinger, now a key NASA scientist.

Careful analysis of some proposed interplanetary missions indicates that, in order for a spacecraft to carry the maximum possible payload, the exhaust velocity of the propellant from the reaction rocket must be in the order of 100km (60 miles) per second. The only means of obtaining this high propellant velocity is through the use of electrically accelerated charged particles, which we now call ion propulsion. Each of the three other possible approaches to space propulsion is seriously limited for one reason or another:—

(1) Chemical system: specific impulse is limited by the energy content of the fuel and the tolerable temperature of the combustion chamber.

(2) Nuclear system: this provides higher energy content of the "fuel" but the propellant temperature and therefore the specific impulse is still limited by the permissible chamber temperature.

(3) Electric system: here the thrust obtainable is limited principally by the power available at light weight; the upper specific impulse level theoretically is unlimited.

Reaction rockets generate thrust by expelling mass (electrically charged particles, in the case of electric rockets). The thrust thus generated is given by the rate at which the propellant is ejected multiplied by the velocity with which the propellant leaves the rocket. The exhaust velocity is usually referred to in terms of a parameter called the specific impulse. The higher the specific impulse from a given rocket, the smaller the mass of propellant that is required to provide the desired thrust. Thus, high-specific-impulse rockets are necessary for long-duration missions, such as interplanetary probes and manned spaceflight. Comparisons between the three types of rockets in current development and use quickly highlights the advantages of the ion engine for such missions.

The chemical rocket produces a specific impulse of about 400sec, the nuclear rocket 800-900sec and the ion engine 3,000-20,000sec. The value of the significant increase in specific impulse as provided by the ion rocket becomes evident as we explore the subject further.

Historically, three independent developments have been necessary to bring electrical propulsion to fruition for space applications:—

(1) High-thrust boosters to carry the propulsion system and payloads beyond the Earth's gravitational field and into orbit, where the electric engines can start thrusting.

(2) Power systems (nuclear and/or solar) of low weight/power ratio to operate the ion propulsion systems.

(3) Adequate knowledge of thrustor physics and engineering.

Since 1959, the technology in all three of these areas has advanced considerably. In the present Atlas-Centaur or Saturn 1B-Centaur, and in a few years with the Saturn V, we have launch vehicles capable of boosting interplanetary spacecraft into orbit.

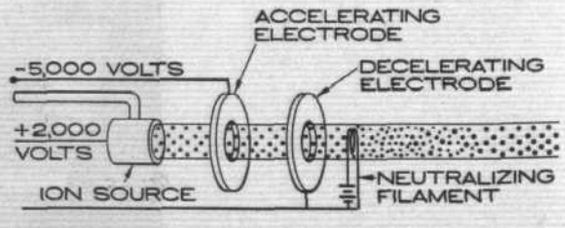
While the ultimate power system, nuclear-electric, is still five to ten years away from operational mission status, solar power systems of low enough specific weight are available now to conduct useful missions. Thrustors and the associated subsystems have been advanced to the stage of long-duration durability testing and, in one case, to a completely flight-qualified condition. Thus all the ingredients are currently available, or will be available in the very near future, to conduct useful missions with electric propulsion.

First, let us briefly examine the operation of an ion engine. A schematic diagram is shown in Fig 1. At the left, we see the ion source, which is a device for ionizing the atoms of the gas which we intend to use as the propellant. These ions are accelerated by the strong electric field created between the source and the negatively charged accelerating electrode, which is held typically at a potential of 3,000 to 10,000V with respect to the ion source. The ion beam is then decelerated somewhat to the potential of the spacecraft and exhausted from the engine.

The ejection of these ions at high velocity gives rise to a thrust which is transmitted to the engine electrode through the electric fields and imparts a force on the engine in the opposite direction. By accelerating the ions through the high potential existing between the electrodes of this engine, we can achieve virtually any desired

* *Manager, Ion Propulsion Department, Hughes Research Laboratories.*

Fig 1 Schematic illustration of an ion engine, showing the ion source and the negatively charged accelerating electrodes. By varying the accelerating voltage, virtually any desired exhaust velocity can be achieved. A neutral beam streams out to the right



exhaust velocity, merely by varying the accelerating voltage. For the propellants currently in use, principally cesium and mercury, the desired high exhaust velocities can be achieved with reasonable accelerating voltages. This class of electric engine depends upon the separation (ionization) of the atom from one of its electrons and the separate acceleration of the resultant charged particles.

As can be seen at the right of Fig 1, electrons must be injected into the beam after it is exhausted from the engine in order to maintain electrical neutrality of the spacecraft. If these electrons were not injected into the beam the spacecraft, which is isolated electrically from the rest of the universe, would quickly charge up to a high negative potential. If this were to occur, all the ions would be drawn back to the spacecraft, thus completely cancelling the engine thrust. Both ground and spaceflight experiments have demonstrated that this neutralization is indeed possible in practice and will impose no serious problem upon the utilization of ion engines for space propulsion.

This class of electric engines is capable of producing specific impulses in the range of 3,000sec and higher. A typical engine will operate at values from 6,000 to 9,000sec. It was mentioned earlier that this specific impulse range is a factor of ten to 30 times greater than that available from chemical rockets or a nuclear rocket engine. This high exhaust velocity means that less propellant must be carried for any given total impulse. This significantly lower propellant weight requirement has great economic value in reducing the amount of weight that must be boosted into the initial Earth orbit. Alternatively, it can provide a much higher payload.

Hughes has been engaged in research and development of ion engines and associated systems and applications for the past six years and is a leading contractor to NASA in this area. Two types of ion engines are currently under active development by the company. They differ primarily in the way in which the electrons are separated from the gaseous atoms to form ions; that is, in the details of the ion source. The first of these engines is illustrated by the schematic diagram in Fig 2 and is called the electron-bombardment ion engine. This engine can in principle utilize any gas as the propellant. Mercury and cesium, however, are the current favourites. In the electron-bombardment engine, the gaseous propellant is injected into the engine from the propellant feed system shown on the left, filling the large discharge chamber in the engine.

At the same time, electrons are emitted from the cathode and are accelerated through a potential of about 20V and confined by means of a magnetic field in such a way that they oscillate back and forth through the gaseous cloud of atoms. The electrons ionize the atoms by impact, providing a dense, highly ionized plasma which fills the interior of the engine. This plasma will extend almost to the engine chamber walls, which include a perforated disc which is shown at the front of the engine. A high negative potential on the accelerating electrode will draw the ions out of this plasma, accelerating them away from the engine in the same manner as illustrated in Fig 1. These engines have been developed to a high state of performance in the laboratory and one has been successfully flight-tested. Efficiency values of 85 per cent or more have been obtained at the specific impulse value of 9,000sec.

An example of this type of engine being developed by Hughes is illustrated in the photograph (overleaf). The 50cm diameter engine shown will produce approximately 0.125lb (57 grammes) at a total power input of 30kW. Smaller electron bombardment engines in the 0.02lb (9 grammes) thrust range have also been built at Hughes. Engines of this type have undergone extensive testing at Malibu and in NASA laboratories.

The second general class of ion engines is illustrated in Fig 3, and is known as the cesium contact ion engine. The ion source here is a hot tungsten plate on to which the cesium propellant migrates from the propellant storage tank. The ionization potential of cesium is very low; specifically, it is lower than the work function of tungsten. Therefore propellant atoms will be evaporated from the hot tungsten surface principally as ions. The easy, rapid ionization of cesium from contact with hot tungsten is the principal reason for the choice of cesium as the propellant in this engine.

These ions are then accelerated by the electric fields and exhausted from the engine in much the same manner as we saw earlier. The contact-type ion engines have also reached a high state of laboratory development and flight qualification. Typical efficiency values of 80 per cent or more have been obtained at a specific impulse of 9,000 sec. These engines can be built in a wide variety of sizes and thrust levels ranging from a few micropounds up to perhaps 0.02lb in an individual engine module. A typical engine module under development at Hughes is capable of producing a thrust of 0.02lb (9 grammes).

Both of these classes of ion engines are now in advanced laboratory development, including long-duration life testing to demonstrate their durability for the intended one- to three-year missions. Because of these long-life requirements, the engines must be extremely reliable and must exhibit high durability over the projected time period. Extensive studies of possible failure modes in such engines have resulted in engineering developments leading to greater engine life. Current estimates of the lifetimes possible for such engines are of the order of one year or more.

Potential Applications

Let us now consider a number of potential applications in which the high-specific-impulse ion engines can show significant mission advantages. One type of such mission involves the use of solar cells to supply the electric power necessary to operate the ion engine. Perhaps the nearest application in point of time will involve the control of satellites.

Consider, for example, a synchronous satellite which is intended for meteorological or communications purposes. It is necessary to keep this satellite oriented towards the Earth on its predetermined station; that is, at a particular point in its orbit above a given spot on the Earth. Such satellite control requirements call for low thrust levels over extended periods of time. This application is ideal for ion engines since the low propellant consumption guarantees a significantly lower total weight for the entire control system. Such satellite control systems will require power levels in the general ranges of 10 to 150W and will weigh from 10 to 50lb.

In such a system, three or four ion engine stations will be provided which can produce thrust vectors through the centre of gravity of the satellite in order to move it around and so maintain it on station in its synchronous orbit. Other engines will be positioned so that they can thrust tangentially to rotate the satellite and so achieve attitude control. This latter control will be necessary, for example, to keep an antenna pointing toward a specific point on the Earth.

Engines in the 0.0005lb thrust range developed for the synchronous satellite control system are presently being life-tested at

Fig 2 Electron-bombardment type of ion engine. The ion source is a plasma created by electron impact with the propellant atoms

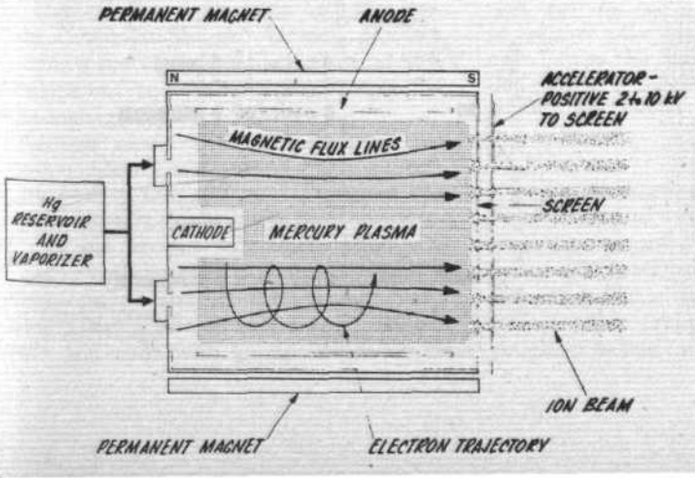
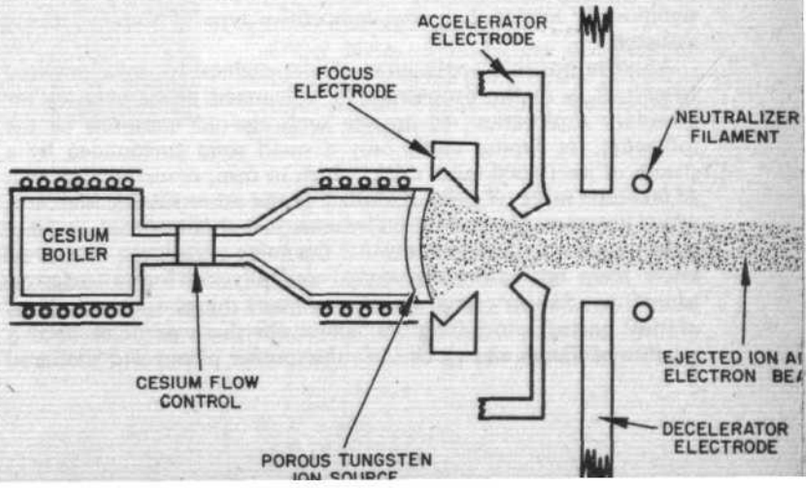
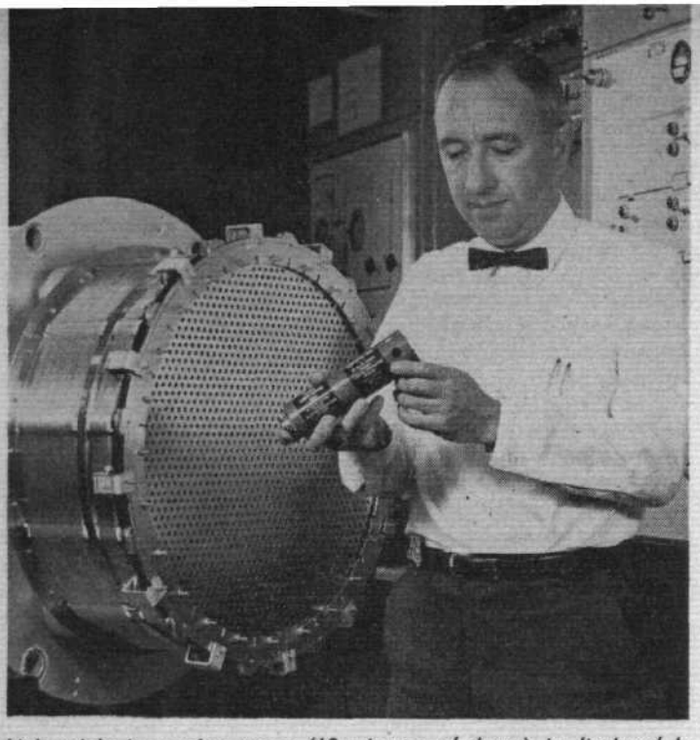


Fig 3 Schematic illustration of a cesium contact-type ion engine. The ion source employed in this case is a hot tungsten electrode





Lightweight ion engine system (10 micropound thrust) is displayed by the author, Dr George R. Brewer. On his right is a 50cm diameter, mercury electron-bombardment type of ion engine designed to produce about 0.125lb thrust

PROGRESS IN ION PROPULSION...

Hughes. The advantages accruing to such an operational satellite system through the use of ion engines for attitude control and station keeping can be illustrated. By plotting the total control system weight for a 1,000lb synchronous satellite against the required time in orbit, a comparison of several types of propulsion systems, including the low specific impulse chemical engines, can be made.

It can be shown that, for orbiting periods greater than six months, the low propellant weight required by the ion engine results in a much lower overall system weight, which includes the weight of solar cells to produce the electric power. In those operational situations in which attitude control of the satellite can be achieved by other means, and the ion engines are intended only for the station-keeping function, the weight is reduced. Thus it is evident that ion engines can provide the lightest-weight control system. Weight, of course, is one of the most important considerations entering into the design of any spacecraft which must be boosted into a high orbit.

If the attitude control of a synchronous satellite is achieved, for example, by a gravity-gradient stabilization system, which produces inherently low restoring torques, the ion engine emerges as having significant advantages for the station-keeping function. In such a satellite, it is very desirable that the station-keeping thrustor have a very low thrust-level so that any inadvertent misalignment of the thrust vector from the centre of gravity of the satellite will not produce a tumbling motion which cannot be corrected by the low-torque, gravity-gradient attitude control system.

An ion engine system has been conceived and designed for this purpose at the Hughes Research Laboratories. This engine produces a thrust level of only 10 micropounds (i.e., ten millionths of a pound or 0.0045 grammes), a power level of about 13W and a total control system weight of only 10lb. Such a system would be significantly lighter than any competitive type of station-keeping thrustor.

Another possible application of ion engines to solar-powered spacecraft is in the propulsion of unmanned probe vehicles for planetary exploration, to answer such age-old questions as the following. Is Jupiter really only a small solid surrounded by a sheath of ice 10,000 miles thick, which in turn, is surrounded by a 25,000-mile layer of gaseous slush? Is the other side of Mercury, which has never been observed by man, just about as cold as it can possibly get—about minus 459°F? Do living organisms—not as we know them but in other chemical and physical forms—exist on Mars? Are Saturn's rings made up of many things, such as billions of tiny particles including ice, and were these particles once a satellite of Saturn drawn close to the mother planet and shattered by gravitational forces? Is Venus, under her frigid garment of clouds, really red-hot?

Hughes is currently undertaking a study for NASA of the feasibility of using ion engines for the propulsion of a probe to Mars. Such an ion engine system would require power levels in the general range of 10 to 40kW. With the advent of newer, lightweight solar cells, it appears that ion engines can offer significant payload advantages for such planetary exploration missions. Such a mission would require, typically, 1,400lb of propellant (cesium or mercury) when a 40kW ion engine is used, compared with roughly 14,000lb for a chemical rocket engine; the mission would require about 300 days when electric propulsion is used compared with 250 days for the chemical rocket.

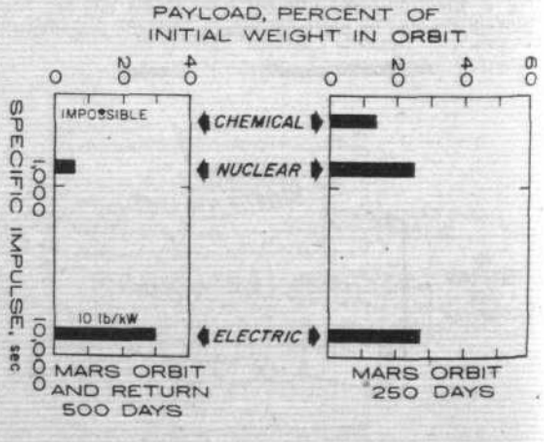
One of the most significant future applications of ion engines lies in the propulsion of manned spacecraft to the near planets and return, or in the propulsion of ferry vehicles to supply proposed lunar bases. Such propulsion systems would require power levels of the order of 2-10MW of electric power. The power for such applications must come from high-performance nuclear-electric power systems. One possible means of obtaining the 10 to 100lb thrust level required for such missions would be through the use of small ion engine modules or building blocks to construct a larger cluster. Thus, a number of engines with a modular power output of 30kW could be clustered to provide a large array which would produce tens of pounds of thrust at several megawatts of electric power input.

The use of the high-specific-impulse ion engine for long-duration missions offers a substantial advantage in the useful payload which can be carried by the spacecraft. A comparison of the payload of nuclear, chemical, and ion-propulsion systems for manned and unmanned Mars missions is shown in Fig 4. It can be seen that the useful payload of the electric propulsion system for the unmanned Mars orbit missions is approximately double that of the chemical rocket (the nuclear rocket is not presently being considered for this mission). For the more ambitious manned Mars-orbit-and-return mission the advantage is even greater; the electric rocket will propel several times the payload of a nuclear rocket. The chemical rocket cannot be used for this mission at all.

During the past five years, remarkable advances have been made in ion engine development along with parallel and significant decreases in the weights of the space power systems necessary to produce the electric power. Ion engines and their associated power-conditioning and propellant-storage systems have been developed in low-power versions to a completely flight-qualified stage. Other types of engines, for satellite application and to provide the primary propulsion of larger spacecraft, have reached an advanced stage of laboratory development whereby they are currently undergoing long-duration life-testing.

It is anticipated that, within two years, low-power systems powered by solar cells could be made operational for use as satellite control devices. For the 1968-70 period, flight-qualified systems of the 10 to 40kW level can be expected to be available for propulsion of planetary probes. Larger engines designed to operate at the megawatt level should be available by approximately 1975 for the propulsion of manned interplanetary spacecraft.

Fig 4 Comparison of useful payload capability for two Mars missions performed by chemical, nuclear and electric propulsion systems



INDUSTRY International

Products

Company News

Great Britain

Two Big Lighting Contracts totalling over £250,000, for airfield lighting and ancillary services at Kuala Lumpur Airport, Malaysia, and Windhoek Airport, South-West Africa, have been awarded to GEC companies in Malaysia and South Africa in conjunction with the Aviation Division of GEC (Overseas Services) Ltd, London.

The Kuala Lumpur contract is for high-intensity approach, runway and threshold lighting for an 11,400ft runway, a full system of visual approach slope indicators, centre-line and side-taxiway lighting. Also to be supplied are stand-by generating sets and airfield lighting control equipment.

The Windhoek contract is for an 11kV ring-main system, LV and HV distribution, and airfield lighting. Two runways, of 9,000ft and 5,000ft, will be equipped with inset runway and threshold lights. In addition, the 9,000ft runway will be equipped with a full system of visual approach slope indicators at each end. The contract also includes the provision of inset taxiway lighting, airfield lighting control equipment and transformers. All the lighting equipment will be supplied from this country.

Elliott Chief Scientist Mr W. R. Thomas, BSC, MIEE, AFRAES, director of Elliott Space and Weapon Automation Ltd, a company in the Elliott-Automation Group, has been appointed group chief scientist of Elliott-Automation.

Ultra Appointment Mr Edwin D. Birch has been appointed general manager of Ultra Electronics Ltd and will have responsibility for engineering, manufacturing and marketing for all the operating divisions of the company.

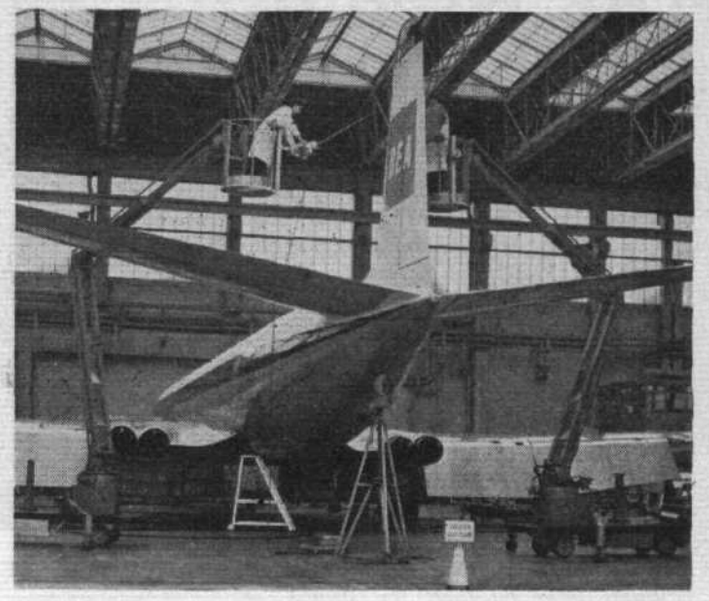
Dr Frank W. Stoneman has resigned the managing directorship of the company. His resignation, offered on March 18, has now been accepted by the directors.

Instruction for Management KLM is sending a team of salesmen next month to the Urwick, Orr & Partners Ltd Management Centre at Slough. Urwick, Orr are running a special course for the airline on a development and training programme for sales management.

Another new course of interest to the aviation industry, airlines and manufacturers is on quality management. Designed "to present the participant with a deep appreciation of the various techniques which are available today to assist in the formulation of quality policy and its achievement," the syllabus begins with an analysis of consumer needs and ends with an appraisal of the extent to which these needs have been satisfied.

The fee for the one-week course is 55gns, and details are obtainable from the Managing Partner, Urwick Management Centre, Baylis House, Stoke Poges Lane, Slough, Bucks (telephone Slough 22267).

Non-destructive testing of tail-unit components and other difficult-to-reach parts of BEA aircraft is being aided by two 35ft Simon hydraulic platforms mounted on Stacatruc electric vehicles. Each unit has a circular cage carrying a rotating turret on which can be mounted an X-ray tube head. Simon hydraulic platforms are manufactured by Simon Engineering Dudley Ltd, of Queen's Cross, Dudley, Worcs



More (Electric) Power from the Avon Rolls-Royce will receive orders for 28 industrial Avon engines following an order for 14 25-megawatt Avon-powered generating sets placed by the Central Electricity Generating Board. This order will bring the total sales of industrial Avons, derived from the aero engine, to more than £7½m.

Canada

To strengthen its international marketing organization, The de Havilland Aircraft of Canada Ltd has appointed Cp Capt J. C. Button, DSO, DFC, to the post of regional sales manager, Europe. He joined DHC after a distinguished RAF career

CT-114 Simulators Canadian Aviation Electronics Ltd (PO Box 6166, Montreal) have been awarded a $3m RCAF contract for six CT-114 Tutor flight simulators. The Canadian Tutor is now in service with RCAF Air Training Command. First simulator is due for delivery before the end of the year. Canadian Aviation Electronics, incidentally, are seeking shareholders' agreement to a proposal to change the company's name to CAE Industries Ltd, as indicative of a wider field of activity.

USA

Low-down Laboratory North American Aviation's Autonetics Division is equipping a T-39 Sabreliner as a flying laboratory to investigate problems associated with low-level flight. Avionics equipment will include low-light-level TV, IR scanner, laser rangefinder and stabilized optics—all for visual designation and ranging. A scan converter will be used for display freeze, while a head-up display and helmet-mounted display are included for visual designation and ranging.

A multi-mode radar will be used for precision automatic terrain-following, ground mapping and ranging. A micro-electronic inertial navigator will be used for precision navigation, and a micro-electronic digital computer for systems integration and checking.

Other NAA divisions are co-operating with the test programme, which is known as Project Alpha. Flight testing is expected to begin by September 1.

Appointment of Mr T. (Tim) Koch de Gooreynd as European representative for aircraft finishes has been announced by DeSoto Chemical Coatings Inc, Des Plaines, Illinois. Stationed in London, he will be responsible for introducing DeSoto finishes to the European aircraft industry.

HS.125s FOR THE WORLD

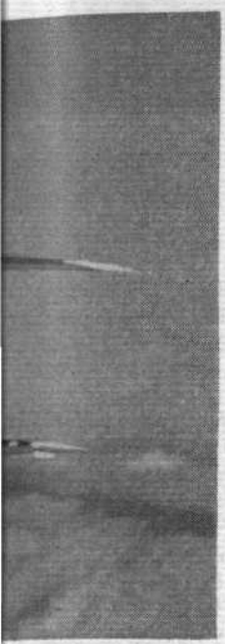
UNLIKE airlines, which generally create a big publicity splash whenever they introduce a new aeroplane, purchasers of business aircraft are usually bashful about having their identities mentioned. While industrial shareholders may traditionally be sceptical about claims in favour of company-owned aircraft, business jets are turning out to be a sound investment for many manufacturers, of whom Hawker Siddeley Aviation are an example. The six- to eight-seat HS.125 springs from the long-established de Havilland tradition and flair for building just the right aeroplane for the private owner; and this first successful business twin-jet—now battling for orders in competition with excellent products from America, France, Germany and Italy—is still ahead of the field in deliveries completed.

At a time when openings for new projects are scarce and when (in the case of bigger military and commercial aircraft) the principal customer very often expects to dictate right down to the detailed specification, the HS.125 is a rare example of a British manufacturer building what it knows to be right. Earlier this year the HS.125 production commitment was stepped up from 90 to 110 (the third time it had been increased), and the current order book stands at 64 aircraft—though the number changes by ones and twos almost daily. By the middle of last month 23 aircraft had been completed, of which 16 had been delivered, including a total of ten to the North American dealers Atlantic, AiResearch, and Timmins.

The HS.125 production and delivery situation in mid-March stood as follows (construction number, customer and delivery date are given in that order): 01 and 02, prototypes; 03, Bristol Siddeley Engines (24.7.63); 04, Viper engine development; 05, Krupp (16.10.64); 06, Chartag (10.9.64); 07, Transair (8.2.65); 08, company demonstrator; 09, RAF; 10, unspecified customer (19.2.65); 11, RAF; 12, RAF; 13, Atlantic (11.9.64); 14, AiResearch (23.9.64); 15, Australian DCA (1.1.65); 16, Timmins (16.12.64); 17, Atlantic (18.12.64); 18, Timmins (27.1.65); 19, AiResearch (9.2.65); 20, Atlantic (23.2.65); 21, Atlantic (5.3.65); 22, Timmins (28.2.65); 23, Atlantic (10.3.65).

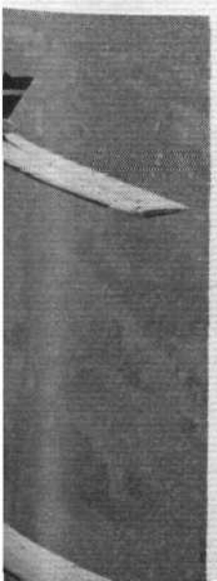
The Australian DCA's HS.125 was delivered on January 1

The fourth HS.125 is used for engine development and inter-factory communications (above). The eig demonstrator (below)



is the widely travelled

The Swiss company Chartag were early customers for the HS.125 (above). The West German industrial organization Krupp have ordered three HS.125s; the first (below) was delivered last October



Air Transport Engineering

BY K. G. WILKINSON, BSc, DIC, A.C.G.I, F.R.Ae.S

A comprehensive exposition of airline maintenance methods as applied by a major operator—British European Airways—formed the subject of the 12th Barnwell Memorial Lecture, a Royal Aeronautical Society "main" lecture given on March 10 at the Society's Bristol Branch by Mr Wilkinson, who was appointed BEA's chief engineer last December. Here, by permission of the RAeS, we give abstracts from his paper which will in due course appear in full in the Society's Journal.

THE most important contribution to economy, comfort and reliability is made during the design and construction of aircraft, and for practical purposes the speed is determined at that stage. The manner in which operations, development in service and maintenance are carried out will have significant effects on economy, safety and reliability, but it must obviously work within limits set at the design and construction stage.

I think it important to recognize that the airline and the manufacturer share in almost equal degree the influence, and therefore the responsibility, for bringing a civil airliner into being; it is analagous to a father/mother situation, with complications due to the current tendency towards polyandry.

An important trend is the increasing importance of capital costs in "A" costs* over the years (Fig 1). The cost of systems has taken a full part in this trend (Fig 2).

BEA took a course of action which has taught significant lessons: it bought an adapted version of a long-haul aircraft—the Comet 4—already in production, although it was not in any way designed originally for BEA routes. It was, however, well developed, fitted with a well-tried engine with good overhaul life, and was cheaper than an aircraft built specially for the purpose. It has been outstandingly successful and for a jet aircraft has economy that is hard to beat on short-haul work (Fig 3), although it is a good deal more expensive than a turboprop for this work.

Its maintenance costs per unit of production are good compared with previous, propeller-driven, aircraft (Fig 4). Although it is thirsty on fuel, the total cost of propelling it, interestingly enough, is pretty competitive (Fig 5). It is reliable, although the engine location and compressor design make it sensitive to ingestion damage.

The era of the second-generation short-haul jet (Trident, 727, One-Eleven, etc) has raised the standards of comfort and accommodation still further; these aircraft have standards of design capable of achieving higher reliability and (particularly in the case of the Trident) the possibility of beating the weather. Performance has been improved sufficiently to carry the increased burden of capital costs, although we are not able to beat the turboprop (Fig 3).

The difficult question which now confronts us is to assess whether a worthwhile possibility exists of achieving lower-cost transport on the hauls below 500 miles. None of the aircraft mentioned [Comet, Trident, 727, One-Eleven] excels in comparison with existing turboprop aircraft in the matter of costs—even with stretched-out amortization.

Alternative courses are to use: (1) Available short-haul jets; (2) stretched-bodied versions of (1)—same cost of development but improved economy; (3) stretch-bodied long-haul aircraft, giving huge seating capacity; (4) retired long-haul jets (cheap) which have been superseded by better models on long-haul routes; (5) stretched turboprops, giving undoubtedly the lowest short-haul costs; (6) a specialized new design. The choice between propellers and jets will have to take account of competitive situations—we need low costs per passenger-mile rather than per seat-mile.

Except in special circumstances, and failing agreement between airlines enabling propeller-driven aircraft to survive, it would be a risky policy to buy other than jet aircraft—which is a pity.

A good deal of work on this subject has been done by the Lighthill Committee, during the course of which BEA offered an outline requirement to enable more specific design study to be made. In my view, the results of this work point to the conclusions that it will be very difficult to beat methods (2), (3), (4) and (5). It is therefore problematical whether the market would show clearly enough to justify the capital investment—that is, unless much of the launching cost is borne by military development or special contract. This is probably the only basis on which the mammoth transport will show attractive costs.

Improved engines in an established airframe may give a good compromise, but even this proposition has to be approached with care. A comparison of Tyne and Dart (Fig 5) shows one can pay too much for performance development on a short-haul aircraft. Ideally we should programme to get as much development from each engine type as possible before we switch to the next major development. This may well mean that the correct timing for the radical development is some time off—say the late 1970s.

The best solution of this very-short-haul problem is much more finely balanced than on the long haul, where speed, aerodynamic and thermal efficiency and light structures bring decisive advantages. The prize in that instance is worth a high price in first cost.

A word needs to be said about propeller turbines. These have been outclassed by jets in comfort, speed and economy on the

* *"A" costs are, basically, direct operating costs.—Ed*

Fig 1 Increasing importance of capital costs in "A" costs

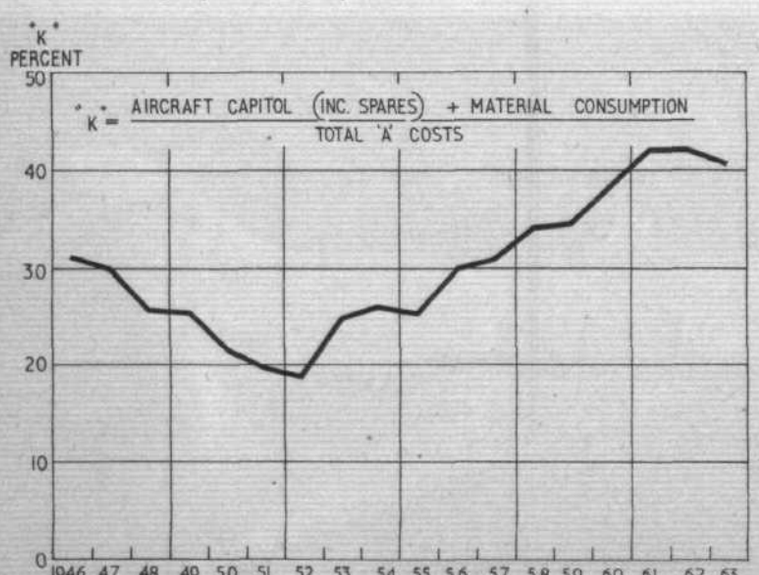
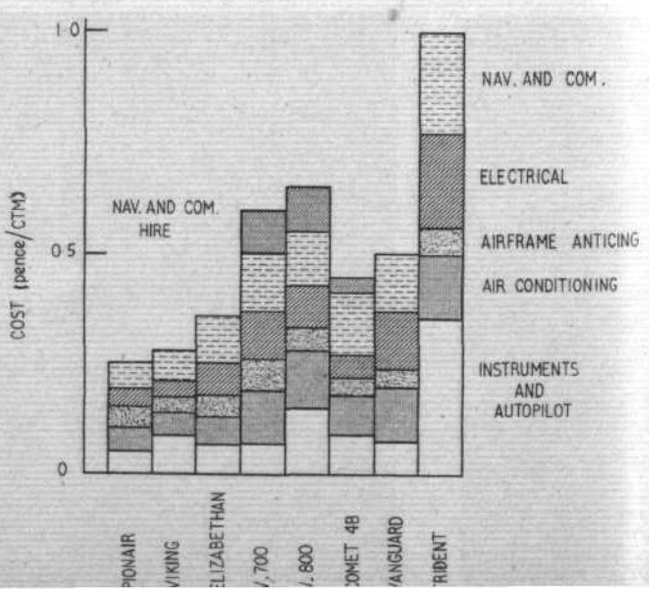


Fig 2 Annual costs of systems



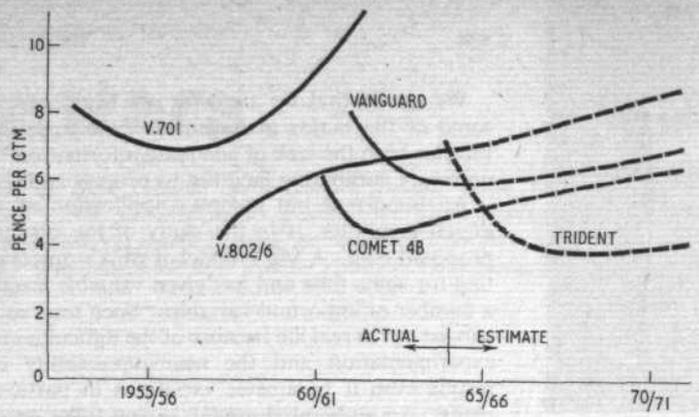


Fig 4 Engineering cost per CTM

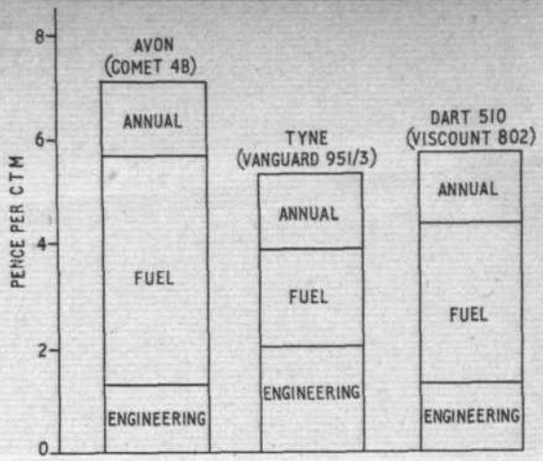


Fig 5 Engine cost efficiency

longer hauls. On short hauls (less than 500 miles) they have been beaten marginally in the matter of comfort, but not much else. There is strong indication that the cheapest short-haul vehicle will always be a turboprop for the foreseeable future—particularly if it is stretched out from an existing type. But can the airlines be clever enough to think of a way of passing this potential benefit to the customer? This is a dilemma in which the engineers alone cannot provide the answer.

There has always been a struggle between the maintenance man (who would like the aircraft to behave in an orderly manner, submitting to regular inspection and preventive maintenance and going like clockwork in between) and the aircraft itself, which probably has quite different ideas. There have been attempts to dragoon aircraft into this system on the assumption that all that was needed was enough preventive maintenance. It was found, however, that increasing preventive maintenance produced diminishing returns and that there was an irreducible random element. Furthermore, the immediate response to preventive maintenance may be an increase in unserviceability.

A scientific approach to this problem leads to a more flexible system based on a study of the natural habits of the various components of the aircraft. Keeping suitable records enables us to determine whether failures are time-dependent or random and, if time-dependent, just how much so. We can then give each part the treatment it needs to achieve the best performance. This has led to a situation in many airlines where the bulk of the work is "non-scheduled," i.e., depends on the condition of the aircraft at the time. This is true of major maintenance and has always been true for minor maintenance between checks—which is largely defect rectification.

This development minimizes the actual physical work on the aircraft and its parts but puts a much more difficult task on the shoulders of planners and supervisors, who now face the situation that no two checks are alike.

The total problem of material costs is of major consequence. Half the cost of maintenance is currently money going into the manufacturers' pockets, either in purchase of materials or specialized overhauls or in the annual cost of spares for the shelf.

When a time life is applied to a component the presumption is that deterioration takes place, with time or with operation. A wear-out stage is then reached where reliability is diminished.

VANGUARD RELIABILITY CAMPAIGN—SUMMARY

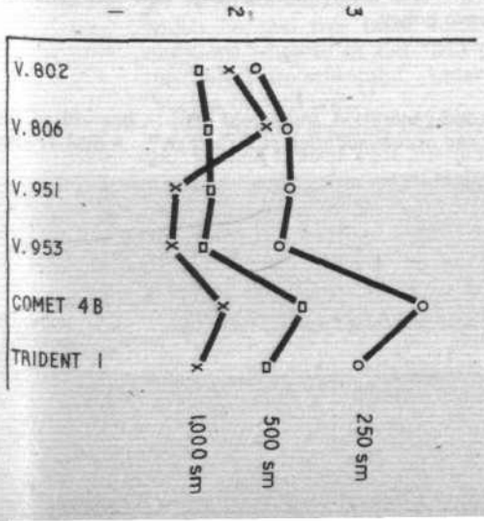
System	% Delay rate Aug-Sept, 1964	Mods issued since 1/1/64	O/H or accel embodiment modifications		% Delay est s.1965	Ultimate % delay estimated
			No	% compl by 4/65		
Powerplant	1.90	5	3	75	1.23	0.85 (Dec 66)
Hydraulics	0.55	3	1	100	0.46	0.04
Air conditioning	0.59	8	3	85	0.20	0.20
Landing gear	1.00	4	2	85	0.45	0.45
Flying controls	0.28	1	0	—	0.15	0.15
Anti-icing	0.30	5	3	70	0.18	0.15
Electrical	0.60	3	1	75	0.20	0.20
Other	0.21				0.21	0.21
Total due malfunction	5.43				3.08	2.61
Delay rate due maintenance	7				3	1
Overall delay rate	12				6	3.3

Basis for this presumption is usually sketchy and often non-existent. However, engineering commonsense plus available evidence had led to overhaul of many components being placed "on condition," so that automatic replacement is avoided. On modern aircraft it is not unknown for 70 per cent of components to be on an "on condition" basis.

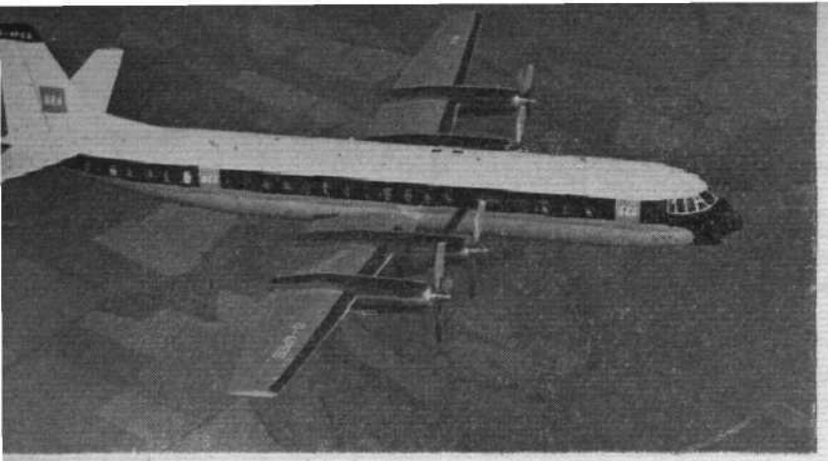
The basis of rational lifing policy can be shown by a completely general graph of survival under random failures. In this situation, by definition, there is no loss of reliability with age, because the probability of failure is not time-dependent. For example, that at an age index of three (e.g., 3,000hr × failure rate of 1/1,000hr) only 5 per cent of components fitted will survive. There is little point in lifing a component which has exhibited random failure characteristics up to this age index.

Where a part is important enough by virtue of its cost or function, it is therefore worth exploring its characteristics by "unrestricted trialling" until its behaviour is clear. It can then be lifed if this is necessary or economic. Perhaps engineering development may be indicated if an increase in failure probability occurs too early after installation. In any event, the characteristics of the premature

Fig 3 "A" cost comparison (all-tourist seating, full meal and bar)



The Comet 4B "for a jet aircraft has economy that is hard to beat on short-haul work"



"None of the aircraft mentioned . . . excels [in operating cost] in comparison with existing turboprop aircraft—even with stretched-out amortization." A BEA Vanguard

AIR TRANSPORT ENGINEERING . . .

removal and failure curves will give important leads on the most fruitful policy.

A small proportion of components reaching an arbitrary overhaul life may indicate the desirability of abolishing the lifing on the component concerned (only 20 per cent of all BEA components reach assigned t.b.o.). The value of extending overhaul life depends on the failure rate experienced. Long lives are nonsensical unless the failure rate is very low.

Complex assemblies, such as engines, are best treated on the basis of the performance of the constituent parts, each with its own life or "on condition" policy. So, for example, t.b.o. life of an engine can be rapidly extended with special attention to burner cans and turbine blading to determine time development of damage, together with continuous monitoring for incipient bearing failure (plug and filter checks) and compressor blade damage, which will be largely random. In this way, reliability (measured by in-flight shut-down rates) can be maintained at the highest level. This results in the straight-through run to overhaul being a rarity.

The use of analytical techniques makes possible the development of optimum maintenance policy and content with a given fleet. There is considerable scope for variation in the efficiency with which this work is programmed and executed.

An actual example of the value of such techniques is the embodiment of an important modification on three different types of aircraft in BEA's fleet. The controlling factor was that the work had to be completed by a deadline to meet a mandatory licensing requirement. Design, procurement of parts and embodiment were involved; failure to meet the deadline would have meant cancellation of services and loss of revenue.

Networks of the familiar "critical path" kind were prepared and optimistic and pessimistic times agreed with each section concerned. The number of events involved (20) made the use of a computer unnecessary. It was found that only by using the "optimistic" estimate could the project be completed on time.

Basic networks were redrawn as Gantt charts, with horizontal scale marking in weekdays. Colour coding was used for each section, slack time by a distinctive colour. The critical path was the centre-line of the chart.

Monthly progress meetings were held. The chart presentation permitted telescoping of essential work and transfer of resources from non-critical to critical work in a way which would not otherwise have been possible. The deadline was met.

Among lessons learned were: (1) Apply "critical path" techniques as early as possible. More time could have been saved in this case. (2) Clear charting is an invaluable aid to understanding by all concerned and in immediately showing the effect of any setback. (3) The critical path could have been guessed by many of the people involved in the progress meetings. But the reaction without the technique would have been "There's nothing you can do about it." (4) If networks are prepared in advance, the starting date to ensure completion economically can be stated in advance, rather than rushing on minimum times after a late start.

In a healthy organization there should be a constant process of enquiry and research, leading to improved techniques for regular management use. Some of the most interesting ideas arise from the work of operations research sections, which have a particularly important part to play in the complex patterns of activity of the kind I have been discussing.

We realize that we are only just beginning to get to grips with some of the major management problems; the main reason for this has been the lack of adequate information "feedback," and the necessary computing facilities to process and analyse data.

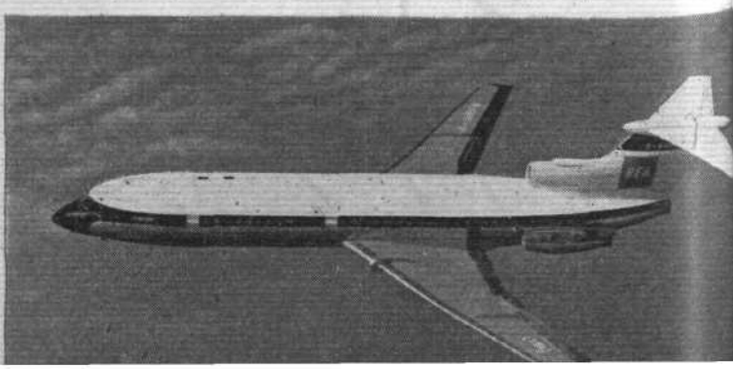
An important but complex application of simulation, using a digital computer, is in the study of the operation of a fleet to a proposed plan. A Mk I model of BEA's operations has been operating for some time and has given valuable insight into the effect of a number of important variables. Such tests could never have been carried out in real life because of the difficulties inherent in full-scale experimentation and the near-impossibility of interpreting the results even if parameter variations in particular cases could be made. An elaborated model, taking fuller account of operational complexities is nearing completion, having been made possible by the approaching availability of the much more powerful Univac 490 for this work.

This Mk II model will permit simulation of maintenance performance with a high degree of realism. Alternative policies will be tested and long-term maintenance planning may well, in future, be guided by research of this kind. Work at present in progress is measuring maintenance and machine performance at a number of key points and providing basic data on which computer models can be based.

Summary and Conclusions

(1) Manufacturer and operator share equally the responsibility of achieving improvements which are clearly possible.
(2) A very important area is the specification and production of transport aircraft. The problem here resolves itself into several stages: (a) Clarification of the development possibilities with existing equipment; (b) Detailed design study to determine more precisely the potential of the radical developments considered by the Lighthill Committee; (c) Phasing the construction of new designs so that the economies possible by development of existing equipment is achieved.
(3) The production of new aircraft must be to a cost figure as well as a performance specification if costs to the passenger are to be lowered. This implies that we must look to the size and efficiency of the manufacturing industry supplying the transport aircraft market, since the total value of aircraft required each year will be limited. Excessive overhead costs cannot be afforded.
(4) Operators will be paying increasing attention to spares and material costs and the current practice of overcharging for these will meet increasing resistance. It is probable in future that a guarantee of material consumption costs for some equipment will be required at the time of purchase.
(5) Opportunities for making use of commercial components and materials, where they are suitable, will have to be taken to the full so as to reduce costs. American manufacturers do this already.
(6) Manufacturer support during the "development in service" phase is important. A large American operator has commented that some European equipment vendors are slow in "relieving service problems" and are "ultra conservative" in design philosophy and on limits and tolerances. We concur that there is much room for improvement.
(7) Maintenance methods can be developed further to improve achieved reliability and the overall economy of the airline by matching programmes to the true needs of the machines and to the commercial opportunities. Component overhaul can be further rationalized now that computers enable the performance of large numbers of parts to be monitored.
(8) Considerable use is foreseen for improved work scheduling and control methods using such techniques as the critical-path system. This is applicable to important modification programmes and to major aircraft maintenance. These should lead to reduction in down-time and hence improved economy.
(9) There is important scope in airline maintenance for advanced techniques using digital computers for simulating complex operational and work situations. These will assist optimizing of investment in such resources as component float and shop capacity, and will guide the selection of maintenance policy.

"The era of the second-generation short-haul jet . . . has raised the standards of comfort and accommodation still further." A BEA Trident



Letters

Letters for these columns are welcomed, though "Flight International" does not necessarily endorse the views expressed. Name and address should be given, not necessarily for publication in full. Brief letters will have a better chance of early publication.

Value of the University Squadrons

SIR,—It would indeed be a very great shame if the University Air Squadrons were axed. Not only do they provide a standing reserve, they also represent the RAF in our universities.

Apart from these two facts, the costs and figures you quoted on March 25 need further analysis. You say [reporting a speech by Air Marshal Sir Patrick Dunn] that the annual cost of UASs is £1.5m, average training cost per member £15,000, and annual number of UAS recruits to the RAF 50. Each recruit is of high academic standard and has £15,000 of training behind him. (In fact he probably has much more than this average figure.) Having already reached a good standard of flying on the Chipmunk at entry to the RAF, he is unlikely to fail his wings course. Costly wastage of aircrew during training is thus unlikely too.

From purely financial considerations, can less than one-tenth of one percent of our defence budget be thought of as too large a sum for the UASs?

Cambridge J. POTTER

(*Recruited to RAF during CUAS membership*)

TSR.2 versus F.111

SIR,—I did not know whether to laugh or cry when I read Mr Browne's letter from Australia (March 25) on the merits of the F-111. He sounds like one of McNamara's super salesmen; or perhaps his taste for truth has been dulled by too much Worcester sauce?

Let us look at some of Mr Browne's comments:—

(1) He asks us to agree that the F-111 will surely turn out cheaper than the TSR.2, although he admits that the extent is debatable.

I'll say it's debatable! If a crystal ball is needed for TSR.2, a globe the size of an Echo satellite will be required for F-111 costs, which at the present time are still rising fast. Apart from the basic airframe, has Mr Browne considered the cost to Britain of the electronics systems, spares, and training, which always seem to be forgotten by those who advocate the F-111 for the RAF on economic grounds?

It will be surprising if Australia gets the F-111 at the originally specified price—unless the USA is prepared to sell at a loss.

(2) The question of Lightning replacement costs is a red herring, since the Lightning replacement is years away. Who can possibly say whether the specification would be met satisfactorily by the F-111B when no specification has yet been agreed?

(3) Next, having first admitted agreement with a statement which he said was most controversial, Mr Browne then questions whether or not the operational requirements for the TSR.2 are still valid. Later he refers to the TSR.2 as "such a limited type."

This is really scraping the barrel. One of the very reasons for the high cost of TSR.2 is the multi-purpose requirement which it was called upon to fulfil. The RAF originally asked for and still needs an aircraft which can be used for tactical and strategic bombing from high or low altitudes, as a reconnaissance aircraft, or as a tactical strike and ground attack aircraft using minimal fields. I have no doubt that developments of the F-111 are likely, but so are developments of TSR.2. The F-111 may sound a wonderfully versatile aircraft—and in many respects it is—but its versatility, when compared with the TSR.2, is somewhat offset by the fact that it does not fulfil to such a high degree those roles for which TSR.2 is designed. The terrain-following capability of the TSR.2 is, for example, greatly superior to the terrain-avoidance system of the F-111.

(4) Why such an emphasis on standardization after the call for versatility, flexibility, and ability to meet threats with the appropriate measured response? Standardization destroys flexibility.

(5) Mr Browne finally reveals his true colours in that nauseating sentence about the splendid sight of multi-coloured F-111s flitting about SE Asia for the common good.

Common good of whom? Only one country would benefit from standardization of advanced equipment, and that would be the United States. And when the United States had achieved its monopoly of the aircraft manufacturing business—starting with Britain—the price demanded for each aircraft would no longer be the rock-bottom minimum. It would be strictly that needed to ensure a profit for the United States.

That state of affairs may be good enough for Australia, but it is not good enough for Britain, whose economic survival depends on technological leadership, and whose military interests in some areas still dictate a need for specialized equipment, independent of foreign suppliers.

Byfleet, Surrey C. G. MILNER

Control of Inclusive Tours

SIR,—The suggestion by Sensor (March 18) that easement of the ATLB's restrictions on inclusive tours, as suggested by the Minister, may invoke a mushroom growth of disreputable tour operators working with marginal charter companies is, in its modest way, a flawless specimen of the mid-twentieth century's love of strangling aviation by restriction, regulation and control.

To be a flawless specimen: (a) the control must not have the effects desired; (b) it must have effects opposite to those desired; (c) the effects desired must be questionable anyway.

Sensor gets full marks on each count. (a) Disreputable tour operators mainly fly foreign, and so by-pass the ATLB. The only effect of the ATLB's interest (in 1964) in the financial fitness of tour operators was to ensure that they *always* do so. (b) Disreputable tour operators only succeed in getting deposits from a few morons and many other people who have been unable to book with a reputable tour organizer operating in the price bracket they can afford. On one route, Sky Tours had sold before Christmas 1964 97 per cent of the capacity the ATLB granted us with Sky Tours on that route for the whole of 1965. This means turning away three times as many people as one books. Where does Sensor think they went? If the restrictions were removed, disreputable tour operators would wither away.

(c) That only leaves the morons to be protected. Is there any more reason for protecting them against unscrupulous travel organizers than against secondhand car dealers, jerry-builders, vendors of patent medicines and diets extensively advertised on television, or even the corner greengrocer? I would have thought no. Even in the hothouse atmosphere of restriction in which unscrupulous tour organizers flourish and marginal airlines come and go, the amount of hardship suffered by the public has been slight.

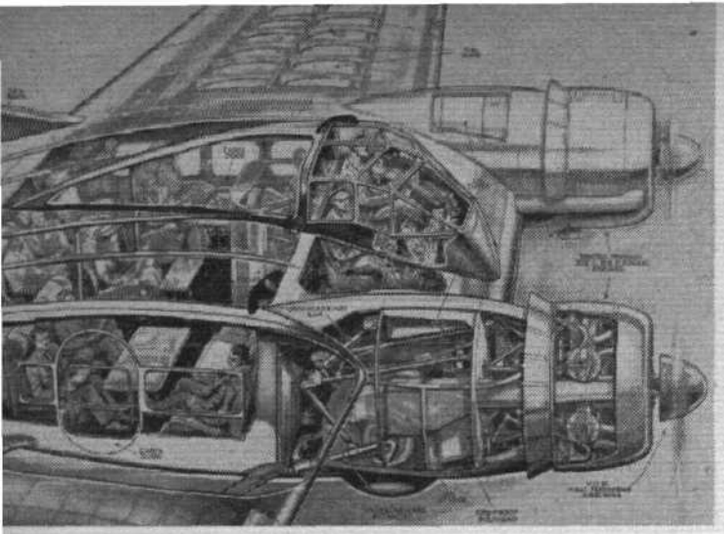
By all the publicity of 1964 the public have been so well warned that the only excuse for falling a victim in 1965 is the knowledge that if the worst comes to the worst the rest of us will pick up the pieces for them as we did in 1964.

Luton Airport, Beds J. E. D. WILLIAMS

Claims for the Burnelli Concept

SIR,—More than anything else, C.C.J.'s "V_1, V_2 and All That" series of articles points the finger of guilt at the FAA and the other government licensing agencies for granting Certificates of Airworthiness to current airliners which in effect authorize them to be operated outside their capabilities and without reference to commonsense safety standards.

Close examination reveals that virtually all C.C.J.'s



The Burnelli "flying wing" concept—subject of the letter from Mr Chalmers H. Goodlin—as seen in a "Flight" cutaway drawing (here reproduced to a smaller scale) published on December 22, 1938. It illustrates the passenger accommodation of the 15/20-seat transport built by Cunliffe-Owen Ltd, of Southampton, under American Burnelli patents. The aircraft, G-AFMB, first flew shortly before the war

LETTERS...

sterling criticisms zero in on one fundamental characteristic of current transport aircraft, and this is *high wing loading*. High wing loading is the mother of most vices in current transports, including deplorably high V_1 and V_2 speeds, inadequate accelerate-stop distance performance and the Mach buffet/stall corner.

Closer examination of the facts will show that the well proved Burnelli "lifting body" principle of aircraft design provides vehicles with incredibly low wing loading and in so doing minimizes by a substantial margin or totally eliminates the aforementioned vices inherent in conventional counterparts. This benevolence is accompanied by much superior structural integrity (due to the compactness of Burnelli aeroplanes), shorter load paths, and the highly desirable spanwise loading feature whereby the payloads are always carried at or adjacent to the c.g. These benefits must certainly greatly improve upon the V_a, V_{ra} and V_{mo}/M_{mo} limitations of current conventional transports. Furthermore, Burnelli aircraft offer exciting gains in payload, cubic capacity, floor area, utility and (last but not least) safety, all of which add up to vastly improved economics for the operator.

Malmö, Sweden CHALMERS H. GOODLIN

Aviation and the Press

SIR,—It was interesting to read David Hoffman's comments [March 11] on the declining amount of attention that the US daily Press is paying to aviation. His remarks could well apply to the situation in most other countries of the world.

As far as the airlines are concerned, the changing attitude of the world's Press seems to be due in part to the fact that commercial aviation has reached the adult stage. It has replaced the ship as the normal way for people to travel between continents and is rapidly supplanting surface transportation for many shorter trips.

No longer is the air passenger a hero to himself and his family (and a bore to his friends). Air transport is becoming the normal way to travel internationally, just as air mail is now the normal way to send an international letter.

Having offered this explanation for the changing attitude of the world's daily Press, I must point out that air transportation is getting increasing in-depth coverage in the weeklies, including the "Sundays." While the dailies tend to mention commercial aviation only when there is a crash or a controversy over fares, the weeklies are giving their readers a steady diet of useful background and well prepared comment.

Montreal ANTHONY VANDYK,
Public Relations Officer,
International Air Transport Association

Cabin-crew Flight Time

SIR,—Let "Galley Slave" (March 18) get it firmly fixed in her pretty little noddle that all we, the travelling public, look to her for is SERVICE. However rough her working conditions may be, it is not for her to drag the customers into it, or to imply we are "unfair to stewardesses." It is not good PR for cabin staff or for air travel. A good job she used a nom de P!

Many of us in tourist seats feel that we get treated more and more like cattle each time we fly. We certainly don't get enough SERVICE—or sufficient attention to help allay our airborne twitching.

Yeovil, Somerset CHEVEAUX-DIX

SIR,—Headline from the *Sunday Express* for March 28: "How Safe are You when you Fly on Holiday?"

"At Farnborough," said the article, "they are determined to find the solution. But no matter how long it takes, you have no cause to worry about metal fatigue when you fly to your holiday in the sun. The battle for safety has already been won."

And now that we know how safe we are from metal fatigue in the air, perhaps other experts could get to work producing a "metal-alloy-all-parts-replaceable-fatigue-and-stress-proof-crew" for the use of those airlines who would not know the difference anyway.

Just think how *much* more value the public would get for its money!

Forest Row, Sussex NANCY COX

SIR,—The letter headlined "Slave Trade?" in *Flight* of March 18 raises an issue which is long overdue, namely, that of excessive duty hours being worked by cabin attendants.

However, "Galley Slave" was understating the facts when she said she had been on duty for "twice the average passenger's working day." It is not uncommon for cabin attendants to exceed 24 hours at a stretch, or to do two or more long successive duty periods with very short rest time between.

I fail to see how a Ministry can lay down flight-time limitations for operating crew in order to prevent excessive fatigue, yet condone unlimited duty hours for cabin attendants—who may, after all, be the only ones left to carry out evacuation and emergency procedures after an accident.

It is therefore essential that, if only from the safety angle, cabin attendants are placed under the same flight time limitations as operating crews. For obvious reasons I would like to sign myself

ANOTHER GALLEY SLAVE

No 24 Squadron's "Airline"

SIR,—The reference in Straight and Level in your issue for March 18 to the RAF All Weather Flight which maintained a daily service from September 1945 until September 1946 is not strictly accurate. As a pilot on the flight for more than half of the time, and officer in charge for six months, I would like to see the record straight before time further blurs the image.

The Flight was part of 24 Sqn, which in 1945 was still based at Hendon, moving early in 1946 to Bassingbourn. It operated at all times with two aeroplanes and three crews and was based on Prestwick, forming the Prestwick - London - Prestwick end of the BOAC Return Ferry Flight, which was operated with Liberators.

You are quite correct in stating that only two services were cancelled. One was when, because of extreme turbulence on the southwards flight, the captain decided it was too hazardous to make the return. The other was, as you state, because of strong crosswinds at Blackbushe. Shortly before this the Ministry of Transport had ordered that the A30 road must not be closed, thus effectively closing the south-west/north-east runway. Had this been available the flight that day would have returned. Swift action by HQ Transport Command resulted in a signal reaching Prestwick next

morning, informing us that we could, whenever necessary, have the traffic held up for landing or take-off.

We used ILS (or SCS 51 as it was then called) at both Blackbushe and Prestwick, and at this time these were the only two RAF stations so equipped and operational. The equipment was kept in service specifically for the Flight. As this aid was not in general use by the civil crews, 24 Sqn pilots initiated many BOAC captains into its use. Babs (Blind Approach Beacon System) was also used and much favoured by the C-in-C, Sir Ralph Cochrane. We found it less reliable than either ILS or the Prestwick GCA. The Prestwick team were particularly good; working with the same pilots for long periods, high confidence in the system was bred on both sides.

Far from no one wishing to travel with us, we never lacked passengers. [Roger Bacon said "*at first* these services flew nearly empty"—Ed.] When the weather was such that all normal flying was cancelled we off-loaded the passengers, taking just mail and freight plus parachutes for the crew. Happily these were never required.

Many leading air personalities travelled with us from time to time, and on one occasion I was able to demonstrate to Sir Watson Watt the shortcomings of Babs compared with a GCA approach at Prestwick. As our frequent criticisms had never reached him this demonstration was most convincing.

The regularity and timing of the morning flight south and the afternoon return was probably higher than ever achieved in civil flying, certainly in my continued experience from then until very recently. We were, however, expendable; and although the war was over the flight was conducted very much in the same way as our operational flying. The unofficial crest of clouds with a lightning flash and the motto "Press on Regardless" is probably the best epitaph this pioneer all-weather service could wish for.

Yateley, Surrey ROBERT LACY

The Outer Radiation Belt

SIR,—Academician Keldysh's statement (*Flight*, March 4) that the outer radiation belt was discovered by a Soviet satellite in 1958 should be treated with reserve. The satellite referred to could only have been Sputnik 3, launched in May 1958 with orbital parameters as follows: perigee 135 miles, apogee 1,167 miles, orbital inclination 65.3°, period 106min. That such a satellite might have recorded certain auroral phenomena is indisputable, but the auroræ are not the outer radiation belt. It is also extremely doubtful if they can be interpreted as an overspill from the belt, the concensus of informed opinion being that they are caused by charged particles that have arrived directly from the Sun.

It appears that the honour for the discovery of the outer radiation must go not to the Soviets but to Professor James Van Allen, of Iowa University, USA, as a result of measurements made by instruments carried in the Pioneer 3 Moon-probe, which passed slap through the centre of the belt in December 1958.

Sputnik 3 had a seven months' lead over Pioneer 3, but it was Van Allen and not the Soviets who first announced to the world the discovery of the radiation. This, too, might be thought significant.

London N4 J. E. W. SURMAN

Skyfame Museum's Future

SIR,—I was dismayed to read in a recent issue of *Flight* that the aircraft of the Skyfame Museum will not fly this year. It seems that for the lack of public support that these aircraft will possibly never fly again.

This must not be allowed to happen, and public support for the Skyfame Supporters' Society is the only way to ensure that it does not.

As Mr D. F. Ogilvy mentioned in his letter, membership of the society is only one guinea per annum—a small enough price for anyone to pay towards ensuring that famous and exciting types such as the Mosquito are kept in flying condition, for the delight of all.

Redditch, Worcs J. C. ROBINSON

German Weapons Components Wanted

SIR,—I have had an appeal from the Deutsches Museum, who are trying to arrange an exhibition of an A-4 and an Me163-B. From the former certain instruments are missing and from the latter the whole Walter engine (HWK 109-509B-1).

If anybody can offer any help I shall be grateful if he will get in touch with me.

4 Hamilton Place, F. H. SMITH,
London W1 *Librarian, the Royal Aeronautical Society*

How Not to Get Sucked Under

SIR,—Re Roger Bacon's Spangles story (March 25), I remember that when I was in the Navy and had been torpedoed by a jet-propelled catamaran I found myself in the water, kept afloat by a Polo while clutching a packet of lifebelts in my right hand. It was their minty flavour that appealed to me.

London W1 INK REDDIBLE

LETTERS IN BRIEF

Mr R. A. Bradley, 2 Spencer's Cottages, Whelpley Hill, Chesham, Bucks, is compiling a brief history of the DH 91 Albatross, and would be grateful for information on these aircraft in BOAC and RAF service during the early years of the war.

Students of No 14 Course, 3 FTS, are restoring a Tempest V (airframe serial SN219, squadron code SRF) for static exhibition. In conjunction with this work Plt Off R. A. King is compiling a record of this particular aircraft and would be grateful for confirmation on such subjects as the squadron or squadrons to which it was issued and operations in which it took part. His address is: Officers' Mess, RAF Leeming, Northallerton, Yorks.

DIARY

Apr 8	Guild of Air Pilots and Air Navigators: Trophy reception. Fishmongers' Hall, London Bridge, London SE1, 7 p.m.
Apr 8	RAeS Yeovil Branch: "Modern Structural Developments," by R. J. Mainstone. Park School Hall, 7.30 p.m.
Apr 9	Institute of Navigation: "Helicopter and Hovercraft Navigation," by Lt Cdr Hammond, RN, and an RAE speaker. Royal Institution of Naval Architects, 10 Upper Belgrave Street, London W1, 4.30 p.m.
Apr 9	RAeS London Airport Branch: Film show and annual dance. Feltham Hotel, 8.15 p.m.
Apr 10-11	British Women Pilots' Association: Flying weekend and aircraft handing-over ceremony, Redhill.
Apr 13	RAeS Astronautics and Guided Flight Section: "Design of Spacecraft for Experiments in the ESRO Programme," by Dr A. W. Lines, 6 p.m.
Apr 13	RAeS Boscombe Down Branch: Film show. A&AEE lecture hall, 5.30 p.m.
Apr 13	RAeS Glasgow Branch: a.g.m. and film show. University, 7.15 p.m.
Apr 13	RAeS Luton Branch: "Recent Developments in Hovercraft," by a Westland Aircraft lecturer. Ashcroft Road School, 6 p.m.
Apr 13-16	International Federation of Air Traffic Controllers' Associations: Annual conference. Hotel Vienna Intercontinental, Vienna.
Apr 14	Kronfeld Club: "Gliding Topic," by B. Jefferson; 74 Eccleston Square, London SW1, 8 p.m.
Apr 14	RAeS Chester Branch: Main lecture, "Post-war Research and Development at Dornier," by Herr Silvius Dornier. Grosvenor Museum, 7 p.m.
Apr 14	RAeS Prestwick Branch: a.g.m. Scottish Aviation Staff Canteen, 7.30 p.m.
Apr 18	PFA Vintage Aircraft Group: Fly-in, Halfpenny Green.
Apr 19	Tiger Club: Flying display, Radlett.

Note: RAeS lectures other than those given at branches take place in the Society's lecture theatre at 4 Hamilton Place, London W1.

SPORT AND BUSINESS

After several false starts at mass production the Model 18A two-seat autogyro which was originally developed by Umbaugh has now been taken over by the Air & Space Manufacturing Company of Muncie, Indiana. It has a C of A from the FAA, and production deliveries are reported imminent

The Isle of Man International Air Rally regulations have now been published by the Royal Aero Club. This interesting new fixture in the RAeC sporting calendar, to be held from May 28 to 30, will include a competitive rally and a revival of the Manx Air Derby in the form of a handicap race around part of the island. The total prize money of 1,000gns has been donated equally by Crockfords Ltd and Cambrian Airways, joint sponsors of the meeting. Contestants may enter either for the competitive rally or the air race, or for both. Pilots of any nationality are invited to take part, the only limitations being on the size and number of aircraft—not heavier than 12,5000lb gross weight and a total field of not more than 100 aircraft. It is unlikely that more than 40 aircraft will be accepted for the Manx Air Derby. Closing date for entries is Monday, May 10.

The rally, with a total prize of 500gns, is to take the form of a timed trial with points awarded for distance covered, airfields visited, and on-time arrival at Jurby, IoM—all within a specified time. Competitors will start from the airfields of their choice after 7 a.m. on May 28 and arrivals in the island will be during the afternoon of that day. Arrival time at Jurby for each competitor will be fixed by the organizers in accordance with the formula $\left(\frac{75}{V} \times 7\right) + 1\frac{1}{2}$hr for total time *en route*, where V = block cruising speed in m.p.h.

Points will be awarded at the rate of one for each five nautical miles covered between landings; ten for each landing at airfields not less than 50 miles apart; five for each passenger seat occupied; and ten for an inward UK Customs clearance. Points will be subtracted at the rate of two for each complete minute ahead of the designated arrival time and five for each minute after it. The pilot gaining the most points will receive the Tynwald Trophy and 200gns.

The race, for which the sponsors have donated the total cash prize money of 500gns, will be held at Jurby Aerodrome on May 29 and will take the form of a handicap race over two laps of a course round the northern part of the island; each lap is about 60 miles. The winner will receive the Manx Air Derby Challenge Trophy and 200gns. This race, which is intended to be international, does not form part of the RAeC's 1965 series of National Air Races for the Air Racing Championships.

Further details, and entry forms, are obtainable from the Royal Aero Club, Artillery Mansions, 75 Victoria Street, London SW1.

Oxford Air Training School personalities: l to r, Capt W. H. Jordan, chief pilot and instructor, who has been delegated MoA authority to conduct instrument rating renewal flights: Mr W. G. Beadle, senior instructor, appointed to the Guild of Air Pilots and Air Navigators Panel of Examiners; and Mr M. L. Scott, who has joined the school as a ground instructor

Piper Sales Growth continues to outstrip the average for American general-aviation manufacturing industry as a whole, according to figures released by Mr J. W. Miller (Piper director of marketing) for the first quarter of the company's financial year. While industry unit sales of aircraft costing under $200,000 (£70,000) showed an increase of 26 per cent over the previous year's figure Piper sales climbed 44 per cent. In dollar volume the industry enjoyed a 22.3 per cent growth, but Piper registered no less than a 41.8 per cent. While the value of American manufacturers' combined exports actually fell 4.8 per cent, the value of Piper's export business rose by 45.8 per cent.

Simulated Flight Training is being investigated by the Federal Aviation Agency in order to see if it is possible to reduce the number of flying hours needed for a private pilot's licence. The nine-month programme involves the use of four ground trainers designed to simulate a typical single-engined aircraft. Two of the trainers are arranged with side-by-side dual controls. The proficiency of students trained on the simulators will be compared with that of students trained in the normal manner.

Build a Beta Working drawings are now available for the Beta midget racer—winner of the Rollason Midget Racer Design Competition (*Flight*, December 24, 1964); the small single-seater is eminently suitable for amateur construction. The full set of drawings costs £20 and is available from Mr R. J. Sellars, 8 Vicarage Road, Silsoe, Beds. Five Betas are being built by Rollason at Croydon.

Cost of Landing at non-State-owned aerodromes in Britain has been cut since April 1; there is now a flat minimum charge of 9s for all single-engined club-registered aircraft. The ABAC, in association with the AOA, is issuing appropriate landing cards to its member-clubs for their aircraft.

General Aviation Services in New York at La Guardia Airport are being improved and expanded by Butler Aviation Inc. Butler, who already operate fixed-base maintenance facilities at the airport, have concluded a 15-year agreement with the Port of New York Authority to lease and turn the existing Marine Terminal Building into a centre providing passenger waiting areas, crew lounge, and operations offices. Refuelling facilities are also to be extended.

HANSA AT GATWICK

The second HFB.320 Hansa at Gatwick Airport during its three-day demonstration visit last week

"Flight" photograph

FOR three days last week the second Hamburger Flugzeugbau HFB.320 Hansa, registered D-CLOU, came to London (Gatwick) airport for its first demonstration in Britain. Principal potential customer was Shell Aviation.

The extremely ambitious certification programme of the Hansa has slipped slightly and the US demonstration originally planned for early this year is now to be replaced by a visit from two aircraft during the summer. The second Hansa has now flown some 90hr and given 55 sales demonstrations in Germany, Sweden, Switzerland, Spain and Portugal. The first is now at Torrejon, near Madrid, using good Spanish flying weather to progress certification testing. Certification to both German and US standards is now expected during June or July. Delivery of production aircraft is offered in nine months' time. Price of a civil Hansa is between DM2.5m and 3m (about £225,000 to £250,000) according to equipment—roughly the same, says HFB, as the HS.125.

The order book stands at nine civil Hansas for German, US and South African customers, plus the German Air Force option on five military versions equipped for training and communications flying. This involves special VHF and UHF com radio, Decca Doppler, Tacan and so on.

In the flight test programme stalls have been completed in all configurations, but only in a mid-c.g. condition. Certification requirements state simply that if the stall is approached at a rate of 3 to 4kt/sec, the elevator must be shown to be effective in pitching the nose down in all appropriate configurations. The Hansa so far fully meets these requirements and has, in addition, natural buffet warnings of the stall and no need of artificial warning. The forward-swept wing is showing numerous advantages in slow flying and in its layout—spar behind the cabin, outer wings clearly visible from the cockpit, better passenger visibility and better psychological reaction from non-jet experienced pilots.

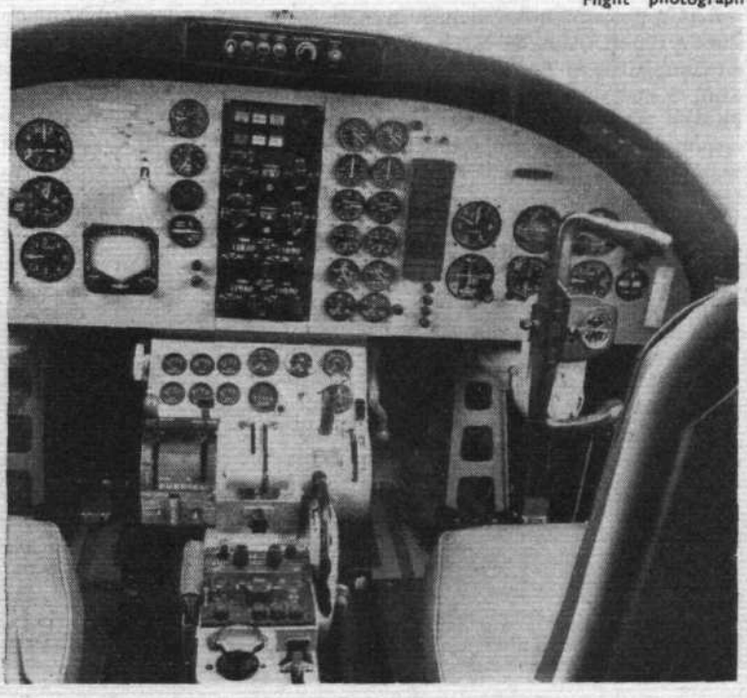
A row of turbulators has been added ahead of the ailerons to prevent shock separation at high Mach numbers, and the Hansa has successfully reached Mach 0.88, well beyond its M_D of 0.83. The fixed slat at the wing-root, anti-iced by Spraymat, has now been replaced on the first aircraft by a retractable slat, and studies are in hand to determine whether a slat or a permanently dropped section is preferable.

In order to avoid scrubbing of the main tyres as the present inclined main oleos contract, the new British Lockheed undercarriage will be rearranged to have a virtually vertical shock strut, but track and fore-and-aft position will remain unchanged. The aircraft has been landed in cross-winds of up to 18kt without difficulty.

Visibility from the distinctively wrapped windscreen panels is excellent straight ahead and down to the near side, but the coaming and centre pillar are to be slightly changed to improve offside visibility. Cockpit layout and flight management are simple. Full radio, autopilot and flight system are fitted. Both main luggage compartments are accessible from inside the cabin. The main door has integral stairs. A small toilet is fitted at the front of the cabin. Normal six-seat executive layout can be replaced by a high-density ten-seat layout.

Left, Hansa external features include the two-piece airstair door, an undercarriage that is to be slightly rearranged, leading-edge slat possibly to be replaced, and aft-mounted GE CJ-610 engine pods. Right, the flight deck is very simple, but already equipped with full airline radio, director instruments and systems layout. The column of black labels is the central warning system

"Flight" photograph



Buccaneers and Sea Vixen 2s operating from HMS "Eagle" during exercise "Showpiece Malaysia" off Singapore (following the recent three-week exercise "Fotex 65") demonstrated weapon firing to important guests, including Malaysian Prime Minister Tunku Abdul Rahman

DEFENCE

TSR.2 Flight Test Progress

THE FIRST STAGE of TSR.2 flight testing has now been completed. In a progress report issued last week BAC says that during this stage the whole of the low-speed portion of the flight envelope, and high speed up to and exceeding Mach 1, has been explored:

"To complete the necessary range of tests in a short flying programme is a remarkable achievement, stemming directly from the high productivity of each flying hour. This has only been possible because of the reliability and exceptionally comprehensive standard of the airborne instrumentation systems employed."

On the 14th flight, made on February 22, XR219 was flown from A & AEE, Boscombe Down to Warton airfield, BAC Preston Division's test centre. This was also the occasion of the first tests of XR219 at supersonic speeds.

BAC's progress notes include quotations from a report made by Mr R. P. Beamont on completion of Phase 1. Mr Beamont—who, as manager of flight operations at the Preston Division, has been personally responsible for the initial flight test programme—lists six points which the tests have confirmed:—

"(1) The first flight impressions of a sound and agreeable standard of stability and control in the landing configuration were correct; and this standard is such that no development work is likely to be needed in this vitally important area, the low-speed stability and control being completely satisfactory over the wide range of conditions tested.

"(2) Stability and control in the clean configuration have shown similar high standards throughout the current flight envelope. The excellent qualities of the pitch control at high indicted air speeds at low altitude are particularly well suited to this specified main operating zone. Similarly, the control qualities in transition to supersonic speeds give cause for confidence that the high Mach number envelope will be achieved without difficulty.

"(3) The airframe response to turbulence has been small and, although flight in severe turbulence has not yet been experienced, conditions described by the Lightning chase pilot as 'moderate to heavy gusts' were felt only as slight vibration in TSR.2.

"(4) Within the current engine limitations, engine handling and performance has been completely satisfactory.

"(5) Supporting system reliability for this

XR219 FLIGHT LOG, FEBRUARY 1 - MARCH 27

Flight	Date	Duration (min)	Pilot	Navigator
10	6.2.65	29	R. P. Beamont	D. J. Bowen
11	8.2.65	38	J. Dell	P. Moneypenny
12	10.2.65	36	D. Knight	P. Moneypenny
13	16.2.65	45	J. Dell	D. J. Bowen
14	22.2.65	41	R. P. Beamont	P. Moneypenny
15	25.2.65	70	J. Dell	P. Moneypenny
16	26.2.65	47	R. P. Beamont	P. Moneypenny
17	8.3.65	52	J. Dell	B. McCann
18	8.3.65	35	J. Dell	B. McCann
19	11.3.65	33	J. Dell	B. McCann
20	12.3.65	46	J. Dell	P. Moneypenny
21	26.3.65	33	J. Dell	B. McCann
22	26.3.65	35	J. Dell	B. McCann
23	27.3.65	34	D. Knight	P. Moneypenny

Using the designation AJ-7, General Electric is reported to have proposed a re-engined attack version of the Swiss FFA P-16 fighter, whose development was abandoned by the Swiss Government in 1958 following the destruction of two prototypes. The basic wing plan-form was subsequently adopted for the Lear Jet

stage in the development programme has been unexpectedly high.

"(6) Retraction problems having been overcome, undercarriage structural vibration remains the only major development problem encountered to date."

Mr Beamont's report adds: "At the end of this first stage of flight testing it can be said with certainty that TSR.2 is a sound and satisfactory flying machine with superior qualities of stability and control, to the predicted or better than predicted values; and there is now good reason to suggest that a high success rate may be achieved in the remainder of the CA [Controller of Aircraft, MoA] release programme."

Commenting on the references, in paragraphs 4 and 6, to engine and undercarriage difficulties, BAC says that these were holding factors early in the programme, leading to a three-month delay between the first and second flights: "Although there are still some troubles in these areas their causes are now known and completely understood. Design changes are being made which should rectify them completely."

Good progress is also being made with the second TSR.2, serial XR220. It has almost completed its engine trials at Boscombe Down, and is now being prepared for flight.

Navy Grounds Wessex Helicopters

THE ROYAL NAVY has temporarily grounded all Wessex HAS.1 helicopters operating from carriers and ships in the Far East, following two unexplained accidents on March 24 and 25 involving aircraft from HMS *Eagle*. Both accidents happened in the Malacca Straits, the first involving the deaths of two members of the crew and the second injuring an airman. One helicopter has been salvaged for investigation.

HMS *Victorious* and HMS *Bulwark* are among vessels affected by the restriction; and the Royal Australian Navy's 26 Wessex Mk 31s have been grounded as a safety measure, although no trouble has been experienced with them. Land-based helicopters are not affected by the restrictions.

Canberras for Argentina?

IT IS REPORTED from Buenos Aires that BAC and Douglas Aircraft have offered Argentina military aircraft at low cost as inducements to Aerolineas Argentinas to buy either the VC10 or the DC-8 respectively as replacements for the airline's Comets. The aircraft offered by BAC are said to be Canberras and those by Douglas A-4D Skyhawks.

F-102's Unmanned Journey

A UNITED STATES AIR FORCE F-102 Delta Dagger flew for more than an hour unmanned, after the pilot, Maj D. Feltey, ejected at 12,000ft over Missouri last week. It passed over the towns of Clinton and Warsaw escorted by two other F-102s, the pilots of which courageously flew in close formation with the pilotless aircraft in order to guide it by altering the pressure distribution round its wings.

After clearing the populated areas the two escorting F-102s withdrew, reporting that the runaway had gone into a left turn after passing through clouds at 6,000ft, and crashed in open country.

A USAF B-57 releases a 1,000lb bomb over the highlands of central Vietnam during strikes in support of southern ground forces. More than 400 B-57s in various versions were built under English Electric licence and the type was considerably developed

Last VC Retires

GP CAPT LEONARD TRENT, VC, DFC, the last serving holder of the Victoria Cross in the RAF and at present Assistant Air Attaché in Washington, is to retire this month.

Joining the RAF from the RNZAF in 1938, he went to France with the Advanced Air Striking Force in 1940 and was later posted to No 487 Sqn, flying Venturas. On May 3, 1943, he was shot down and captured during a raid on Amsterdam in which the squadron lost ten out of 11 aircraft. In 1946 he was awarded the Victoria Cross for outstanding leadership when the full story of the raid became known.

More Missiles for India

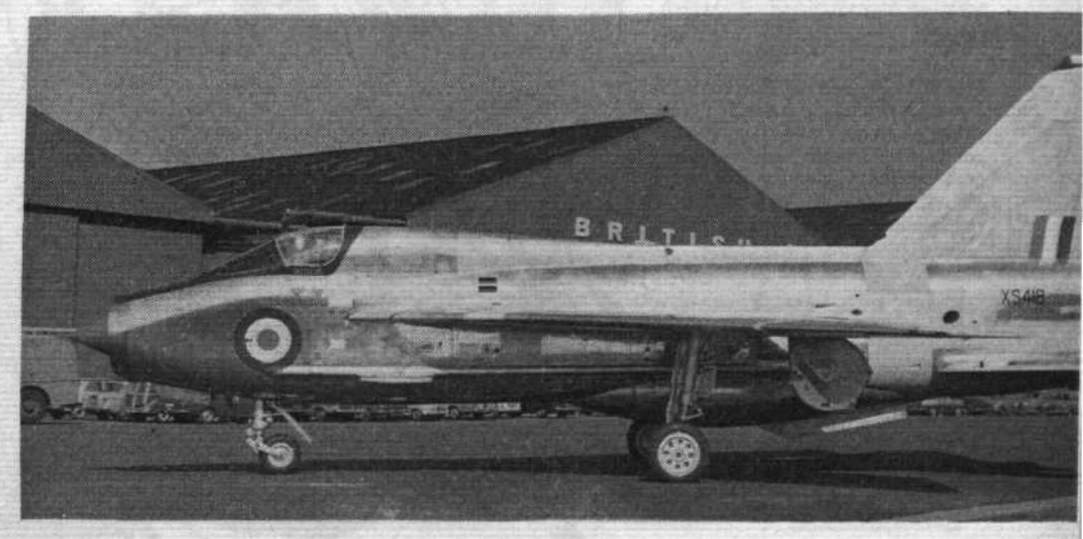
A CONTRACT HAS BEEN CONCLUDED for the purchase by India of surface-to-air missiles with "a certain country," reported to be Russia. Training of Indian personnel and site preparation in certain vital areas have already begun.

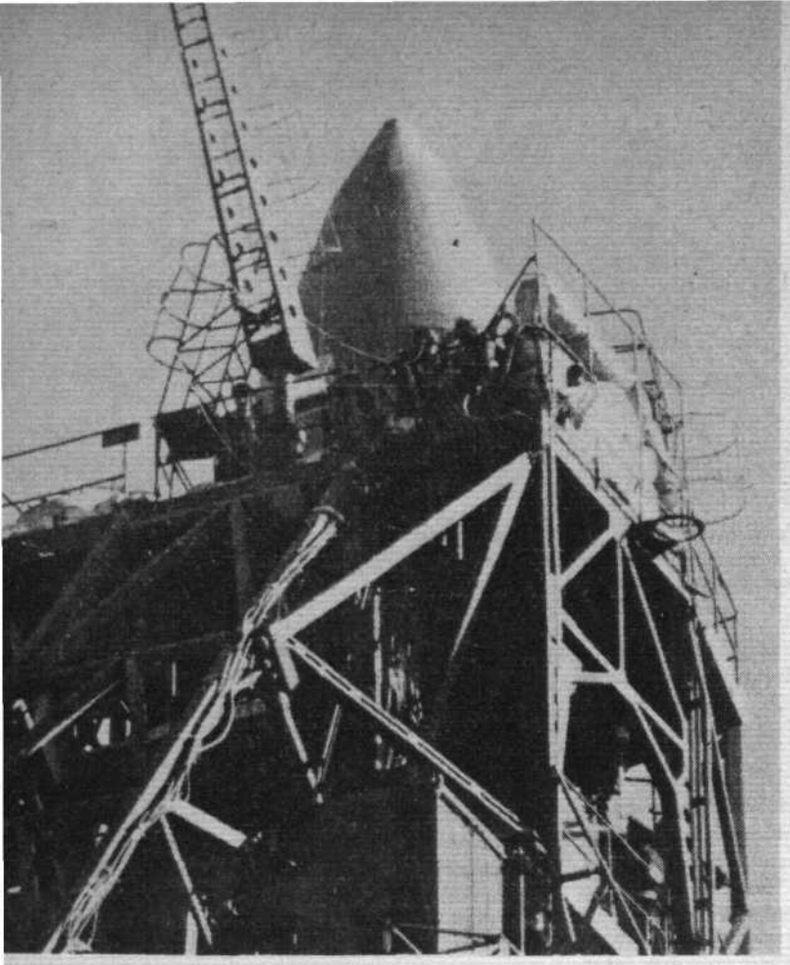
In addition, some installation work for US defence radars in northern and north-eastern India has already been completed in preparation for installation of the radars themselves later this year.

THE RAF TECHNICAL COLLEGE, Henlow, is to be amalgamated with the RAF College at Cranwell later this year. Air Cdre I. D. N. Lawson—the present Commandant of Cranwell—will be the Commandant of both colleges, with the rank of air vice-marshal.

NORTH AMERICAN'S XB-70 supersonic bomber reached and sustained a speed of Mach 2.1 at 55,000ft for 1hr 20min during its eighth flight from Edwards AFB, on March 24.

The first production Lightning T.5 was cleared for issue to the RAF on March 29 following its ninth final proving flight, made jointly by BAC Warton chief production test pilot Desmond de Villiers and Sqn Ldr R. L. Davis, OC of 226 OCU, Coltishall, to which the aircraft is to be delivered. The next day chief test pilot J. L. Dell and chief navigator P. J. Monneypenny, one of BAC's TSR.2 crews, delivered the second production Lightning T.5 to Boscombe Down. A fourth squadron is now re-equipping with Lightning F.3s, with which the T.5 is associated





COSMONAUTS "PLEASED" BY ORIENTATION FAULT

CONFIRMATION that a technical fault in the automatic system of re-entry and landing had forced the crew of the Soviet spacecraft Voskhod 2 to make an extra orbit and a manual descent was given at the cosmonauts' press conference in Moscow on March 26, seven days after the landing. The commander of the spacecraft, Col Pavel Belyayev, said that it was planned the Voskhod 2 should land on the 17th orbit but, following a failure in the "solar orientation system," he was given permission to land by manual control on the 18th orbit. Voskhod 2, he said, used the same kind of soft-landing system as Voskhod 1.

Nearly 2,000 correspondents, scientists and diplomats were reported to have attended the press conference, held in the assembly hall of Moscow University. Cosmonauts Belyayev and Leonov were introduced by Academician Mstislav Keldysh, President of the Soviet Academy of Sciences, who said that man's first walk in space marked a new stage in the study of the universe.

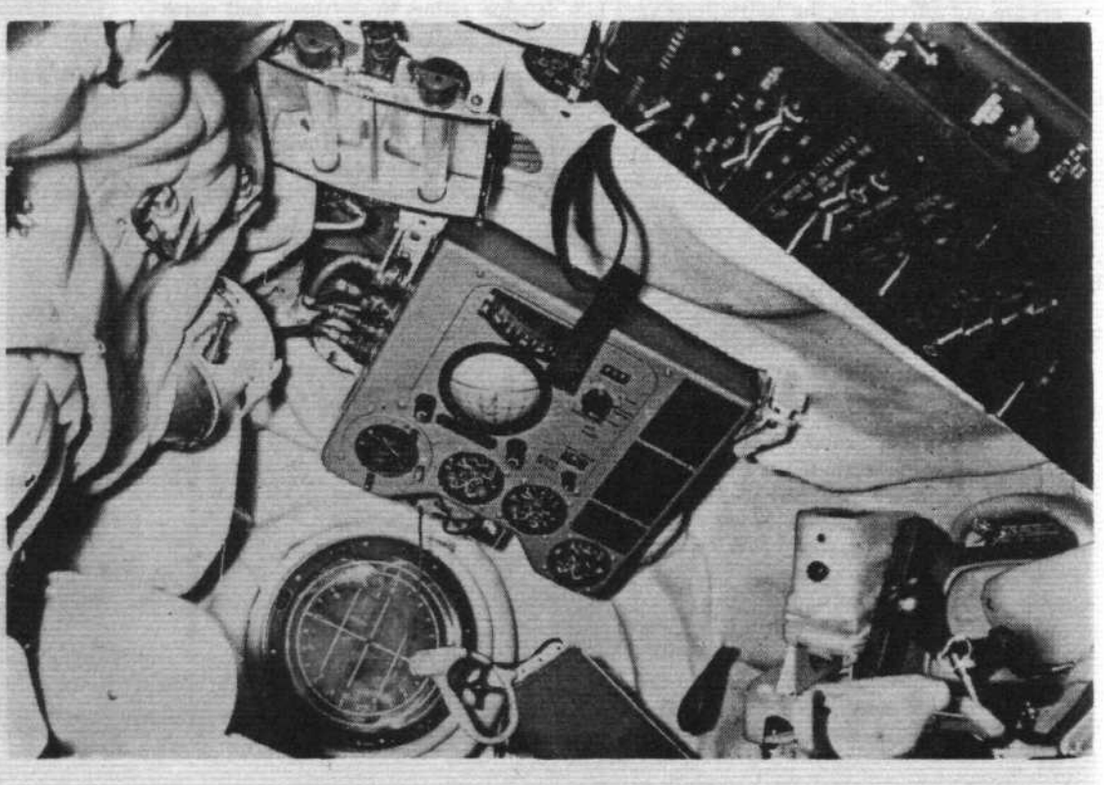
New prospects were opening up, Academician Keldysh continued, for the establishment of orbital stations, the link-up of spaceships in orbit, and the carrying out of astronomical and geophysical explorations. It would be possible in the near future to place in Earth orbit a space research institute, in which scientists specializing in the most diverse fields would work. The results obtained by the Voskhod 2 flight were extremely important steps towards flights to the Moon and other celestial bodies. The President went on to present the cosmonauts with gold Tsiolkovsky medals of the Academy of Sciences.

Describing the descent and landing phase of the flight, Col Belyayev said: "According to our flight programme we should have landed automatically on the 17th orbit by means of the solar orientation system. All previous manned spaceships have landed by this method. In case of a failure in the automatic landing system the cosmonauts could always land by manual control employing duplicate orientation systems. Our cosmo-

Spaceflight

The three pictures on these pages are reproduced, by courtesy of the Novosti agency, from "Walk into Space," a booklet published last week in Moscow. The heading photograph, captioned simply "1000 hrs Moscow time," is by implication a pre-launch view of part of the Voskhod 2 launch vehicle

The interior view of the Voskhod 2 cabin (right), captioned "The cabin is ready," shows an Earth-position indicator and viewing port similar to those in published Vostok interiors, and a small television screen (lower right)



nauts have always wanted to use the manual landing system, having carefully practised it on the ground during training, and were ready to use it in flights.

"We, too, had been trained for this. I confess that we cosmonauts have always borne a secret grudge against automatic systems which prevented us from doing things ourselves. To our annoyance they have always worked faultlessly. When, during our preparations for automatic descent, we discovered certain anomalies in the solar orientation system, we were even pleased. Now we had the opportunity of landing by manual control and revealing another fine feature of Soviet spaceships, piloted in the full sense of the word.

"Frankly speaking, only one thing worried us, that we would not be given permission to do this, as it would not have been difficult to use the automatic landing system on the following orbit. The 30-odd seconds required for a decision on our report and request for permission to land by manual control seemed very long. Finally we were cleared for a manual landing on the 18th orbit.

"On the ground they had no doubts about our ability to carry out our task. For this trust we are grateful to the organizers of our flight. We did not doubt our ability to land by manual control. The manual controls worked perfectly and we landed approximately where we had expected to land, overshooting our target a bit because of the novelty of such landing . . .

Lt-Col Leonov described his part of the flight as follows: "Immediately after getting into orbit we started preparations for the experiment. While in the ship's cabin, before stepping into the air-lock chamber, I put on the pack with the autonomous life-support system, with the help of my commander, and connected myself to it. We checked all the equipment, including the apparatus for registering the physiological parameters which were to be measured during the free floating in space, and for registering the spacesuit parameters.

"We equalized the pressure in the chamber and in the cabin, then we opened the hatch from the ship's cabin to the air-lock chamber and I entered the chamber through that hatch. I inflated the spacesuit, checked on its air-tightness, checked the seal of the helmet and the position of the light filter on it, checked the oxygen supply to the spacesuit and, going once more over all the steps of the drill, I prepared myself for my emergence into outer space.

"Pavel Ivanovich closed the hatch to the cabin after comparing the pressure in the air-lock. Then I opened the hatch of the exit; dazzling sunlight filled the air-lock. . . .

"I was impatient and wanted to look out quickly. I asked my commander but everything had to go according to a predetermined plan and, of course, it was not worth being too hasty in a case like this. I waited a short while. At last everything was ready; I was allowed to step out. . . .

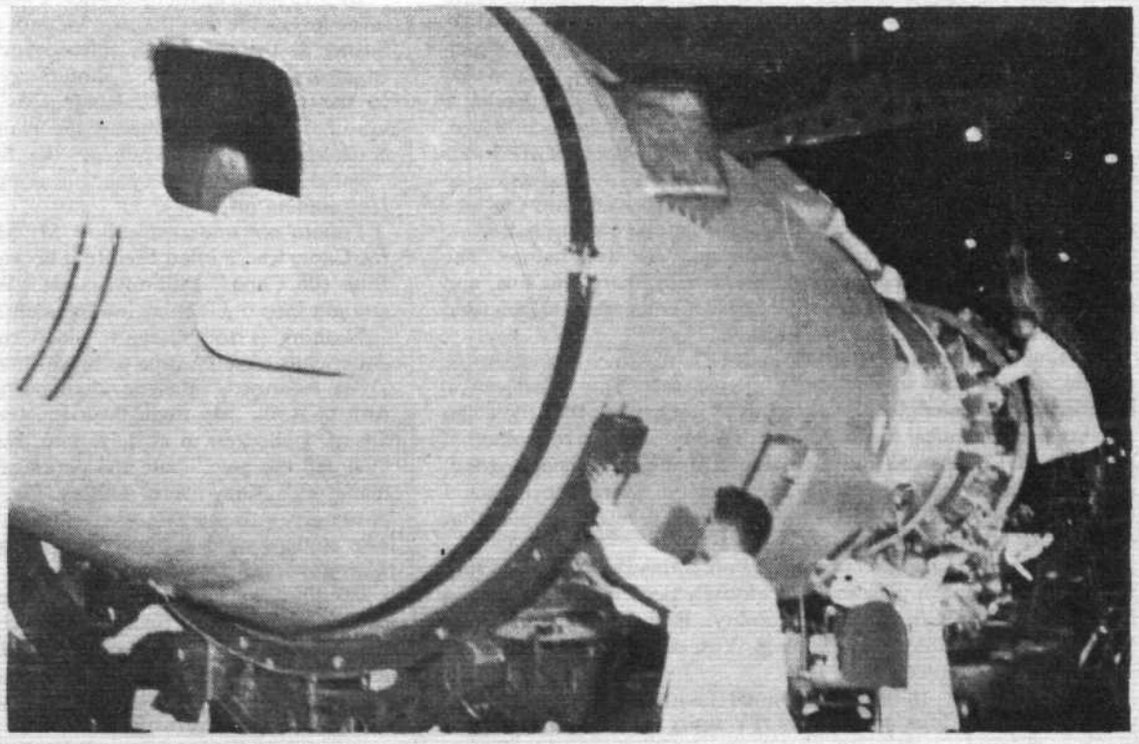
"The time had come to leave the ship and step into space. This moment, for which we have been preparing ourselves for so long, for which so much thinking had had to be done, had come! . . . I looked through the light filter and through the glass of the spacesuit. The stars were bright and unblinking. I could distinguish clearly the Black Sea with its very black water and the Caucasian coastline. One could even see what the weather was like there—I saw the mountains with their snow tops looking through the cloud blanket covering the Caucasian range. The Volga appeared and disappeared; the Urals floated under us; I saw the Ob and the Yenisey. When we were over the Yenisey the order was given for me to return to the ship. I complied. It was somewhat more difficult to get into the ship because I had to dismantle the cine camera and climb into the air-lock with it. I did all this within the set time-table and re-entered the ship . . .

"In spite of the rather considerable amount of physical work I had to do, the life-support system proved on the whole to be quite reliable. I experienced no shortage of air or any unfavourable flunctuations in temperature. But when I returned to my seat I noticed sweat streaming down my forehead and cheeks . . ."

In reply to questions Col Belyayev said that Voskhod 2 had been removed from the landing site by air and was now at the cosmodrome. A spaceship of the Voskhod 2 type with a crew of two could remain in orbit for more than a month. Such craft did have the ability to manœuvre in space and to change orbit like the Polyet satellite, "but, in the present flight, manœuvring was not envisaged in the flight programme."

The sighting of the Earth satellite in orbit was not part of the scheduled programme; it took place at 5.12 a.m. Moscow time and "I was unable to determine what kind of a satellite it was." Leonov could have left the spaceship and returned to it without Belyayev's help, "but the programme provided for the work of two members of the crew." Voskhod 2 could be used again after its flight, and it had not been damaged at all during the "very soft" landing.

After landing, the two cosmonauts were in the cabin of the spaceship for "not more than five minutes." The first heli-



"The last preparations" is the caption to this photograph, slightly off-focus for artistic effect, from "Walk into Space." It appears to show the final stage of the Voskhod launch vehicle, possibly the main body of the spacecraft itself, and its nose fairing. Compared with similar views of Vostok craft in earlier Soviet films, the Voskhod design appears to be of the same diameter as Vostok

Spaceflight

copter arrived in 2½ hours, and the two men were taken to Perm by air on the next day. "Since it required certain preparations, we could not leave for Perm immediately." Asked whether the manual controls of Voskhod 2 could be used in principle for a soft landing on the Moon, Belyayev replied: "The system of manual control with which the Voskhod 2 is equipped is not designed for use in a soft landing on the Moon."

Further questions were answered by Leonov, who said that he had been outside the spaceship for 10min and in the airlock chamber for 10min, "thus spending 20min in a pure vacuum." The lifeline connecting Leonov with the spaceship contained a telephone cable and telemetry lines. While outside the craft he did not use any special tools. In returning to the spaceship "the planned procedure of the flight programme was not upset, I only entered from the left side instead of the right." Both cosmonauts, Leonov said, wore "absolutely identical spacesuits which we put on on the ground." Leonov said that he did not take any medicines to protect himself from radiation or to neutralize its effects while outside Voskhod 2. "The flight and exit into space took place in a quiet radiation condition."

Asked whether his oxygen supplies came through the lifeline, Leonov replied that he had used only the autonomous system in his pack. The pressure inside the spacesuit was 0.4 atmospheres. In reply to the question "At what height did you leave the spaceship; was the height established?", Leonov declared: "The ship's orbit during the flight was constantly measured from the ground."

Leonov was asked what would have happened if he had lost consciousness outside the spaceship, or had been unable to climb on board unaided. He said: "I think that the spaceship commander could have come to my aid at any time." Leonov added that his spacesuit was suitable for a prolonged stay in space and for working there; he did not remove his spacesuit after returning to the capsule, although he could have done; and he did not take any cine pictures while outside the cabin. The cine camera was fixed on a bracket to the hatch sill of the spacecraft. Its film had been developed and no traces of exposure to cosmic radiation had been found. Leonov said he breathed pure oxygen in the spacesuit.

Final questions at the press conference were answered by Belyayev and by Academician Keldysh. The colonel confirmed that his spacesuit was of the same type as Leonov's: "I would have been able to emerge, and provisions for this contingency had been made in the programme." Academician Keldysh was asked about alternatives to the airlock system for emerging into space. He said: "There is at present still some discussion in the Press about a variant involving the complete depressurization of the capsule. As for the advantages of the airlock system I would give the following example, which in my opinion is particularly comprehensible to a Russian: I would compare the depressurization of the capsule to a hut without a porch—if you open the door every kind of unpleasantness pours into the premises at once."

Keldysh also said that Voskhod 2 was equipped with an ion velocity-vector adjuster (as distinct from the plasma motor used on Zond 2, which was designed for guidance purposes). The weight of Voskhod 2, he said, was about six tons.

Gemini—and America—on the move

TO sit in the tourist cabin of a jet at 30,000ft watching the Dan Brady TV Breakfast Show may not be everyone's idea of civilized progress. But it is certainly technological progress. American passengers just take it all for granted. So they're watching TV at 550 m.p.h. at 30,000ft. So what? Doesn't everybody?

Visiting foreigners can see perhaps better than Americans can just how fast their country is moving. I was made acutely conscious of this on a flight by American Airlines Boeing 707-320B between New York and St Louis on March 23.

We were not watching the Dan Brady Breakfast Show; we were watching a live transmission of two Americans being launched into space.

When Iliffes bought my ticket in London I did not know which airline would fly me to St Louis, or that it would have TV, or that the flight would coincide with the Gemini launch. The experience was all the more impressive for having been completely uncontrived.

Having been flown to New York by BOAC Super VC10, I was on my way to St Louis to see the Phantom in production at McDonnell. By complete chance my visit coincided with the very first manned Gemini launch. McDonnell, as everyone knows, designed and built Gemini, and the Mercury that went before. The CBS television news programme *Two Men In Space* was live, and included shots of the McDonnell Space Center at St Louis and interviews with designers and engineers.

An Englishman used to BBC and ITV treatment of scientific current affairs was in for quite a surprise. The interviewers' questions and the engineers' answers did not assume that the 150m viewers were technical morons. The discussion on the monomethyl and dimethyl hydrazine and nitrogen tetroxide propulsion system, for example, was as natural as anything on *Sportsview*. This, I thought, was an informed public—or at any rate a public that expected to be informed.

The captain's voice interrupted. "Folks, there's a bit of a chop so I suggest you have your seat belts loosely tied. There's light rain at Lambert Field with two-mile visibility. Right now we are being vectored by radar on to our landing. You can expect to be on the ground in ten minutes . . ."

On the ground, in the McDonnell factory, the only sign of excitement were three commercial TV units in the section where Geminis are assembled on their white jigs. The deafening clatter of rivet guns on the adjoining Phantom (and TFX escape-capsule) assembly lines continued as on any normal working day. "They watched the launch and they'll watch the recovery," said a McDonnell man, "but otherwise it's old hat—we've had six previous Mercury or Gemini shots."

Over lunch at 12.25 local time conversation stopped as the voice of the president, Mr David Lewis, came over the factory address system. "The latest news from the Cape is that GT-3 is just going over Australia for the third time. Everything is going well . . ."

By 3.15 p.m., again by chance, I was actually in the Gemini design office just as the first manned Gemini mission was safely completed. Sitting at their desks in shirtsleeves were 300 of America's best engineers—average age, I should say, about 40—listening intently to the voice of the chairman, Mr McDonnell himself. "Congratulations to everyone in the team," he was saying, adding a crack about the sea-urchin eggs that had been on board the Gemini. "Well done to you from your old skipper. This is the old Scotchman [*sic*] signing off."

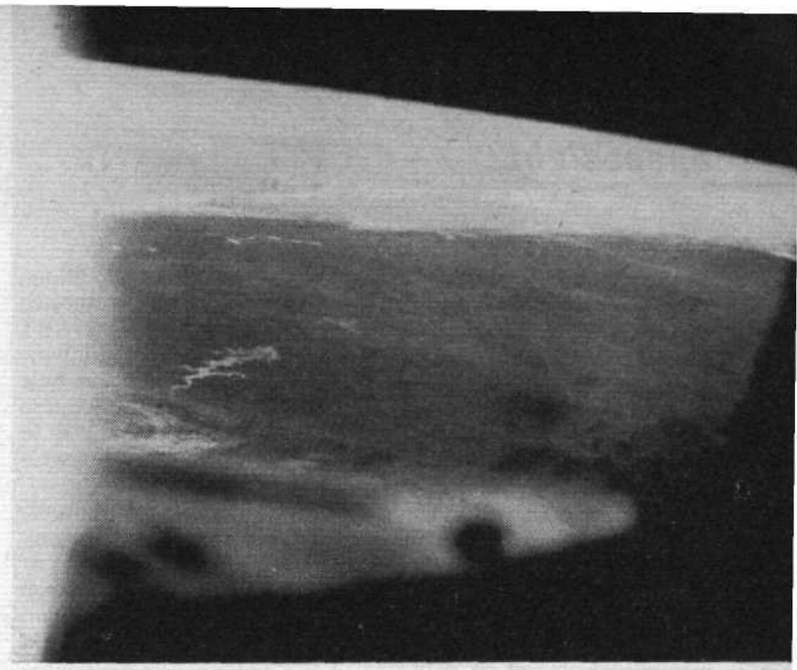
I could not understand how Mr McDonnell had got back from the Cape, where I had been told he was, so quickly. "He's speaking *from* the Cape," said my guide. What, from 900 miles away straight into the factory loudspeaker? Well, why not?

Nothing is too difficult, which could well be the reason why Americans have become technical masters of the world.

An informed, efficiency-demanding public is probably at the root of it all. My flight back to New York left Lambert Field at 5 p.m. I checked in at 4.57 p.m., assuming the flight was closed. "I'll call the gate," said the American Airlines clerk—"you'll just make it." They were waiting for me, an entirely non-special passenger, with the gate open and the steps still at the door of the 727. The engines were actually running as I climbed aboard, and we were moving before I had sat down.

Of all the things I had experienced during the day, nothing impressed me more than that. It could so easily have been too difficult to allow a passenger on board at the last minute. But it is *not* too difficult; and it is because of this that in America you can lean back in your jet armchair watching live TV of two men being launched into space.

J. M. RAMSDEN



This photograph of Bermuda was taken by John Young through the co-pilot's window of the Gemini spacecraft during the GT-3 orbital flight on March 23

The summary flight-plan for the GT-3 mission lists the main actions scheduled for Grissom and Young during their three-orbit flight. The left-hand scale shows the timing in hours and minutes from lift-off

TIME	COMMAND PILOT	PILOT
	Launch	
0 10	Insertion Checklist Align Platform Unstow Equipment	Unstow Equipment Trajectory Update Communications Check Blood Pressure
0 20	Control Mode Check Sea Urchin Egg Exp - Twice	Empty Launch Day Urine Bag Suit Integrity Check
0 30		
0 40	Blood Pressure T/M Calib	Oral Temp
0 50	GO/NO GO Decision	S/C GMT Time Hack Trajectory Update Human Blood Irradiation Exp Start
1 00	RCS Plume Observation	
1 10	Catch-up Mode Check Sea Urchin Egg Exp - Once	Human Blood Irradiation Exp Stop
1 20	Align Platform	
1 30	GO/NO GO Update for Translation No. 1 Control S/C to 0°, 0°, 0° Translation No. 1 ORBIT 2 Tape Plybk	Trajectory Update Blood Pressure
1 40	Platform Alignment and Caging Check Blood pressure	Food and Waste Evaluation
1 50	Control S/C to 0°, 180°, 0°	
2 00		
2 10	Horizon Scanner Check	
2 20	Control S/C to 90° Yaw Translational Systems Check	
2 30	GO/NO GO Decision Trajectory Update Hor Scan Control Mode Characteristics Check	Suit Integrity Check
2 40	Align Platform	O_2 High Rate Check
2 50	GO/NO GO Decision	Gage Correlation Report
3 00	Tracking Task	Oral Temp Blood Pressure

TIME	COMMAND PILOT	PILOT
	Tracking Task	SEC Coolant Pump B Check PRI Coolant Pump B Check
3 10	Control S/C to 0°, 0°, 0° Oral Temp ORBIT 3 Blood Pressure Landing Area Conditions Update	Trajectory Update Tape Plybk
3 20	Platform Stabilization Check	
3 30	Backup CO_2 Sensor Check	
3 40		Control Mode Characteristics Check
3 50	Sea Urchin Egg Exp - Once Preretro Checklist	Control S/C to 0°, 180°, 0° Preretro Checklist
4 00		Trajectory Update if required
4 10	Align Platform Translation No. 2 Align Platform	Update for Translation No. 2 if required
4 20	T_R-5 Checklist	
4 30	T_R-30 Checklist Retrofire Postretro Checklist 400K	
4 40	BBO	
	ORBIT 4 EBO 50K 10K	Reentry Communications Exp
4 50	Landing	

Spaceflight

SV-5 DETAILS

Flight tests of the Martin Company's SV-5 manœuvrable, lifting-body re-entry vehicle (illustrated in our March 25 issue) are expected to continue for about three years as part of the USAF START (Spacecraft Technology and Advanced Re-entry Test) programme. Flight models will be launched from Vandenberg Air Force Base aboard Atlas SLV-3 boosters and will be tested over the Western Test Range. The overall objective of the test programme is to obtain data on the aerodynamics, materials and structural characteristics of manœuvrable re-entry vehicles.

The lifting body will be equipped with two movable flaps on the underside of the tail to provide control in pitch and roll; these will be used in combination with reaction jets during the early part of re-entry to control the course of the spacecraft. The SV-5 test model will be constructed using conventional aircraft type aluminium structure, covered with a new Martin-developed ablative heatshield material which will be evaluated in the flights. This material is flexible to absorb the stresses caused by extreme changes in temperature; a heat-resistant material will be used for areas of maximum heating such as the nose and leading edges of the fins.

Tests will be made as the spacecraft descends at hypersonic speed from orbital altitudes into the Earth's atmosphere. Parachute recovery will begin when the craft has decelerated to about Mach 2, and mid-air or surface recovery will be made near Kwajalein Island in the Pacific.

EXPANSION AT HUNTSVILLE—

An expansion of engineering and structural work at NASA's Marshall Space Flight Center, Huntsville, has resulted in contracts being negotiated with nine firms to provide support services at an estimated cost of $58.5m. Some 4,700 personnel will be involved, working in specific laboratories at the centre in support of the Saturn/Apollo launch-vehicle programme, as follows:—

Astrionics Laboratory This laboratory develops electronic equipment for multi-stage launch vehicles; Sperry Rand Corporation is to provide some 880 engineers and technicians under a $12.69m contract. Areas of work will include component evaluation and qualification testing; facilities engineering; and the design of electro-mechanical, guidance and control and inertial systems.

Propulsion and Vehicle Engineering Laboratory Approximately 920 personnel of Brown Engineering Corporation will work on research and development projects in the fields of structures, materials and propulsion and mechanical systems under a $12.35m contract. Other areas of work include design studies, vehicle systems engineering and programme co-ordination.

Test Laboratory To support Huntsville's test programme on components and boosters Vitro Corporation will employ 550 men under a $4.1m contract. Their work will include data acquisition and instrumentation for all test operations; and the reduction of test data acquired from component systems, subsystems, dynamic, engine and booster testing operations. The company will also handle power, control, communications, television and photography in the test area; operation of the facility and other support.

Manufacturing Engineering Laboratory Approximately 355 personnel of Hayes International Corporation will be required under a $6.8m contract to support this laboratory in the manufacture, assembly and checkout of experimental and prototype boosters and space vehicles. Saturn V boosters being assembled at present include a static-test stage and two flight stages. Specific areas of work include modification and maintenance; assessment of manufacturing reliability; engineering processing; engineering tool design; plant engineerings; data processing; and precision model and mockup processing.

Aero-Astrodynamics Laboratory Northrop Corporation will provide some 200 engineers and scientists under a $3.9m contract to work on aero-astrophysics, aerodynamics, flight evaluation and operations studies, dynamics and control, flight mechanics, planning of Saturn systems and technical documentation.

Quality and Reliability Assurance Laboratory Approximately 540 personnel will be provided by the Spaco company under a $7m contract in this laboratory. Their work will include checkout, data acquisition and instrumentation; quality engineering analysis evaluation; calibration and environmental testing; engineering support in preparing design, development and test documentation; reliability and related work; and fabrication and related services.

Facilities and Design Office Some 70 architects, engineers and planners of Rust Engineering Co will provide services under a contract amounting to $830,000.

Management Services Office A $5m contract is being negotiated with RCA Service Co under which 840 people will carry out general administrative services at Huntsville. These include communications, technical publications and documentation, maintenance and repair of photographic equipment and safety engineering.

Technical Services Office Management Service Inc under a $3.9m contract will employ some 425 people in providing vehicle support services; photographic support; instrumentation repair; and chemical, hydraulic and ultrasonic cleaning, general maintenance and repair. In this and all the above-mentioned contracts the exact amount is calculated on a cost-plus-incentive-award basis under which firms receive additional payments for superior performance, keeping costs within estimates and meeting schedules.

—AND AT CAPE KENNEDY

Further support services connected with the Saturn programme are the subject of a contract award by the John F. Kennedy Space Center to the Chrysler Corporation. Supplementing an existing contract, this will amount to more than $41m up to June 30, 1968, and will provide pre-launch, launch and post-launch services to the Kennedy centre. Chrysler makes the first stages of Saturn I and Saturn IB vehicles at NASA's Michoud facility near New Orleans.

The new Chrysler contract concerns Saturn I and Saturn IB operations on launch complexes 24 and 37 at Cape Kennedy. Two Saturn Is remain in the current launch schedule, and these will be followed by 12 Saturn IBs. The work will include the installation, checkout and maintenance of ground support equipment; the modification, installation and checkout portions of the propellant and pneumatic systems required for Saturn IB on launch complexes 34 and 37; and engineering assistance in other design modifications on these launch pads.

FIRING BY FLOX

The first firing of a complete engine system using flox (a combination of liquid fluorine and liquid oxygen) as oxidizer has been carried out by Rocketdyne under a $2.3m contract for NASA's Lewis Research Center. The test employed the sustainer engine system of an Atlas launch vehicle and was made at the Rocketdyne plant in Canoga Park, California.

Approximately 20 firings will be conducted in this series, using a standard concentration of 30 per cent fluorine and 70 per cent liquid oxygen. A number of factors including thrust level and oxidant/fuel ratio will be varied in order to establish limitations on engine performance. These tests follow a long period during which the compatibility of Atlas engine components with flox has been studied.

Fluorine is a highly reactive element which combines vigorously with many other elements, including carbon, and most plastics. A number of changes had to be made to the oxidizer system in the Atlas sustainer engine so that flox could be used safely. All hydraulic devices were replaced by pneumatic units, and non-metallic gaskets and seals were changed wherever necessary.

Bonus for Thor The Missile and Space Systems Division of Douglas Aircraft Company has received a $500,000 bonus following 25 consecutive successful launches of Thor vehicles from Vandenberg Air Force Base during 1964, under the terms of an incentive-type contract with the USAF Space Systems Division. Total value of the contract is approximately $18m; reductions were prescribed for possible failures, and further incentives covered bonuses for cost reductions.

NASA's Floating Launch Platform, the USNS *Croatan* (described in *Flight* of February 18), has completed the first leg of its equatorial expedition off the west coast of South America. As the converted aircraft transport ship sailed from Balboa, Panama Canal Zone, to Lima, Peru, last month, ten two-stage sounding rockets and three single-stage Arcas meteorological rockets were launched from the ships' deck. Aboard the sounding rockets were upper atmosphere and ionosphere experiments devised by the Universities of Michigan and New Hampshire and by NASA's Goddard Space Flight Center.

Straight and Level

COMMENTING on his airline's £7m net profit, Sir Giles Guthrie, chairman of BOAC, says: "The past year was another boom year for traffic and revenue. Booms do not last for ever."

BOAC's revenue increased during the year by 10 per cent. I wouldn't call that a boom. In fact BOAC have increased revenue by more than 10 per cent every year except one in the last decade. I would say it was an average year.

Without in any way belittling the great work the new chairman is doing, BOAC's staff would have made this profit, or something very like it, under the old management, which was sacked by Mr Amery when it was clear that the airline was moving towards profitability. Just for the record.

● Mr Eric Rylands, chairman of Skyways Coach Air, launches his new East Midlands-Paris Avro 748 service with a remarkable political flourish.

He says the new service "proves the point that the Government's policy is at least clear and has opened the way ahead for the development of independent airline operations alongside the two national corporations."

I can't see why it proves anything of the sort. Mr Rylands' new service owes nothing to the Government. It was considered and granted by the Air Transport Licensing Board in January, well before the Board was told of the Minister's new policy on February 16.

Ah yes, you will say, but perhaps BEA objected or appealed, and the Minister overruled them, and it is this for which Mr Rylands is so grateful? No, I gather that BEA had no objections.

I would like to bet Mr Rylands that if BEA *had* objected he would not be operating his new service.

Knock knock

Sign outside Middleton-St George Airport, Durham

turn back.
The aircraft, with both engines feathered, circled Mascot for some time before landing.
Engineers im[illegible]ediately

From "The Australian," February 10

● "Correction to Ministry of Aviation press release... The first line should read:

"'The Minister of Aviation, Mr Roy Jenkins, has ALLOWED the appeals—NOT dismissed the appeals.'"—from an MoA press release.

● Mr C. J. Stevens, chairman and managing director of BKS Air Transport Ltd, says in a letter to *Flight* about air shuttle services: "There is no doubt that the existing airport facilities at both London Heathrow and Leeds/Bradford Airports are grossly inadequate when related to the shuttle service concept."

If public demand for air services is great enough then pressure must be put on ATC and airports to cater for it. Airliners land one a minute at Chicago night and day throughout the year. You can imagine what the peaks are like. But the airlines don't want to know Chicago's difficulties. They just want results.

As for air shuttle terminal facilities, all you need are four walls, a roof, a boarding-pass dispenser, some chairs and a bunshop. In La Guardia's Air Shuttle terminal I counted three ground staff dealing with 8,000 passengers a day.

● *"The Speedbird, trademark of British aviation since it was first designed for Imperial Airways nearly 30 years ago, has been designed to suit the 1965 BOAC—a little more wing area and a little less body"*—from a BOAC press release.

More drag and less payload for the new BOAC, eh?

And yet I suppose if they'd altered it the other way, and given it a little less wing and a little more body, someone would have made a crack about less lift and less range or something. BOAC can't win.

Thinks: why change it at all?

● **Keith McWoosey, ace air correspondent:** Hello, that you Washers old boy? You wicked, wicked aircraft manufacturers, charging the airlines £17 for lavatory door bolts that can be bought at Woolworths for a couple of bob. Disgraceful.

Julian Washbrain, Scruggs Aircraft PRO: Steady on, my dear fellow. The overcharging discovered by Mr Newbroom Wilkinson when he took over as BEA's chief engineer has been going on for *years*. Why have BEA—and other airlines with, I might add, American as well as British aircraft—been such chumps as to pay these prices? Is charging what the market will bear so wicked? Anyway, just to show willing we've reduced the price to £12.

● Mr Beverley Shenstone, technical director of BOAC: "Aerodynamic noise in the cabin of the Concorde may be so great that passengers will think they are flying in an Argonaut again."

ROGER BACON

Don't be like that

Parachute jumping from a Vickers Virginia in about 1930

FLIGHT International

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April 22 issue closes for press 1st post Tuesday, April 13, 1965

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SHACKLETON AVIATION LTD.

Head Office: 175 Piccadilly, London, W.1. HYDe Park 2448. Private Branch Exchange. [0608

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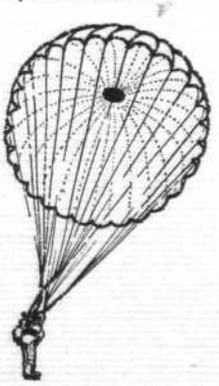

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